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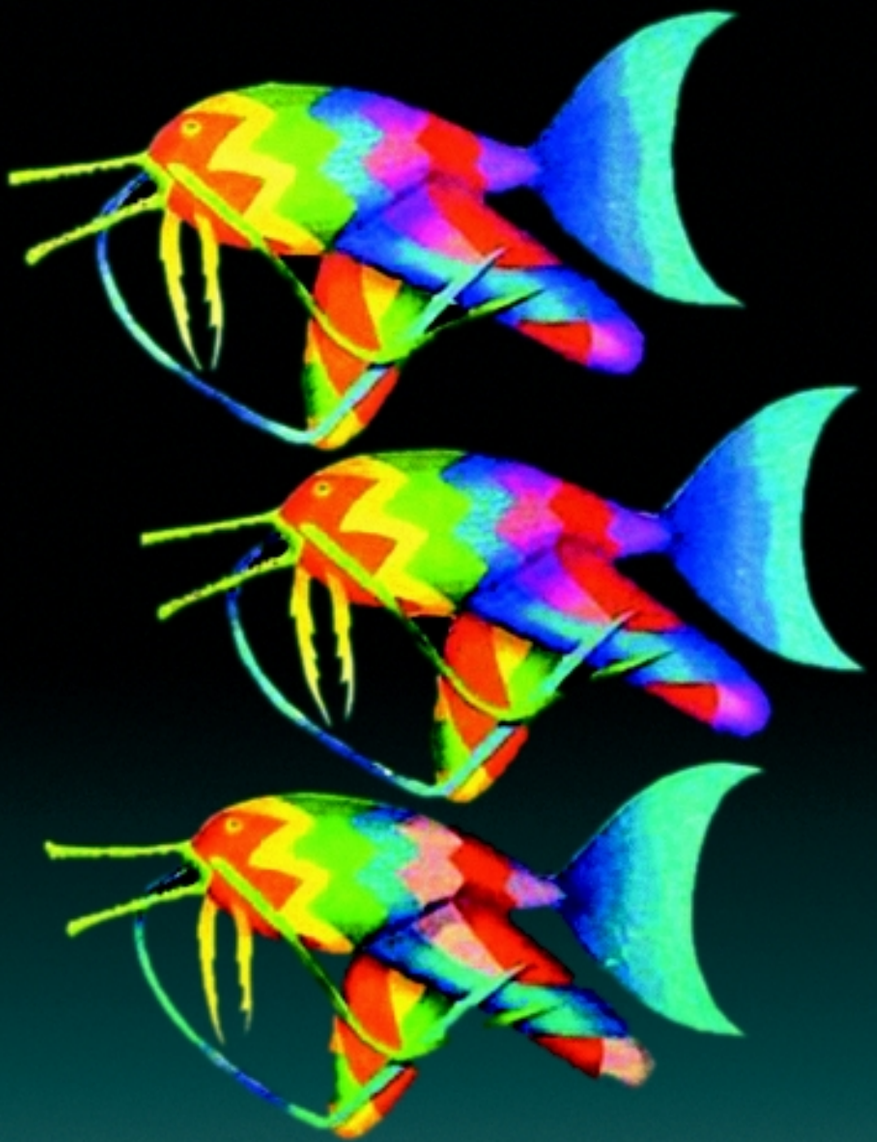

भाकृ अनुप
ICAR

CMFRI

वार्षिक प्रतिवेदन
Annual Report
2002-2003

Annual Report

2002-2003

भाकृअनुप
ICAR

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
Indian Council of Agricultural Research
Post Box No. 1603, Tatapuram P.O., Cochin - 682 014, India

CMFRI Annual Report 2002-2003

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Graphic image of marine ornamental fish. CMFRI is pioneering research on breeding and culture of marine ornamental fishes. It has developed technologies for breeding of highly valuable clown fishes, damsel fishes and seahorses.

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PREFACE

Management of marine living resources requires time series data on the resource size, dynamics, exploitation rates and replenishment capacities. The major mandate of CMFRI is to monitor and assess the exploited marine fishery resources and render policy support to the Union and State Governments. The voluminous data collected are processed and analyzed to formulate appropriate management decisions on various exploited resources. During the year under review the scientists of the Institute have looked at management of these dynamic and valuable resources through new approaches like predictive and ecosystem modelling. In an effort to strike a balance between maximization of yield and profit and conservation of stocks, the scientists of the Institute have applied non-equilibrium production models to arrive at optimum period of seasonal closure of the fisheries along the west coast. Besides, the optimum fleet sizes for different craft-gear combinations in several maritime states have been resolved. Over the years, the Institute has come to realize that measures for conservation of resources cannot be put to practice without the active participation of fishers. During the year, the lobster conservation programme was initiated in the states of Maharashtra, Gujarat and Tamil Nadu through public rallies and mass education programmes and the public feedback has been very encouraging. In another initiative under NATP, an animation film on responsible marine fisheries was produced and disseminated through television channels.

The Institute continued its monitoring programme on the health of the seas. An ambitious programme to monitor the level of xenobiotics in marine mammals inhabiting the Indian EEZ was initiated this year. The changes that global warming has brought about on oceanographic conditions in our seas and on coastal fisheries formed another aspect of new research. Through EIA studies on the coastal ecosystem, the Institute provided consultancies worth Rs. 46.4 lakhs during the current year.

On the mariculture front, the Institute continued to make rapid progress during the year. The period saw the development of marine mussel culture as an accredited small-scale sector in the state of Kerala with an all time production high of 1250 t. The Government of Kerala has constituted a task force with scientists of the Institute to oversee the development of mussel farming in the state. The year also saw the spread of this technology to other maritime states like Maharashtra through the NATP scheme. The researchers in the Institute made rapid strides in the up gradation of sea farming technologies for edible oysters, clams, marine ornamental fishes, sea cucumbers, sea crabs, lobsters, seaweeds etc. Provisional patents have been obtained for the Institute's on-shore pearl farming and grouper breeding technologies. Novel pellet feeds have been developed for mud crabs and ornamental fishes. The year witnessed the development of a new technology for the production of *Mabe* pearls in the Indian pearl oyster. This cost-effective technology for value addition of marine pearls is in the process of further refinement and field-testing. A new project on production of the queen of pearls - the black pearls, from Andaman and Nicobar Islands was launched during the year.

The Institute brought out a state-of-the-art book on Management of Scombroid Fisheries, besides in-house publications like the Marine Fisheries Information Service, Newsletters and Special Publications on key topics. The Institute also published two volumes of the premier journal on fisheries, the Indian Journal of

Fisheries. The Institute organized two important conferences on focal themes during the year. The First Indian Pearl Congress and Exposition was an epoch making event attracting the entire gamut of pearl researchers in the country, besides policy makers and pearl traders. The public exposition, wherein the finest of pearls in the country where on display and sale, was an overwhelming success. The National Conference on Aquaculture Nutrition focused attention on aquaculture feed development and quality standards and was attended by nutrition scientists from all over the country.

Under human resource development, the Institute organized several training programmes in key areas of marine fisheries and mariculture through the KVK and TTC, apart from offering the M.F.Sc and Ph.D programme in mariculture. A winter school on recent advances in diagnosis and management of diseases in mariculture was also organized by the CMFRI. To improve work efficiency and quality, staff of the Institute underwent professional training in HRD.

The summary and highlights of the research work carried out by the Institute are presented in this report. The staff of the Institute have contributed immensely to the accomplishments made by the Institute, and I place on record my gratitude to each one of them. I am grateful to Dr. Mangala Rai, Director General, ICAR for the support he has extended to achieve our targets. The Institute has received the required encouragement of the fisheries division of ICAR and I place on record our thanks to Dr. S. Ayyappan, Deputy Director General (Fy.), Dr. A.D. Diwan, Assistant Director General (M.Fy.) and Shri. Anil Agarwal, Principal Scientist (M.Fy.).

Cochin
28 July 2003

MOHAN JOSEPH MODAYIL
Director

EXECUTIVE SUMMARY

The mandate of the Institute was addressed through the implementation of 50 in-house projects, 31 externally funded projects and 17 NATP schemes. Besides, scientists of the Institute undertook 5 consultancies for the benefit of various industries. The salient research findings and achievements of the Institute during the year are presented here.

The marine fish landing in India during 2002 was estimated at 2.64 million tonnes, which is 3.14 lakh tonnes (13.5%) more than that of the previous year. The increase was primarily due to increased catches of sharks, oil sardines, Bombay duck, ribbonfishes, carangids, seer fishes, tunas, penaeid prawns and cephalopods. Perches and non-penaeid prawns showed a decrease in landings. The mechanized sector accounted for 67.9%, motorized sector 25% and artisanal sector 7.1% of the production. The northwest coast accounted for 9.08 lakh t, followed by southwest coast 8.6 lakh t, southeast 6.11 lakh t and northeast 2.27 lakh t.

Using discrete and continuous versions of the Schaefer model, simulations on different closure scenarios for the demersal trawl fishery of Kerala were done. Results indicated that complete closure of trawl fishery during June and July would result in increased profits to trawlers. An intervention analysis on the introduction of motorized crafts in Kerala revealed that the increase in total landings to the tune of 56,000 t was obtained due to the intervention.

Massive and continuous recruitment of oil sardine was observed during the current year and the fishery was mainly sustained by juveniles and sub-adults. Some of these juveniles showed stunted growth due to the high density of the stock and competition for food. Oil sardines were exploited at MSY level. High stock density of anchovies was observed off Mangalore and low stock density was observed off Kerala coast, however, the stock was exploited at MSY level. The exploitation rate of *Stolephorous indicus* was estimated as 0.33 and that of *Coilia dussumieri* as 0.35 indicating that the fishery can sustain increased fishing pressure.

The exploitation rate of the king seer *Scomberomerous commerson* ranged between 0.51 and 0.78 showing that the species is exposed to higher fishing pressure along the southwest coast, while it is exploited at optimum level along the northeast coast. Catch of the skipjack and yellow fin tunas by drift gill-netters have shown an increasing trend since 1998 from the fishing grounds off Kerala and Lakshadweep. The exploitation rates of mackerel stocks was estimated to be low at Vizhinjam, Calicut and Mangalore-Malpe (0.27-0.38) and optimum at other centres like Cochin, Tuticorin, Chennai and Kakinada (0.63-0.66). The spawning season of ribbonfish was observed to extend from November to June with two recruitment peaks, one in January and another in July-August. Bombay duck landings were estimated as 1.22 lakh tonnes and it showed an increase of 42% as compared to the previous year. Out of the eleven species of carangids studied, only five are over-exploited, that too in restricted areas. The taxonomic position of fishes of the family clupeidae, chirocentridae, carangidae and scombridae were reassessed. Under the INARIS programme under NATP 16 digit species codes were generated for 46 fish groups following the standard coding pattern. Marine fishing practices, mariculture and post-harvest technologies available in India were documented.

The elasmobranch fishery registered an increase in yield by 3.1% as compared to 2001 with Tamil Nadu contributing the major share. Sex ratio studies in rays (*Himantura bleekeri*, *H. alkaki* and *Gymnura poecilura*) indicated that males dominated the populations. Groupers, snappers and pig face breams constituted the perch fishery. *Epinephelus diacanthus* was mainly caught in trawls and *E. tauvina* mainly by hooks and lines. The spawning season of *Nemipterus mesoprion* and *N. japonicus* was during October-November off the west coast and November off the east coast. Twenty-four species of croakers contributed to all India sciaenid fisheries. Spawning period of *J. glaucus* off Veraval was January-April and October-December. Maximum landings of lizardfishes were observed at Veraval. While *Saurida tumbil* and *S. undosquamis* were the only species caught from the west coast, *S. micropectoralis* and *S. longimanus* were also caught in addition to the former along the east coast. Among flatfishes, *Cynoglossus macrostomus* dominated the fishery along the southwest coast and along the east coast *C. macrolepidotus* was the major species. The taxonomy of fishes of the family sciaenidae, cynoglossidae and soleidae were reassessed using morphometric and meristic characters.

In the multi-institutional programme on DSL, the percentage of nektonic components were less during the year when compared to the zooplankton in almost all stations. Study of the impact of bottom trawling on the benthic fauna revealed that the average biodiversity indices (Shannon-Weiner and Simpson diversity) generally showed a decrease after trawling.

The major contributor to the penaeid prawn fishery along the northwest coast and south Karnataka coast was *Solenocera crassicornis* and *S. choprai*, respectively. Increase in deep sea shrimp catch from Quilon Bank indicated the possibility of revival of the fishery. The stock-recruitment relationship of *Metapenaeus affinis* from Mumbai was fitted according to the Ricker curve, and it indicated that the highest recruitment in *M. affinis* is possible with 193 t of spawning stock biomass (SSB). In the non-penaeid prawn fishery at Mumbai and Navabunder, the exploitation rate of *Nematopalaemon tenuipes* was estimated as 0.72 and 0.69, respectively. At Mumbai, the exploitation rate of lobster (*Panulirus polyphagus*) reached an alarming level of 0.87 for males and 0.80 for females. Implementation of regulatory measures for fishing and export of lobsters were addressed through an MPEDA funded project. The edible crab *Charybdis lucifera* emerged as an important constituent of the crab fishery. Taxonomic identity of 50 species of shrimps, 39 species of crabs, 9 species of lobsters and 4 species of stomatopods were confirmed.

The exploitation rate of the Indian squid (*Loligo duvauceli*) stock at Cochin showed a drastic decline from 0.72 in 2000 to 0.48 during 2002, while the exploitation rate of *Octopus membraneaceous* showed considerable increase. Both *L. duvauceli* and *Sepia pharaonis* stocks did not show signs of over-fishing. The all India fishery for bivalves and gastropods was estimated as 60,307 t with bivalves forming 97% of the catches. The clam *Villorita cyprinoids* and the green mussel *Perna viridis* contributed to the bulk of the landings.

Monitoring of environmental characteristics of coastal water was continued all through the year. The zooplankton biomass had a range 1.1-33.0 ml / 100 m^{-3} along the west coast 0.2-40.0 ml / 100 m^{-3} along the east coast. Heavy metal content analysis of the seawater and selected marine organisms revealed that the mean metal concentration observed from our coastal waters was within the safe level given for marine organisms, except for Zinc from the east coast. The annual mass nesting (*Arribada*) of the olive ridley turtle (*Lepidochelys olivacea*) along Orissa coast was a failure during 2002 when compared to 2001 when more than 7 lakhs turtles were observed. Under the sea cucumber conservation strategy more than 10,000 hatchery produced *Holothuria scabra* were sea ranched in the sea grass beds of Van Island, Tuticorin. Two families of zooplankton namely the calanoid copepod family pseudodiaptomidae under the super family centropagodea and the decapod family sergestidae were reviewed as to their taxonomic status.

Surveillance of toxic algal blooms along the west coast of India was continued. A bloom of *Hornellia marina* was observed in the coastal waters of Calicut in September, which resulted in heavy fish mortality due to the presence of super oxide radicals. Influx of total suspended solids (TSS) and total dissolved solids (TDS) to the sea were found to be impaired in rivers having dams in Veraval, Mangalore, Cochin and Visakhapatnam. Twenty-three species of true mangroves, 31 species of mangrove associates and 10 species of mesophytic bio-invasive plants were recorded from the mangrove ecosystems of Kerala, West Bengal and Andaman and Nicobar Islands.

In marine finfish culture broodstock of groupers were maintained in indoor tanks and induced maturation trials were made through hormonal manipulations. In groupers methyl testosterone induced sex reversal was completed in 40 days, but functional maturity could not be obtained. Success in broodstock development, breeding and larval raring was achieved in the marine ornamental fish, the one-spot damselfish, *Chrysoptera unimaculata*. Third generation babies of the seahorse *Hippocampus kuda* were produced at Mandapam. A marine aquarium open to the public was established at Calicut RC of CMFRI to conduct research on breeding ornamental finfishes and shellfishes.

Successful domestication of the tiger shrimp *Penaeus monodon* was achieved using both pond reared and tank reared F_1 generation. A *state-of–the–art* marine hatchery facility was established at Regional Centre, Visakhapatnam for conducting hatchery experiments with pearl oysters, cephalopods, shrimps and crabs. A technology for maturation and breeding of the lobster *Panulirus homarus* in captivity was developed and standardized. Scientists of the Institute also achieved capability in hatchery production of the mud crab *Scylla serrata* and *S. tranquebarica*.

With increased thrust in TOT, the area under farming of green mussels and edible oysters in the coastal areas continued to increase. The production by farming was estimated as 1600 t with 1250 t of green mussel and 350 t of edible oyster. Shri Gul Mohamed, one of the pioneers in mussel farming using the CMFRI technology was awarded the '*Karshaka Shiromani*' award by the Ministry of Agriculture, GOI. Pearl oyster spats with black band had maximum growth rate followed by green and red-banded oysters and these are being used for selection experiments. At Tuticorin shellfish hatchery, 98,500 seeds of pearl oyster *Pinctada fucata* and 1,74,400 spat of the clam *Paphia malabarica* were produced. The explant culture of the pearl oyster mantle resulted in good growth of cells *in-vitro* and formation of thick cell sheet, which had the precursors for crystal formation.

The total mussel seed biomass from A&N Island, Kerala, Karnataka, Maharashtra, Goa, Gujarat, Tamil Nadu, Pondicherry and Andhra Pradesh was estimated at 16,130 t covering an area of 702 ha. Successful spawning and larval rearing of the whelk *Babylonia spirata* was achieved at Cochin. The impact assessment of suspended bivalve culture showed that the total organic carbon (TOC) in the sediment decreased due to farming. Under NATP, large (6-8 mm diameter) marine pearl production was achieved from the Port Kollam farm. Besides, the technology for production of marine *Mabe* pearl was developed. Initial results on colour manipulation of marine pearls using trace metals through the feed were encouraging. Under the revolving fund project on pearl culture 40,800 implanted oysters were supplied to M.S. Swaminathan Research Foundation for a community level pearl farming programme.

Under experimental culture using long line coir ropes, the seaweed *Kappaphycus alvarezii* grew 5-fold in 48 days. Laboratory culture of the microalgae *Chlorella* and *Nannochloropsis* in different concentrations of sodium bicarbonate showed improvement in growth and protein content. The technology for the agarophyte *Gracilaria edulis* culture by the vegetative propagation method was transferred to fishers of Vadakadu in Palk Bay and Naalupanai in the Gulf of Mannar. A total of 870 kg of agar was produced in the agar plant at Mandapam and an income of Rs. 1.67 lakhs was generated through the sale of agar sheets.

By repeated trials, a duplex PCR assay of white-spot syndrome virus (WSSV) of shrimps was developed. This is faster and more reliable compared to the nested PCR kits, which are currently in use, and its commercialization is underway. A formulated pellet feed for mud crab fattening and ornamental fish rearing was developed. Multivariate analysis of truss morphometry of threadfin bream stocks indicated *N. japonicus* stocks of Cochin and Visakhapatnam are separate based on body shape and *N. mesoprion* stocks are phenotypically homogenous. Under the National Referral Laboratory for Marine Fish and Shellfish Microbial Diseases programme, 37 isolates of *Vibrio* sp., 26 isolates of *Aeromonas* sp. and 8 isolates of *Pseudomonas* sp. have been segregated from diseased organisms.

The influence of combined immunostimulation on the non-specific defense in *P. monodon* was evaluated. A single dose of *Ulva* sp. (1 g/kg) gave 80% survival against an infection caused by the potentiated *Vibrio* pathogen. Chemical stressors like copper was found to lower the hemocyte count, haemolymph protein and phenol oxidase activity in *P. monodon*. The human probiotic yeast *Saccharomyces boulardii* has been proved to be effective in curbing *V. harveyi* induced mortality in marine shrimp larvae. The complete protocol for feeding of probiotic organisms to shrimp larvae up to PL-20 and bio-encapsulation of probionts in *Artemia* metanauplii has been developed.

The annual average price for different species of marine fish and shellfish was worked out at landing centre, wholesale and retail level for all maritime states. In the mechanized sector, the operating ratio ranged from 0.49 for single-day trawling to 0.68 for multi-day trawling and for gill netters the operating ratio varied from 0.60 for single-day trip to 0.55 for multi-day trip. The economic loss due to over-fishing estimated in terms of the net present value (NPV) of MSY for 30 years was Rs. 160.6 crores for catfishes, Rs. 458.5 crores for elasmobranchs and Rs. 3.9 crores for goatfishes. Under the IVLP programme, 15 techno-interventions were approved for the second phase at Elankunnapuzha village in Vypeen Island near Cochin. All sales, services and products of the Institute are now channeled through the single window delivery system after the commissioning of the ATIC by the Director General, ICAR, Dr. Mangala Rai. The FAO code of conduct for responsible fisheries was translated to Malayalam and published as a book with the permission of FAO, Rome.

The staff of the Institute published 28 papers in peer-reviewed journals, 34 technical articles and presented 67 papers in seminars and symposia during the year. Scientists of the Institute have obtained two provisional patents for the on-shore pearl farming and grouper breeding technologies. Scientists of the Institute also gave consultancies worth Rs. 46.4 lakhs on EIA to various industries. During the year, 5 new in-house projects on GIS mapping of mariculture sites, organic farming of shrimp, simulation games for fisheries management and transfer of technology of bivalve mariculture and crab fattening were approved for implementation. Besides, the Department of Ocean Development sanctioned 3 new projects on black pearl production in A&N Islands, xenobiotics in marine mammals and predictive modeling during the current year. The AP Cess Fund of ICAR also sanctioned two projects on impact of global warming and risk assessment of mariculture products. Scientists of the institute were recipients of several awards for their achievements, including the prestigious Rafi Ahmad Kidwai award.

Under the education and out-reach programmes, 17 students were awarded the Ph.D degree and 10 the M.F.Sc degree in mariculture. Two M.F.Sc students received gold medals. The KVK of the Institute conducted 126 training programmes and the TTC conducted 12 courses. Staff of the institute were also given training in HRD, specifically on leadership skills and research management.

INTRODUCTION

India is endowed with a long coastline of 8,129 km, 0.5 million sq km of continental shelf, 2.02 million sq km of EEZ and an estimated annual Marine Fishery Resource Potential of 3.9 million t. The vast areas along the coastline offer ideal sites for seafarming and coastal mariculture. The Indian marine fisheries sector plays a significant role in supplying protein-rich food to the increasing population, employment generation and foreign exchange earning. The present marine fisheries scenario in India is characterised by declining yields from the inshore waters, increasing conflicts between different resource users, increasing demand for sea-food for domestic consumption and export and prospects for large scale seafarming and coastal mariculture. This warrants greater and more effective R&D efforts to enable implement suitable action plans for sustained marine fisheries and mariculture development.

The Central Marine Fisheries Research Institute (established in 1947) is the nodal agency in India, responsible for research support in marine fisheries development. Over the period of 56 years since its inception, the CMFRI grew significantly in its size and stature by building up a fairly adequate research infrastructure and recruiting suitably qualified R&D staff. The Institute's multidisciplinary approach to research in marine capture and culture fisheries has won the recognition as a premier Institute comparable to any well-established marine fisheries laboratory in the world.

The Mandate

To monitor the exploited and 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 change in the environment.

To develop suitable mariculture technologies for finfish, shellfish and other culturable organisms in open seas to supplement capture fishery production.

To act as a repository of information on marine fishery resources with a systematic database.

To conduct transfer of technology, post graduate and specialized training, education and extension education programmes.

To provide consultancy services.

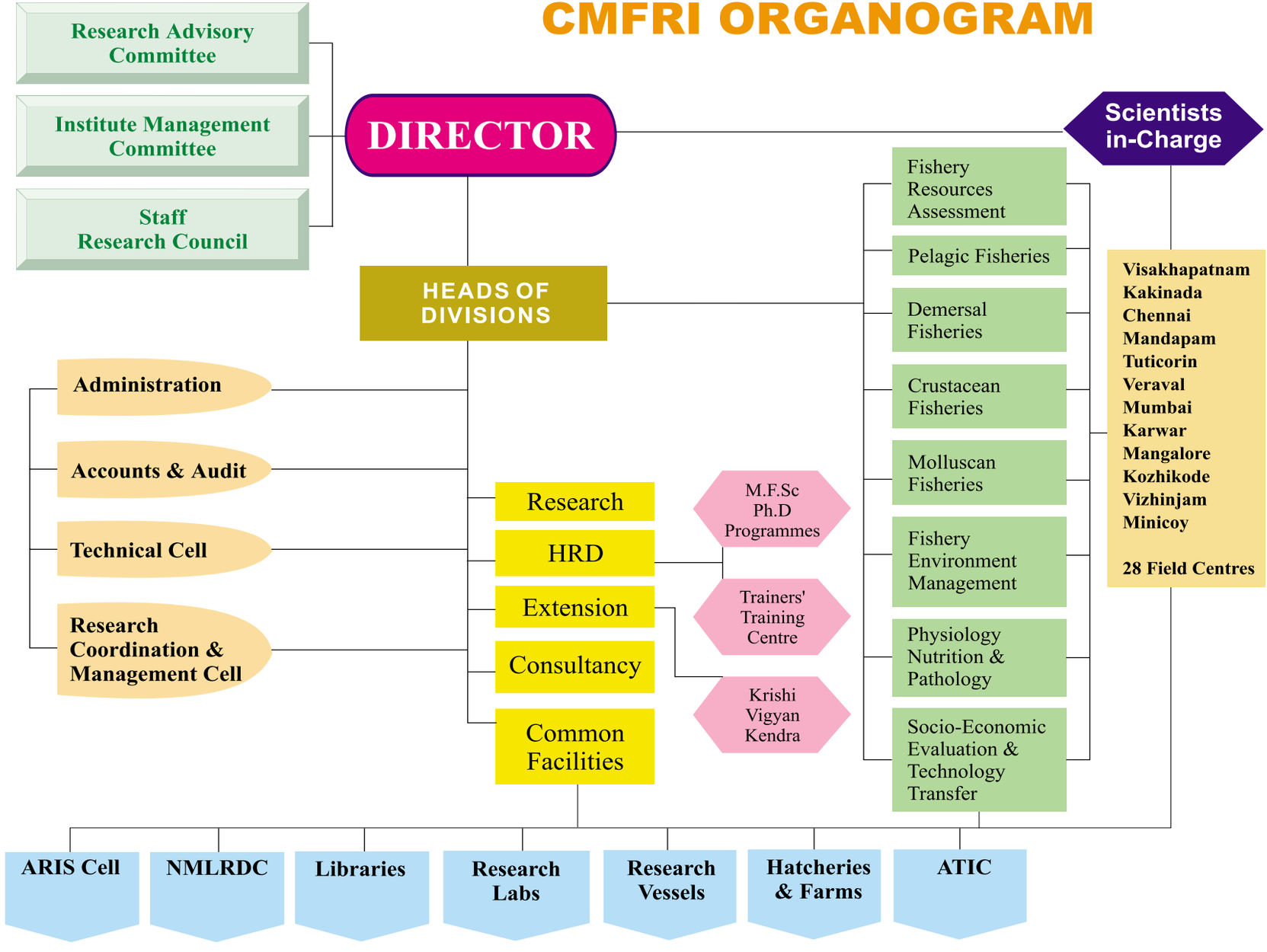
To accomplish its mandate, the Institute monitors the landings on a continual basis from all along the country's coast, conducts researches on characteristics of exploited marine fish stocks; carries out exploratory surveys and assesses the under - and unexploited resources, develops seafarming techniques, undertakes research in fishery environmental characteristics and sea-dynamics and conducts postgraduate education programmes leading to M.F.Sc. and Ph.D. degrees. Studies are also conducted on economics of fishery enterprises and socio-economic conditions of fisherfolk.

The organisational set-up

To effectively carry out these tasks, the Institute has established Regional Centres at Mandapam Camp, Veraval and Visakhapatnam, Research Centres at Minicoy, Mumbai, Karwar, Mangalore, Kozhikode, Vizhinjam, Tuticorin, Chennai and Kakinada and 28 Field Centres all along the coast. The entire activity is coordinated by the Headquarters at Kochi. The Institute has, over the years, built up laboratory and field facilities for carrying out research programmes and has been upgrading the same to meet the changing needs and additional requirements. The sanctioned staff strength of the Institute is: Scientific 190, Technical 376, Administrative 159, Auxiliary 6 and Supporting 304.

The multidisciplinary researches in capture and culture fisheries are conducted under eight Divisions: Fisheries Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries, Fishery Environment Management, Physiology, Nutrition and Pathology and Socio-economic Evaluation and Technology Transfer. Interdivisional and interinstitutional programmes are carried out for greater utilisation of expertise and facilities. Besides, the Institute also takes up short-term research projects on important and priority areas

CMFRI ORGANOGRAM



Budget 2002 – 2003

(Rs. in lakhs)

Sl. No.	Sub Head	Budget Allocation for the F/Y 2002-2003	Expenditure for the F/Y 2002-2003
NON PLAN			
1	Estt. charges	1275.00	1275.00
2	O.T.A.	1.20	1.20
3	T.A	14.00	14.00
4	Other Charges	150.00	150.00
5	Works	3.00	3.00
6	Other items	3.00	3.00
	Non-Plan Total	**1482.00**	**1482.00**
PLAN			
1	Estt. charges	-	-
2	T.A	37.00	37.00
3	(a) Other charges including Equip	122.00	122.00
	(b) Information Technology	3.00	2.89
4	Works		
	1. Works as per EFC		
	(a) Special Repairs	-	-
	(b) Major works	130.00	130.00
	2. One time Catch-up-grant	-	-
5	(a) Other items	15.00	15.57
	(b) HRD	3.00	2.43
	Plan Total	**310.00**	**309.98**

Externally Funded Research Projects

S.No.	Fund Source	Receipts during the year	Expenditure during the year
1	AP Cess Fund	11.67	22.77
2	DOD	2.88	2.67
3	DBT	-	2.74
4	KFD	5.00	3.05
5	DST	-	5.31
6	MoEF	-	2.76
7	MPEDA	8.13	3.28
8	IFS	-	0.48
9	IGIDR	-	2.71
10	NATP	241.88	206.50
	Total	**269.56**	**252.27**

through *ad hoc* research projects funded by outside agencies in the country and abroad, and offers consultancy services to the clients from Government organisations as well as private industry.

Under the Postgraduate Programme in Mariculture, the Institute organises M.F.Sc. and Ph.D programmes of the Central Institute of Fisheries Education, Mumbai, a Deemed University under the ICAR. The teaching programme is carried out by the scientists of the Institute.

The *Krishi Vigyan Kendra* imparts training in mariculture, agriculture, animal husbandry and other related subjects to fish farmers, agricultural farmers and farm women and the Trainers' Training Centre to the officials of state and central governments, banks, societies and autonomous bodies interested in fisheries development.

The Library and Documentation Section provides reference facilities to research staff and students of the Institute as well as to visiting scientists both within and outside the country.

The results of research carried out in the Institute are published in various journals. Besides, the Institute brings out Bulletins, Special Publications and the Marine Fisheries Information Service and publishes the Indian Journal of Fisheries.

Posts	Sanctioned	In-position
Scientists	190	126
Technical	376	349
Administrative	159	154
Supporting	304	275
Auxiliary	6	6

Research Achievements

FISHERY RESOURCES ASSESSMENT DIVISION

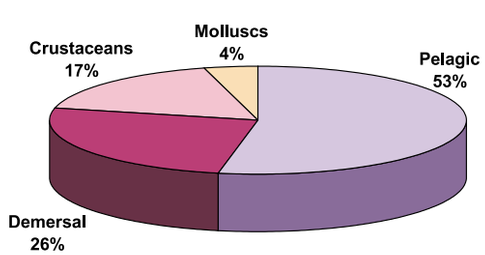
The division has 7 scientists who are engaged in 4 research projects of the Institute viz.,

1. Assessment of exploited marine fishery resources
2. Stock assessment techniques in marine fish and shellfish resources and management
3. Predictive modelling in marine fisheries
4. Determination of optimum sample size to evaluate the catch and effort for use in marine fisheries

Besides carrying out these research projects, the scientists of the Division have also been involved in Teaching and Training programmes of the Institute. All the scientists were associated with the teaching programme of MFSc and PhD courses under the Post Graduation Programme in Mariculture.

The Division periodically organizes computer training programmes for the technical and administrative staff members of the Institute and during this year a course was arranged during September 2002 for the staff of Regional Centre of CMFRI, Mandapam Camp and Tuticorin RC of CMFRI.

PROJECT CODE	**FRA/ASSESS/01**
PROJECT TITLE	**Assessment of exploited marine fishery Resources**
SCIENTISTS	**K. Balan,** M. Srinath, K. Vijayalekshmi, T.V. Sathianandan, Wilson T. Mathew, Somy Kuriakose and K.G. Mini
CENTRES	Cochin

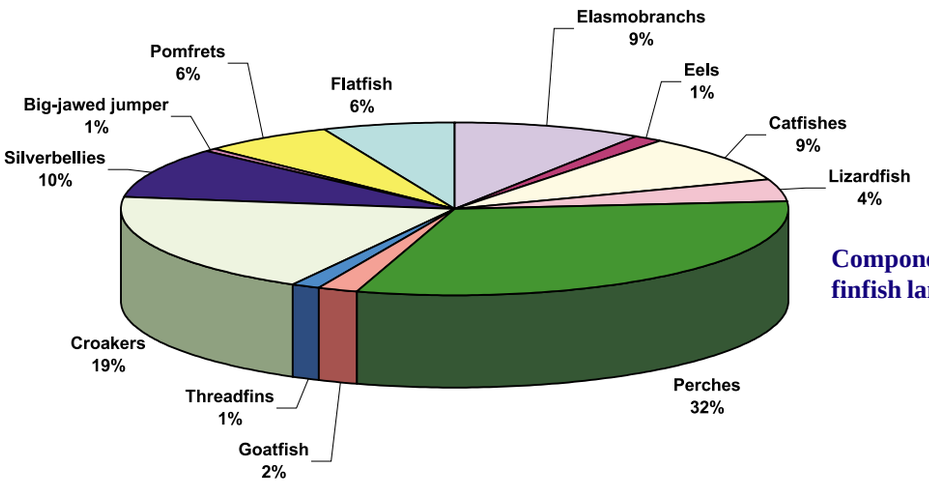


Components of marine fish landings in India during 2002

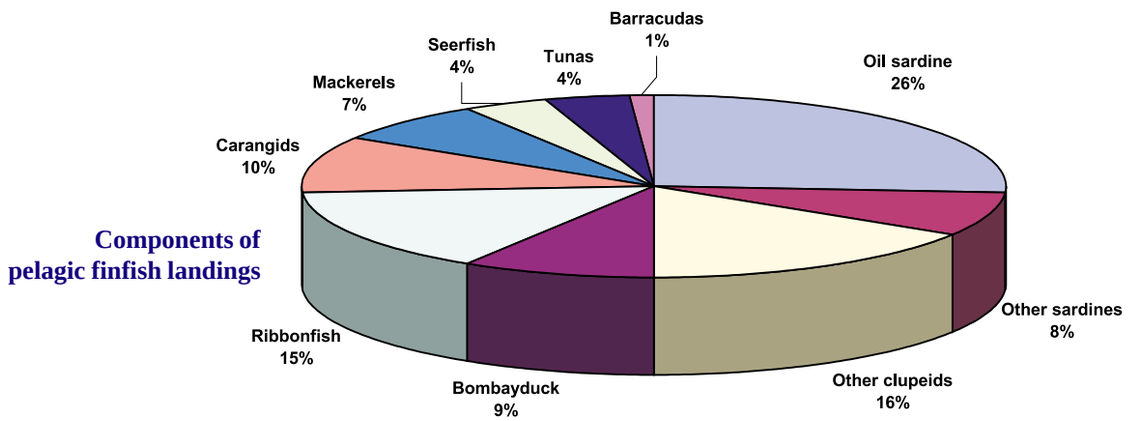
Salient findings

The marine fish landings, in India during 2002 have been provisionally estimated at **2.64 million tonnes**. Compared to the estimate of the previous year, the production recorded an increase of 3.14 lakh tonnes (13.5%).

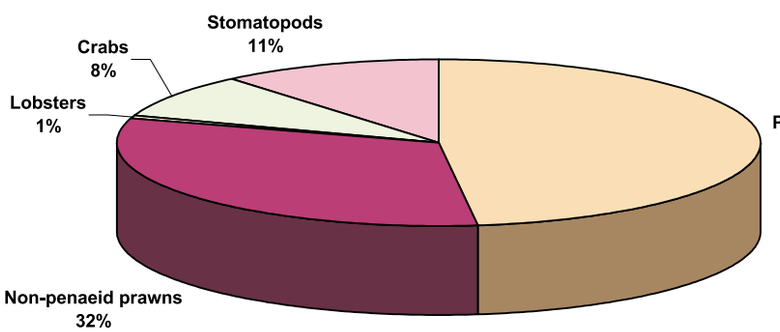
- An increasing trend was noticed in the landings of sharks, oil sardine, Bombay-duck, ribbon fishes, carangids, seer fishes, tunas, penaeid prawns and cephalopods. Landings of perches and non-penaeid prawns decreased.
- The pelagic finfishes formed about 53 % of the total landings, demersals 26 %, crustaceans 17 % and molluscs 4 %.
- The contribution of mechanized sector was 67.9 %, motorized sector 25.0 % and artisanal sector 7.1 % to the total production.
- The shark fishery recorded a slight improvement of 2,800 tonnes with an estimate of 37,000 tonnes during 2002.



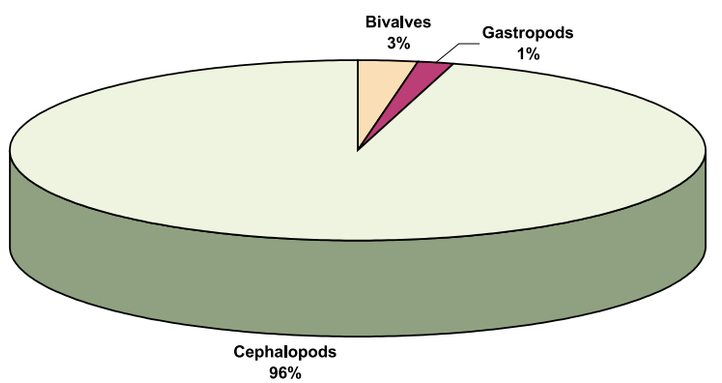
Components of demersal finfish landings



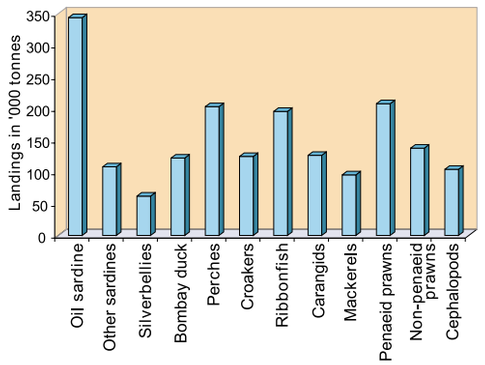
Components of pelagic finfish landings



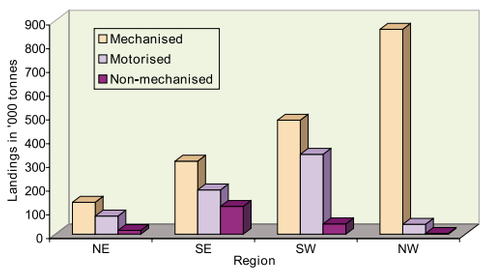
Components of crustacean landings



Components of molluscan landings



Landings of major fishery resources during 2002



Sector-wise landings in different regions, 2002

- Oil sardine landings increased by 76,000 tonnes with a record estimate of 3.43 lakh tonnes during 2002.
- Bombay duck fishery improved by 36,000 tonnes with an estimate of 1.22 lakh tonnes.
- The landings of perches recorded a marginal reduction of about 220 tonnes, the estimate during 2002 being 2.03 lakh tonnes.
- The ribbon fish landings were 1.96 lakh tonnes with an increase of 20,000 tonnes.
- Carangids fishery was 1.26 lakh tonnes with an increase of 7.5% .
- Seer fish landings increased by 9,000 tonnes with an estimate of 51,000 tonnes in 2002.
- The landings of tunnies were 50,000 tonnes which indicated an improvement of 2,200 tonnes over the previous year.
- The landings of penaied prawn increased substantially by 31,000 tonnes, with an estimate of 2.08 lakh tonnes.
- Non-penaied prawns landings reduced by 7,500 tonnes, the estimate during 2002 being 1.38 lakh tonnes.
- The landings of cephalopods were 1.04 lakh tonnes which recorded an improvement of 30,000 tonnes.

Estimated regionwise landings (in lakh tonnes)

Region	2002	2001	Change (%)
North East	2.27	1.69	34.0
South East	6.11	5.15	18.6
South West	8.60	7.44	15.6
North West	9.08	8.63	5.2

PROJECT CODE FRA/ASSESS/02

PROJECT TITLE **Stock assessment techniques in marine fish and shellfish resources and management**

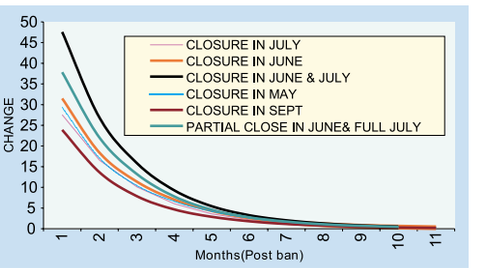
SCIENTISTS **M. Srinath,** T.V. Sathianandan, Wilson T. Mathew and Somy Kuriakose

CENTRES Cochin

Salient findings

- Investigations on applicability of time varying discrete and continuous versions of Schaefer model under non-equilibrium were carried out. The parameters were estimated by observation error methods and the estimaton routines were developed in BASIC.
- Analysis of annual demersal catch and the effort in terms of fishing hours for assessing overall impact of fishing in Kerala was carried out. The data were fitted to the discrete time varying Schaefer model and the estimated MSY was about 2.4 lakh tonnes, obtainable at the effort level corresponding to that during 1996-1997 period.
- The trend in the estimated annual biomass from 1982 to 2001 indicated that the biomass was higher during the initial years of the ban phase and subsequently reduced with increase in fishing pressure. Using the estimated population parameters, the effect of changes in effort on the biomass was projected under different effort regimes.

- The analysis revealed that if the effort were to be maintained at the current level for the next five years, the total yield would decline (and hence the catch rate). A 10% reduction in effort from the current level would yield marginal increase in the landings. More significant increase in the yield could be obtained if there is 20% reduction in effort.
- The lower catch rates during 1997-2001 reflect the lower levels of biomass. The analysis revealed that reduction in effort was expected to result in higher catches. A 20% reduction which corresponds to level of effort from the 45 days current ban period is expected to produce corresponding increase in the yield.
- The possible effects of seasonal closure on the expected yields from the demersal resource assemblage were investigated by the analysis of monthly demersal catch and the effort in terms of fishing hours from 1999-2001.
- Two approaches, one based on time varying continuous version and the other based on time varying discrete versions of the Schaefer model in the non-equilibrium situation were attempted. Simulations were carried out to estimate the effect of different fishing strategies. The following scenarios were projected: closure in May, closure in June, closure in July, closure in September, closure in June and July, partial closure in June and full close in July. The relative change (%) in yield during the months between the closures was estimated and the analysis revealed that there was larger gain in yield in the months immediately after the closure. Both the approaches seem to be in agreement with the fact that with respect to improving the yield from the demersal resource assemblage, complete closure of trawl fishery during June and July is expected to be beneficial.



Percent change in demersal yield after ban for succeeding months in different scenarios (Kerala)

PROJECT CODE	**FRA/MOD/01**
PROJECT TITLE	**Predictive modelling in marine fisheries**
SCIENTISTS	**T.V. Sathianandan,** K. Balan, and Mini, K.G
CENTRES	Cochin

Salient findings

- Time series data on quarter-wise landings of oil sardine, mackerel, anchovies, penaeid prawns and total landings in Kerala during 1960-2000 were used and seasonal ARIMA models were fitted for each of these species/groups.
- To study the significant changes in the landings in Kerala, by the introduction of crafts fitted with outboard engines, intervention analysis was carried out, using time series data, on quarter-wise total marine fish landings during 1960-2000. Results revealed that the increase in total landings by the intervention was, on an average, about 56,500 tonnes.

PROJECT CODE	**FRA/MOD/02**
PROJECT TITLE	**Determination of optimum sample size to evaluate the catch and effort for use in marine fisheries**
SCIENTISTS	**M. Srinath,** K. Vijayalekshmi, Somy Kuriakose and Mini, K.G
CENTRES	Cochin

Salient findings

- The Monte Carlo Bootstrap methodology was applied to the data on trawl landings for each month at the Cochin Fisheries Harbour during 1992 and 1993 to evaluate the sampling scheme in terms of estimates of the coefficient of variation and determining the number of

days for observation. The bootstrap evaluation was carried out in two stages, one for the days and the other on the number of boats on the selected day. Analysis of variance revealed that major contribution to the total variance is mainly from variation among the first stage units only. The bootstrap software for this study was developed in C language. The bootstrap experiment was carried out with 1000 bootstraps for the first stage and the coefficient of variation was estimated for different bootstrap sample sizes.

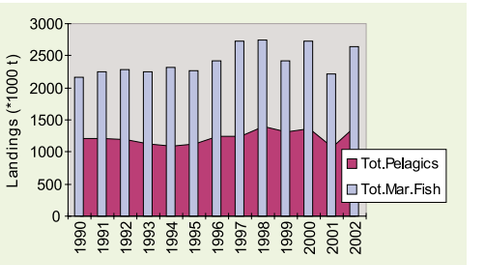
- The monthly coefficient of variation for different sample sizes starting from sample size of 2 days during 1992 and 1993 ranged from 40% to 8% for 2 days to 18 days observation, respectively. In most of the months, the coefficient of variation ranged between 10% and 15% for 10 or more days of observation per month. In general, 10-12 days observation in a month would be sufficient to estimate the total catch.

Estimated marine fish landings (t) during 2001 and 2002

Name of fish	Pelagic finfish 2001	2002	Name of fish	Demersal finfish 2001	2002
CLUPEOIDS			ELASMOBRANCHS		
Wolf herring	13783	17109	Sharks	34586	36859
Oil sardine	267790	343743	Skates	2254	2740
Other sardines	76374	108341	Rays	20182	20209
Hilsa shad	16756	23747	EELS	8198	9406
Other shads	4834	5959	CATFISHES	49729	57967
Coilia	31955	38316	LIZARD FISHES	24331	26949
Setipinna	3445	6556	PERCHES		
Stolephorus	44539	44209	Rock cods	25885	25539
Thrissina	1	295	Snappers	4004	4961
Thryssa	30042	32231	Pigface breams	13215	11406
Other clupeids	43539	43325	Threadfin breams	114410	111051
BOMBAYDUCK	85836	122217	Other perches	45942	50273
HALF BEAKS&FULL BEAKS	4378	5922	GOATFISHES	10434	12412
FLYING FISHES	5724	6236	THREADFINS	6976	9240
RIBBON FISHES	175837	195792	CROAKERS	121487	124722
CARANGIDS			SILVERBELLIES	51814	62100
Horse Mackerel	18982	21230	WHITEFISH	4913	3991
Scads	40914	38626	POMFRETS		
Leather-jackets	6957	6262	Black pomfret	12795	12681
Other carangids	50735	60348	Silver pomfret	25026	26007
MACKERELS			Chinese pomfret	1147	2042
Indian mackerel	90134	95628	FLAT FISHES		
Other mackerels			Halibut	962	1181
SEER FISHES			Flounders	251	148
S. commerson	27549	35136	Soles	37979	40473
S. guttatus	14840	16373	MISCELLANEOUS	30504	32470
S. lineolatus	39	14	**Total**	**647024**	**684827**
Acanthocybium spp.	150	24			
TUNNIES			**Shellfish**		
E. affinis	21171	24421			
Auxis. spp	11202	11833	CRUSTACEANS		
K. pelamis	2672	3117	Penaeid prawns	176717	207880
T. tonggol	9040	6350	Non-penaeid prawns	145232	137737
Other tunnies	3827	4401	Lobsters	1389	2605
BILL FISHES	4367	4126	Crabs	29880	36423
BARRACUDAS	18576	18019	Stomatopods	34944	48555
MULLETS	5594	6221	MOLLUSCS		
UNICORN COD	482	891	Cephalopods	101287	104354
MISCELLANEOUS	55964	67046	Miscellaneous	2006	4762
Total	**1188028**	**1414064**	**Total**	**491455**	**542316**
			Grand total	**2326507**	**2641207**

PELAGIC FISHERIES DIVISION

- During 2002-2003 the Pelagic Fisheries Division implemented eight in-house research projects on economically important pelagic finfish resources such as sardines, anchovies, mackerel, seerfishes, tunas and billfishes, ribbonfishes, Bombay duck and carangids. Besides these, one in-house project on taxonomy of pelagic fishes and five externally funded projects were also implemented. The Division has built up a strong data base on catch, effort, c/e, species-wise catch composition, size composition and other biological parameters of all the commercial pelagic finfishes and based on this, stock assessment studies have been made.
- Pelagic finfish production during 1985-2002 fluctuated from 0.78 million tonnes (mt) in 1985 to 1.4 mt in 2002 forming 53% of the total marine fish production. During the last decade, pelagic finfishes have contributed 46-56% (average 51%) of the total marine fish production in India.
- Pelagic finfish landings during 2002 showed an increase of 7.4% compared to the last year. Landings of all the major resources were higher by 6-42% compared to those in the previous year.
- 67% of the production of pelagics in 2002 was obtained from the west coast and 33% from the east coast.
- Oil sardine landings during 2002 were higher by 28% compared to the previous year while the peak catch of the species recorded to date was 3.67 lakh t in 2000.
- A major pelagic resource, the Indian mackerel landings which had shown a continually declining trend since mid nineties showed a slight increase by 6%.
- Tuna and billfish landings also improved considerably along the mainland and Lakshadweep islands.
- Annual population parameters were assessed and stock estimates of tunas, seerfishes, mackerel, oil sardine, lesser sardines, whitebaits, ribbonfishes, carangids and Bombay duck were done.



Pelagic fish and total marine fish landings in India during 1990-2002

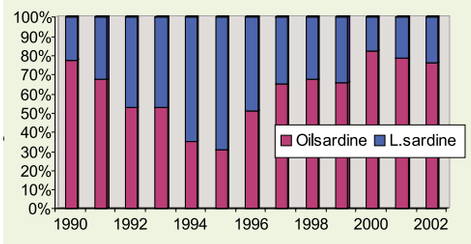
PROJECT CODE	**PEL/CAP/1**
PROJECT TITLE	**Development of management strategies for sustainable fishery of sardines (*Sardinella* spp.)**
SCIENTISTS	**A.A. Jayaprakash,** Prathibha Rohit,N.G.K.Pillai, M.Sivadas, E.M.Abdussamad, H.Mohamad Kasim and A.K.V.Nasser
CENTRES	Karwar, Mangalore, Calicut, Cochin, Tuticorin, Mandapam, Chennai and Visakhapatnam

- The stock building process in oil sardine was evident from massive recruitment that followed during the ensuing years ever since it attained a highest density and peak production of 3.67 lakh t in the year 2000. This has resulted in large scale swarming of these fishes along the southwest coast of India during the year. Also these young ones have been found to enter the Cochin backwaters.
- Unusual occurrence of the juvenile fishes of 80-120 mm and their exploitation by the ring seines was noticed. Out of 3.43 lakh tonnes of oil sardine landed in Kerala, juveniles constituted 88,000 t.
- Oil sardine was exploited at MSY level. The continuous fishery gave a face-lift to the coastal economy. Dry-fish trade worth Rs. 12.6 crores, Rs. 1.46 crores and Rs.9.7 crores were carried out from Alleppey, Calicut and Karnataka, respectively.

Oil sardine showing stunted growth due to high density of stock and lack of food

Salient findings

A better understanding of the mystery of fluctuations in the stock of oil sardine was obtained. Nearly 100 years' rainfall data (1900-2000) and oil sardine landings were compared and a correlation to the fluctuations in abundance of oil sardine was offered leading to the possibility of a fishery forecast model.



Composition of all India sardine landings - 1990-2002

- Compared to other areas along the east and west coast of the country, the occurrence of spawning population was highest off Cochin.
- The current production of oil sardine is 3.43 lakh t (+28%). Oil sardine dominated in all the gears along the west coast and lesser sardines along the east coast.

Recommendations

- The sustained occurrence of juveniles of oil sardines indicated continuous recruitment, but these young ones showed stunted growth due to high density of the stock and lack of food. They had an emaciated look, low in fat deposition and may not reach maturity to spawn and would meet a natural death. Hence there is no harm in exploiting them for human consumption.
- Concerns have been raised about the ring seine operations along the southeast coast of India. Oil sardine of 110 mm and above are exploited by this gear. Further, the adults are mostly in the spent recovering stage. Hence the ring seine operations here are not detrimental to the stock if they target the adults.
- A comparison of fishery and biological parameters of the pelagic fishes exploited off Cochin during the pre-trawl ban and post-trawl ban period has not indicated any positive or negative impact by the existing trawl fishing ban on the stocks of these fishes.

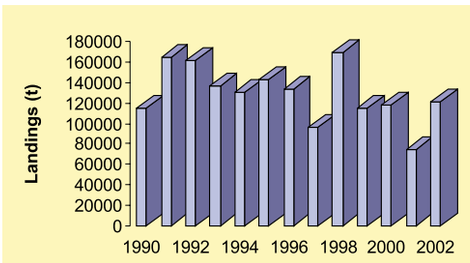
PROJECT CODE **PEL/CAP/2**

PROJECT TITLE **Development of management strategies for judicious harvesting of anchovies**

SCIENTISTS **Mohammad Zafar Khan,** Prathibha Rohit, A.A.Jayaprakash, R.Thiagarajan and H. Mohamad Kasim

CENTRES Mumbai, Mangalore, Cochin, Vizhinjam and Chennai

*Stock assessment studies indicated that the current year's exploitation rate (F/Z) for **S.indicus** is 0.33 and for **C. dussumieri** is 0.35 indicating that the fishery can sustain increased fishing pressure.*



All India anchovy landings

- During 2002, the estimated anchovy landings were 0.82 lakh t showing an increase of 10% compared to the previous year's catch but is much below the average decadal (1990-2000) catch of 1.34 lakh t.
- Major gears employed were trawlers, purse seines, boat seines and *dol* net.
- Landing by trawlers showed a decline at all the major fishery centres like Mumbai, Mangalore and Vizhinjam while it increased at Malpe, Kochi and Chennai. Catches by purse seines declined at Mangalore and Vizhinjam by 48% and 79%, respectively.
- Major species recorded were *Encrasicholina devisi* (*Stolephorus devisi*) and *E.punctifer* (*S.buccaneeri*) on the south west coast and *Stolephorus indicus* and *S.commersonii* on the east coast. *Coilia dussumieri* constituted the fishery on the northwest coast of India.
- High stock density of anchovies was observed off Mangalore. Low stock density was observed off Kerala coast, however, stock available was exploited to MSY level.
- *E. devisi* spawns throughout the year whereas *S. waitei* has a restricted spawning season of November-January.
- Increased exploitation of golden anchovy *C. dussumieri* was observed by trawl net forming 4.1% of the total catch at New Ferry Wharf while a decade ago it constituted only 1.5% of the trawl landings. This incursion into the traditional *dol* net area is causing resentment among the *dol* net fishermen.

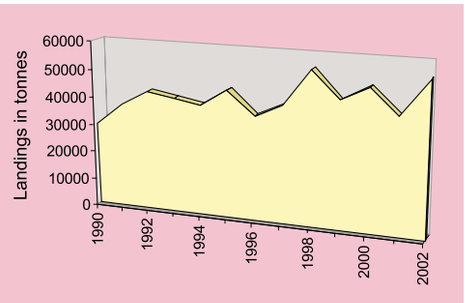
PROJECT CODE	**PEL/CAP/3**
PROJECT TITLE	**Development of strategies for rational exploitation of seerfishes**
SCIENTISTS	**C. Muthiah,** N.G.K. Pillai, U.Ganga, E.M.Abdussamad, H.Mohamad Kasim and A.K.V. Nasser
CENTRES	Veraval, Mangalore, Cochin, Tuticorin, Chennai and Visakhapatnam

- Seerfish landings were estimated at 0.52 lakh t which showed an increase of 21% over the catch of the previous year.
- On the west coast the seerfish landings was found to decline at fishery centres such as Veraval (-26%) and Cochin (-4%) while it showed an increase at centres like Mangalore-Malpe (+8%), Tuticorin (+28%), Chennai (+147%) and Visakhapatnam (+72%).
- Major gears employed were gill nets, trawls and hooks and line which contributed 63%, 24% and 6%, respectively. Rest was contributed by purse seines and indigenous gears.
- Catch rates in large meshed drift gillnet ranged from 24 kg at Veraval to 142 kg at Chennai. Catch rate in trawls varied from 0.3 kg at Kochi to 17 kg at Mangalore-Malpe.
- Species-wise composition of the landings were *Scomberomorus commerson* (71%), *S. guttatus* (26%) and Wahoo, *Acanthocybium solandri* (2.3%). Streaked seer, *S. lineolatus* accounted for less than 1% of the landings.
- King seer, *S. commerson* dominated the seerfish catch of all the gears at centres like Mangalore, Calicut, Kochi, Tuticorin and Chennai. Wahoo (*A. solandri)* landings were mainly at Cochin and Tuticorin fishery centres while *S. lineolatus* was caught from Tuticorin waters only.
- The size of *S. commerson* caught ranged from 12-152 cm. Mean size of the king seer landings was highest in hooks and line catches (69-86 cm). In large meshed drift gill nets mean size varied from 54-74 cm and 37-43 cm in trawl landings.
- The spotted seer, *S. guttatus* ranged in sized from 18-64 cm. The mean length of fish landed by trawls at different fishery centres was 33-45 cm and 39-42 cm in drift gill nets. Young fish (<18 cm) were caught only at Visakhapatnam forming 4% of the estimated numbers landed.
- At Mangalore centre, during the peak fishery from November-March pre-adults dominated the catches. Partially spent fishes were more abundant during November-December period.
- Growth parameters and mortality rates were estimated for *S. commerson* and *S. guttatus.*
- The exploitation rate of spotted seer was relatively high along the northeast and northwest coasts (E=0.69-0.74) compared to that along the southwest coast (0.45).
- As hooks and line and large meshed gill nets are landing larger sized fish, it is desirable to encourage these operations while the use of small meshed gill nets like *podivalai* along the Tuticorin coast in which nearly 50% of the seerfishes caught are juveniles (<34 cm size) is discouraged.
- Fishing operations may be extended to distant waters to tap the seerfish stock from deeper areas.

Young fish (<34 cm) of king seer were most abundant in the trawl catches at Mangalore (43%) followed by Tuticorin (42%), Chennai (38%) and Cochin (13%). However, compared to previous year, component of the smaller sized fishes was less at all these centres except Chennai. They also formed a substantial number (46%) of the seerfish landings in the small mesh drift gill net, ***podivalai*** *at Tuticorin.*

Exploitation rate (E) of king seer ranged between 0.51-0.78 and indicated that the species is exposed to higher fishing pressure along the southwest coast while it is exploited at optimum level along the north east coast.

During 2001, the frozen seerfish exports from India was 6,711 t valued at Rs. 52.7 crores.

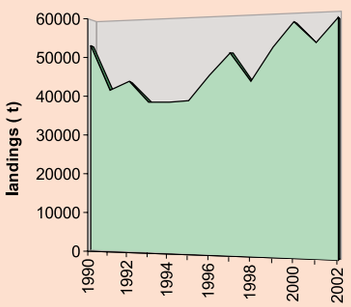


Seerfish landings in India

PROJECT CODE	**PEL/CAP/4**
PROJECT TITLE	**Development of strategies for sustainable exploitation of tunas, tuna live-baits and billfishes**
SCIENTISTS	**N.G.K. Pillai,** C.Muthiah, U.Ganga, G.Gopakumar, E.M.Abdussamad, H.Mohamad Kasim and K.P.Said Koya
CENTRES	Veraval, Mangalore, Cochin, Vizhinjam, Tuticorin, Chennai and Minicoy

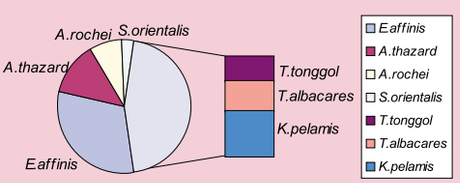
Artificial live-baits are being tried as innovative fishing methods by the pole and line fishermen of Minicoy to overcome live-bait scarcity during peak seasons.

- The total tuna and billfish landings during 2002 were 54,248 t showing a marginal increase of 3.7% compared to 2001. Tuna landings increased by 4.6% compared to previous year. Tuna catches increased at all the centres (Veraval-Dhamlej, Cochin, Chennai and Minicoy) except Vizhinjam and Mangalore-Malpe where it declined by 26% and 37%, respectively.
- Major gears employed in the fishery were drift gill nets, hooks and line, purse seines, pole and line and troll line.
- Tuna species landed were *Euthynnus affinis*, *Auxis thazard*, *A. rochei*, *Thunnus albacares*, *T. tonggol*, *Katsuwonus pelamis*, *Sarda orientalis* and *Gymnosarda unicolor.*
- Billfish species landed included *Istiophorus platypterus*, *Xiphias gladius* and *Makaira indica.*
- Among tunas, *E. affinis* and *A. rochei* dominated the drift gill net and hooks and line landings, respectively. At Minicoy, skipjack, *K. pelamis* dominated the pole and line and troll catches followed by yellowfin tuna.



All India landings of tunas and bill fishes

- Major live-baits caught for the pole and line tuna fishery were apogonids and sprats and their catch rates were higher compared to last year. Only about 7% of the pole and line units carried out tuna fishing without live-baits.
- Size range of *E. affinis* in the fishery was 18-82 cm, *A. thazard* 18-47 cm, *A. rochei* 14-38 cm, *T. tonggol* 32-62 cm and *S. orientalis* 32-58 cm. In drift gill nets, size range of *K. pelamis* was 34-84 cm compared to 12-70 cm in the pole and line fishery at Minicoy. Immature *T. albacares* of size 22-78 cm were caught by pole and line at Minicoy compared to large ones of size 62-160 cm in troll line.
- There is ample scope to deploy drift gill netting techniques to more islands in Lakshadweep following the successful adoption of gill net fishing in Androth island.
- Exports of tunas like yellowfin and skipjack in whole frozen form is picking up. During 2001, frozen tuna (587 t) valued at Rs. 2.18 crores was exported compared to 92 t during 2000.

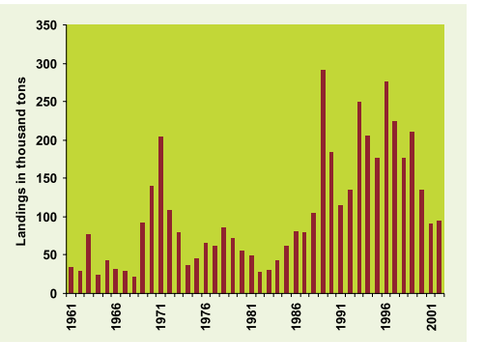


Species composition of all India tuna landings

- A declining trend was observed in the hook and line fishery for *A. rochei* along the Vizhinjam coast since 2000.
- Landings of *K. pelamis* and *T. albacares* by drift gill netters showed an increasing trend since 1998 from the fishing grounds off Cochin-Calicut and the Lakshadweep islands.
- A seasonal (March-April) troll-line fishery for yellowfin tuna has been developing since 2000 at Colachel, Kanyakumari district. An unprecedented good fishery for *T. albacares* (0.8-1.7 m size) was recorded during March-April 2003 when 10-15 units landed daily with catches of 1-5 tonnes.

PROJECT CODE	**PEL/CAP/5**
PROJECT TITLE	**Development of management strategies and options for sustainable harvest of mackerels**
SCIENTISTS	**G.Gopakumar,** Mohammad Zafar Khan, Prathibha Rohit, M.Sivadas, P.N.Radhakrishnan Nair, E.M. Abdussamad, H.Mohamad Kasim and A.K.V. Nasser
CENTRES	Mumbai, Karwar, Mangalore, Calicut, Cochin, Vizhinjam, Mandapam, Tuticorin, Chennai, Kakinada and Visakhapatnam

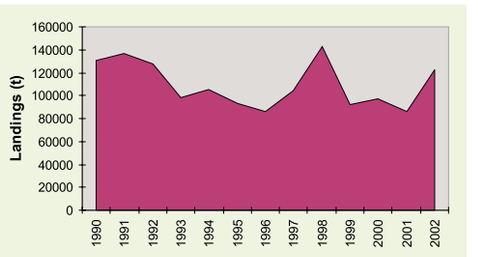
- Mackerel landings estimated at 0.95 lakh t during 2002 showed a marginal increase by 6% compared to the year 2001. Although mackerel catches declined by 15-48% compared to the previous year at major fishery centres along the southwest and southeast coast, it was compensated by an increase to the tune of 51-53% along the northeast coast.
- Major gears employed along the southwest coast were purse seines, ring seines and trawls. At Vizhinjam, bulk of the mackerel catch was landed by drift gill nets (88%) followed by hooks and line. At Rameswaram-Pamban, gillnets landed 81% of the mackerel catch followed by trawlers. At Chennai and Kakinada, 81-84% of the mackerel catch was landed by trawl nets followed by gill net while at Visakhapatnam, gillnets contributed 55% followed by trawls.
- Catch rates in purse seines varied from an average of 0.2 t to 0.83 t, the highest catch rates being at Mumbai. Along the northeast coast catch rates by trawls varied between 31-60 kg.
- Size range of mackerel caught in gill nets varied between 75 and 310 mm while in trawl it varied between 30 and 290 mm; in ring seines from 90 to 220 mm and in purse seines 120 to 295 mm. The length at first capture was comparatively low at some centres like Calicut (115 mm) and Visakhapatnam (113 mm).
- Mackerel spawners were observed almost throughout the year at Vizhinjam, Calicut and Tuticorin. At Mandapam, a spawning peak was noticed during April-May and July-September.
- Exploitation rates during the period were found to be low at centres like Vizhinjam, Calicut and Mangalore-Malpe (0.27-0.38) and optimum at other centres like Cochin, Tuticorin, Chennai and Kakinada (0.63-0.66).



Mackerel landings in India during 1961-2002

PROJECT CODE	**PEL/CAP/6**
PROJECT TITLE	**Development of management strategies for sustainable fishery of Bombay duck**
SCIENTISTS	**Alexander Kurien**
CENTRES	Mumbai, Veraval and Kakinada

- The total Bombay duck landings during 2002 was estimated to be 1.22 lakh t showing an increase of 42.4% compared to the previous year.
- The northwest coast accounted for 55% of the Bombay duck landings, the southeast coast 23% and northeast coast 22%. Trawl nets and *dol* nets were employed in the fishery.
- *Harpadon nehereus* was the sole species recorded along the northwest coast while at Kakinada fishery centre, *H. squamosus* accounted for 56% of the Bombay duck landings and only rest by *H. nehereus*.

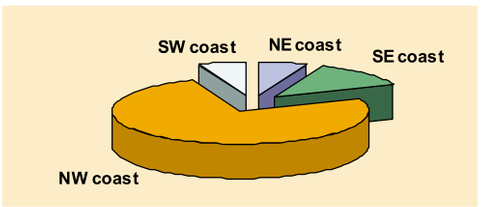


All India Bombay duck landings

- Along the Gujarat coast, *H. nehereus* of size 75-255 mm were captured in *dol* nets.
- In Maharashtra, *H. nehereus* was recorded in *dol* net and trawl landings. While the size range in *dol* nets was 75- 210 mm with mean size 164 mm, in trawls it was 135-225 mm with mean size 213 mm.
- At Kakinada, *H. nehereus* landings in trawl had a size of 240-254 mm and *H. squamosus* 195-214 mm. In stake nets it was 285-309 mm and 270-284 mm for *H. nehereus* and *H. squamosus*, respectively.

PROJECT CODE	**PEL/CAP/7**
PROJECT TITLE	**Monitoring of fishery and resource characteristics of exploited ribbonfish stocks and their management along the Indian coast**
SCIENTISTS	**P.N.Radhakrishnan Nair**, Mohammad Zafar Khan, C. Muthiah, H. Mohamad Kasim, R.Thiagarajan, and A.K.V.Nasser
CENTRES	Veraval, Mumbai, Mangalore, Cochin, Vizhinjam, Chennai, Kakinada and Visakhapatnam

- The estimated all India ribbonfish landings was 1.95 lakh t and showed an increasing trend. The overall growth rate in production during the last decade was 6.3%. During 2001, ribbonfish exports from India was 1,05,263 t valued at Rs. 277 crores.
- Trawl net was the major gear in the fishery, which contributed 96.2% of the total ribbonfish landings while the rest was by indigenous gears such as gill nets and boat seines. Compared to last year there was an increase in catch rates of ribbonfishes by trawls to the tune of 6 to 138% at all centres irrespective of the increase or decrease in fishing effort indicating increased abundance of ribbonfish in the fishing grounds.
- The peak fishery season was the post monsoon period (October to December) contributing 52% to the total annual landings.
- *Trichiurus lepturus* was the dominant species all along the coast of India. Other species landed included *T.russelli*, *Lepturacanthus savala*, *L. gangeticus* and *Eupleurogrammus muticus.*
- The size range of *T. lepturus* in the trawl catches was 15-124 cm, 36-124 cm in gill net and 22-84 cm in boat seines. Recruitment size in trawl fishery was lower along the east coast (15-30 cm) compared to that in the west coast (16-34 cm).
- The spawning season was found to extend from November to June with two recruitment peaks, one in January and another in July-August.



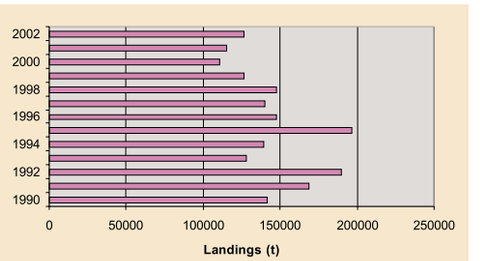
Regionwise contribution to ribbonfish landings 2002

PROJECT CODE	**PEL/CAP/8**
PROJECT TITLE	**Management of carangid resources of Indian EEZ**
SCIENTISTS	**H. Mohamad Kasim,** Prathibha Rohit, A.A.Jayaprakash and E.M. Abdussamad
CENTRES	Veraval, Mangalore, Cochin and Tuticorin

- The all India carangid landings during 2002 was 1.25 lakh t showing an increase of 7.6% compared to the previous year.
- Trawls were the major gear employed in the carangid fishery all along the Indian coast in addition to purse seines, gill nets and ring seines

along the west coast and gill nets and hooks and line on the east coast.

- At Veraval, trawl was the dominant gear contributing 86% of the carangid landings with the catch and CPUE registering an increase of 43.6 and 91.6%, respectively compared to the previous year. At Cochin, trawls contributed 57%, gill nets 40% and ring seines 3% of the total carangid landings. At Mangalore, trawl accounted for 70% of the total carangid catch with catch and CPUE registering an increase of 53 and 47%, respectively compared to previous year. Purse seines accounted for 29% and rest was by gill nets and ring seines. At Tuticorin, trawls contributed 89% of the carangid landings, followed by large mesh gill net *paru valai* (7.7%), hooks and line (2.1%) and *podivalai* (1.7%).
- Several species supported the carangid fishery. *Megalaspis cordyla* dominated the gill net landings at Veraval and Mangalore. *Decapterus russelli* dominated in trawl landings at Veraval, Mangalore and Kochi and also in the purse seine landings at Mangalore. At Cochin, *S. crumenopthalmus* dominated the gill net landings and *Alepes djedaba* in ring seines. At Tuticorin, *C. carangus* dominated the small mesh gill net (*Podivalai*) compared to *C. sexfasciatus* in large meshed gill nets (*Paruvalai*) and hooks and line.
- Spawning season for *S. crumenopthalmus* is April to May; May to October for *M. cordyla*, April to June for *D. macrosoma*, June to September for *Alepes djedaba* and May to October for *D. russelli*.

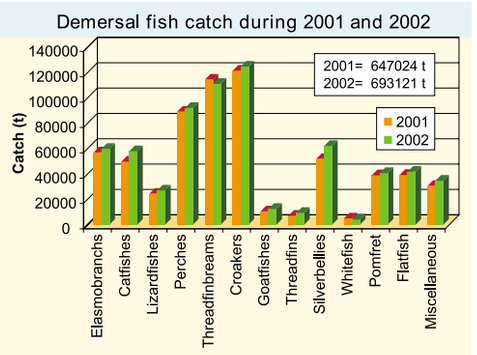


Carangid landings in India

PROJECT CODE	**PEL/BIOD/01**
PROJECT TITLE	**Taxonomy of marine pelagic finfishes**
SCIENTISTS	**Prathibha Rohit**, A.A.Jayaprakash, P.N.Radhakrishnan Nair, U.Ganga, E.M. Abdussamad and A.K.V. Nasser
CENTRES	Mangalore, Cochin, Tuticorin and Visakhapatnam

- Eleven major families of pelagic fishes viz., Clupeidae, Engraulidae, Chirocentridae, Elopidae, Megalopidae, Albulidae, Scombridae, Xiphiidae, Istiophoridae, Carangidae and Trichiuridae were selected for detailed studies.
- A format to record the morphometric and meristic characters along with details of the fishery was designed.
- Fishes of family clupeidae (8 species), chirocentridae (1 species), carangidae (31 species) and scombridae (3 species) were collected, identified and taxonomic characters recorded.

DEMERSAL FISHERIES DIVISION



Estimated landings of demersal fishery resources of India contributed to 24.9% of the total marine landings (6,59,471 t) in the year 2002 showing an increase of 7.12 % over the previous year.

The Demersal Fisheries Division has been monitoring the resource characteristics and biology of major demersal fish groups such as elasmobranchs, croakers, perches, threadfin breams, silver bellies, lizardfishes, pomfrets and flatfishes through six capture fisheries research projects. The cultivable perches such as groupers and snappers and marine ornamental fishes were studied for their culture and seed production possibilities. Encouraging results were achieved in brood stock management of groupers and in successful breeding of ornamental fishes. The biodiversity of demersal finfishes were evaluated through a project on taxonomy.

The scientists of the Division have implemented three projects funded by DOD.

A publication on " Bibliography of Gulf of Mannar" which gives a retrospect of taxonomic, biological and ecological studies of various components of the Gulf of Mannar ecosystem was another milestone in the achievements of the Division.

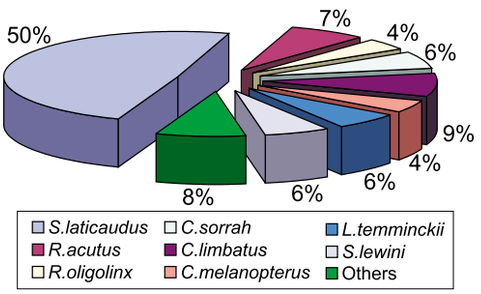
PROJECT CODE	**DEM/CAP/01**
PROJECT TITLE	**Fishery and biological characteristics of the exploited stock of Elasmobranchs**
SCIENTISTS	**S. G. Raje,** V. Gandhi, G. Mohanraj, P. Livingston, K.K. Joshi, Rekha J. Nair, P.P. Manojkumar, Shoba J. Kizhakudan
CENTRES	Mumbai, Mandapam, Chennai, Tuticorin, Cochin, Calicut, Veraval.

110 species of elasmobranchs have been recorded from Indian waters. This includes 66 species of sharks, 4 species of saw fishes, 8 species of guitar fishes and 32 species of rays. Of this, 17 species of sharks, 16 species of rays and 4 species of skates were landed at different centres along the Indian coast during 2002 contributing to 2.26 % of the total marine landings (59,808 t). Tamilnadu had the major share in elasmobranch landings with 5051 tonnes. Skate landings were more from West coast (699t, 81%); Gujarat and Maharashtra contributed 81% of the share.

- The all India estimated landings of elasmobranchs during 2002 was 59,808 t contributing to 2.26 % of the total marine landings and representing an increase of 3.1 % over the last year (57022 t in 2001). The elasmobranch fishery was contributed by sharks (61.6 %), rays (33.8 %) and skates (4.6 %). The east coast contributed to 58.34 % of the total elasmobranch landings followed by the west coast (41.66 %). Along the east coast, Mandapam (2585 t) and Chennai (1984 t) were the major contributors, while off the west coast, Mumbai (1808 t) and Veraval (1300 t) brought maximum elasmobranch landings. A total of 17 species of sharks, 4 species of skates and 16 species of rays were caught from different centers. Gear wise, trawls contributed to 80.2 % of the elasmobranch catch with drift gill nets, bottom set gill nets and hook and line contributing to the rest.
- Sharks and skates were landed the maximum off Mumbai along the north west coast, while rays were recorded more off Mandapam along the east coast. Among sharks, *Scoliodon laticaudus* dominated the landings along the west coast (59 % in trawl, 25.3 % in gillnet at Mumbai and 31 % in gillnet at Cochin) with *Chiloscyllium indicum* (54 %) and *Sphyrna lewini* (34.1 %) along the east coast. Among rays, *Mobula diabolus* dominated the landings on both the coasts (72 % in drift gill net at Cochin and 67.8 % in gill net at Tuticorin). At Mandapam and Tuticorin, *Himantura bleekeri* dominated the gill net ray landings.
- At Veraval, size range of *Scoliodon laticaudus* and *D.imbricatus* were

in the length range 180 – 620 mm and 140 – 300 mm, respectively. Along the east coast off Mandapam, *H.uarnak* had a size range of 26 –176 mm. *H. bleekeri* landed at Tuticorin was in the size range 50 – 120 cm, *D. kuhlii* 17 – 42 cm and *D.imbricatus* 16 – 31 cm. Off Chennai, length range of *D. jenkinsii* and *D. imbricatus* in the fishery was 15-104 cm and 110-240 mm, respectively.

- Sex ratio studies in rays indicated the males to dominate the population of *H. bleekeri*, *G.poecilura* and *H.alkaki*. Rays were generally found to feed on prawns, squilla, fish, *Amphioxus* and *Polychaetes*.



Species composition of sharks landed along the Indian coast

PROJECT CODE	**DEM/CAP/02**
PROJECT TITLE	**Fishery and biological characteristics of exploited resources of Groupers, Snappers, Breams and Catfishes.**
SCIENTISTS	**V. Gandhi,** N.G Menon, Rekha J. Nair, S.G Raje, G.Mohanraj, P.P Manoj Kumar, P. Livingston, K.V.S Nair, P.U Zacharia
CENTRES	Mandapam, Cochin, Mumbai, Chennai, Calicut, Tuticorin, Veraval, Mangalore and Vizhinjam.

- Total all India estimated production of major perches was 41,906 t (25539 t of groupers, 4961 t of snappers and 11406 t of pig face breams). Trawl fishery for groupers along the west coast was exclusively represented by *Epinephelus diacanthus*, the length range of which varied from 100 –520 mm; *E.tauvina* was landed more on the east coast. Production details of groupers at various centres are given in table.
- Twelve species of groupers were landed by drift gill nets at Cochin; their fishery is seasonal during October – March. Of the estimated 50.80 t of groupers landed by trawlers at Chennai, 35.72 % was by trawlers, 52.51 % by gill-netters and 11.77 % by hooks and line.

Production details of Groupers in different maritime centres

Centre	Production (t)	Gear	Dominant species	Length group (mm)
Veraval	434	Trawl net	*Epinephelus diacanthus*	170 –489
Mumbai	1346	- do -	- do -	100 – 419
Mangalore	4	- do -	- do -	170 -389
Calicut	2023	- do -	- do -	
Cochin	549	Trawl net, Drift gill net	- do -	90 - 520
Vizhinjam	542	Trawl net, Drift gill net, Hooks and line		
Tuticorin	2542	Fish traps	*E.tauvina*	150 - 1150
Mandapam	62	Gill net, Trawl and	*E.tauvina*	
Chennai	50	Hooks and line	*E.tauvina*	

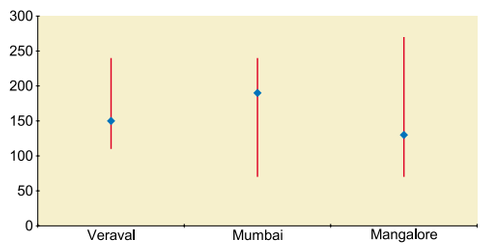
- **Pigface breams** were landed more on the South east coast by trawlers, the catch being 257.2 t at Chennai, 74.7 t at Mandapam, and 1127 t at Tuticorin. The dominant species was *Lethrinus nebulosus* at all the centres. Length range of *L.nebulosus* in the fishery was 140 – 390 mm at Mandapam, with mode at 210 mm; 100 – 720 mm in trawl

Fishery for major perches in India is mainly constituted by Groupers, Snappers and Pig face breams. Trawl fishery for groupers was exclusively for ***Epinephelus diacanthus****. Hook and lines landed more* ***E.tauvina*** *on the east coast. Pigface breams are landed more on the south east coast in trawlers. Snappers were landed more on the east coast.* ***Lutjanus rivulatus, L.russelli, L.bohar*** *and* ***L.fulviflammus*** *are the dominant species.*

fishery at Tuticorin with modes at 160 mm and 180 mm and 160 – 740 mm in hooks and line fishery.

- **Snappers** were landed more on the east coast –an estimated 356 t at Tuticorin, 65.71 t at Chennai and 33.61 t at Mandapam. *Lutjanus rivulatus* of length range 240 –840 mm dominated the hook and line landings at Tuticorin, *L.russelli* and *L.bohar* at Chennai and *L.fulviflammus* at Mandapam.
- The all India **catfish** landing during 2002 amounted to 57967 t; maximum production of 1254.8 t was observed at Mumbai. Along the east coast, landings to the tune of 167.8 t were recorded at Mandapam. *Tachysurus dussumieri* and *T. militaris* were the dominant species at Mumbai, *T. serratus* at Cochin and *T. thalassinus* at Mandapam. *T. thalassinus* landed at Cochin was in the length range 50 – 60 cm and were in the mature stage.

PROJECT CODE	**DEM/CAP/03**
PROJECT TITLE	**Characteristics of exploited stocks of Threadfin breams and Silverbellies.**
SCIENTISTS	**V.S.R Murty,** K.K. Joshi, Shoba Joe Kizhakudan, S.Sivakami, P.U Zacharia, E.Vivekanandan, V.Gandhi, U.Rajkumar.
CENTRES	Cochin, Veraval, Kakinada, Mangalore, Chennai, Mandapam, Visakhapatnam



Length range (in mm) of *N.mesoprion* at different centres along the coast

Threadfin breams

- The all India landings of threadfin breams during 2002 amounted to 111051 t, and contributed to 4.2 % of the total marine landings. Highest estimated landings of threadfin breams was along Gujarat and Maharashtra coast (27298 t) followed by Mangalore, Malpe and Cochin (16,275 t), Chennai (2706.8 t) and Kakinada (553t). Landings showed an increase at Mumbai and Mangalore over the previous year.
- Five species of threadfin breams contributed to the fishery, the major species being *Nemipterus mesoprion*, followed by *N.japonicus*, *N.delagoe*, *N.tolu* and *N.luteus*. *N.tolu* and *N.luteus* were available only at Kakinada and Cochin.
- Length frequency studies in *N.mesoprion* revealed that dominant mode at Veraval was 110 mm while off Mumbai and Mangalore,the modes were at 195 mm and 110 mm, respectively. Spawning season of both *N.mesoprion* and *N.japonicus* was during October -November off the west coast and November off the east coast.

The north west coast brought maximum landings of Threadfin breams (27298 t). ***N.mesoprion, N.japonicus, N.delagoe, N.tolu, N.luteus*** *were the major species landed.*

A total of 13 species contributed to the silverbelly fishery, the dominant species being ***L.dussumieri*** *and* ***L.brevirostris*** *along the east coast and* ***L.splendens*** *and* ***L.bindus*** *along west coast. South east coast brought the maximum landings of silverbellies.*

Silver bellies

- The estimated all India landings of silver bellies during 2002 was 62100 t which contributed to 2.35 % of the total marine landings. South east coast (Tamil nadu) with an estimated catch of 12894 t from Mandapam (9685 t) and Chennai (3209 t) was the highest contributor to the silverbelly landings. Twelve species contributed to the fishery in Tamil Nadu, while on the west coast only four species were reported in the commercial trawler landings. *Leiognathus brevirostris*, *L.dussumieri*, *L.bindus* and *L.jonesi* dominated the landings on the east coast, while on the west coast the dominant species were *L.bindus*, *Secutor insidiator* and *L.splendens*.
- Off Mandapam, spawning season of *L.dussumieri* and *L.brevirostris* was during June to August.

Species composition (%) of silverbellies landed at various centers

Species	Mangalore	Mandapam	Pamban	Rameswaram	Chennai
Leiognathus jonesi	-	10.5	0.06	16.56	-
L.brevirostris	-	80	1.5	54	2
L.lineolatus	-	2.2	2.3	4.15	4.3
L.dussumieri	-	3.2	78.6	15.4	5.5
L.daura	-	0.3	2.56	0.03	
L.bindus	27	-	3.2	-	38
L.fasciatus	-	-	0.06	-	
L.splendens	16	-	-	-	15
L.equulus	-	-	-	-	0.3
Secutor ruconius	-	2.6	5.06	5.93	1.4
S.insidiator	57	0.9	1.92	3.27	17.7
Gazza minuta	-	0.17	3.77	0.66	16
Total catch (t)	1086	1438	1265	1054	3208.6

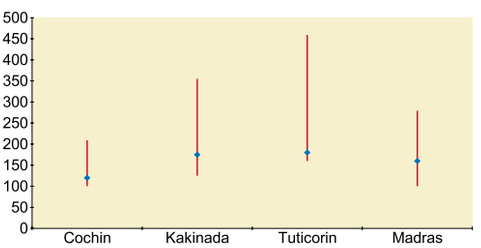
PROJECT CODE **DEM/CAP/04**

PROJECT TITLE **Fishery and biological characteristics of exploited stocks of croakers**

SCIENTISTS **G. Mohanraj,** K.V.S. Nair, K.K. Joshi, P. Livingston, S. Sivakami, U. Rajkumar

CENTRES Chennai, Veraval, Cochin, Tuticorin, Kakinada, Visakhapatnam

- Estimated landings of sciaenids during 2002 were 1,24,722 t, which formed 4.72% of the all India marine landings. Veraval along the North west coast contributed the maximum of 5610.6 t contributed by trawlers (73%), gill net (2 %) and dol nets. The sciaenid fishery off Veraval, however, indicated a decline by 49 % this year when compared to that of 2001 (10,949 t). However, an estimated 1389 t was landed by the *dol* nets off Veraval, which showed a sharp increase by 89 % when compared to that of 2001 (735 t). Along the east coast, Kakinada (1685 t) and Chennai (1475 t) brought good landings of Sciaenids.
- Of a total of 24 species of sciaenids reported, from various centres, *Otolithus cuvierii* (90 -270mm size range) was dominant off Veraval, *O.ruber* (90 – 230 mm size range) and *Johnieops sina* (100 – 190 mm) off Kochi, *Nibea maculata* (120 – 300 mm) off Tuticorin and *Kathala axillaris* off Kakinada were the major species landed. In gill nets off Kakinada, larger sized *Protonibea diacanthus* (21 – 160 cm) was landed while off Veraval, *P.diacanthus* and *O.biauritus* were the major species landed. *O.ruber* caught off Kakinada (121 –359 mm) and Tuticorin(160 – 459 mm) were of larger size than those caught off Cochin (90 - 210mm) and Madras (100- 279 mm).
- Spawning period of *J.glaucus* off Veraval was during January- April and October –December while for *O.ruber* and *J.carutta* off Tamil nadu, it was during June to September.



Length range (in mm) of *Otolithes ruber* in trawl landings at different centres

*Twenty-four species of croakers contributed to the all India sciaenid fishery. All the centers except Veraval indicated an increase in croaker landings this year. Spawning period on the west coast (off Veraval) for **J. glaucus** was January – April and October-December, while off Tamilnadu. it was June – September for **O.ruber** and **J. carutta .***

Centre-wise distribution of croakers and peak breeding period

Centre	No. of species	Dominant species	Month of occurrence of gravid fish
Veraval	9	*Otolithes cuvieri*	January – April, October – December
Kochi	6	*Johnieops sina*	
Tuticorin	3	*Nibea maculata*	March and August
Chennai	16	*Otolithes ruber*	
Kakinada	17	*Kathala axillaris* *Protonibea diacanthus*	

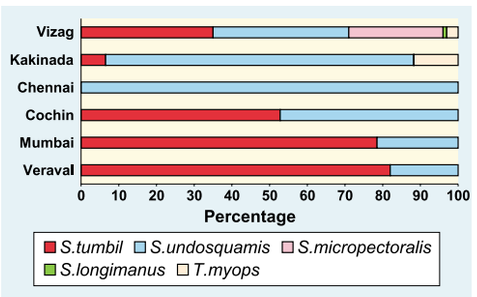
PROJECT CODE DEM/CAP/05

PROJECT TITLE **Biology and stock assessment of Lizard fishes, Bulls eye, Polynemids and Pomfrets.**

SCIENTISTS **S. Sivakami,** E. Vivekanandan, S.G Raje, Rekha J Nair, Shoba Joe K, U.Rajkumar

CENTRES Kakinada, Chennai, Mumbai, Cochin, Veraval, Visakhapatnam

- The all India estimated landings of lizardfishes during 2002 were 26949 t. Of all the centres studied, Veraval recorded the maximum landings of 4438 t followed by Chennai (1663.3 t), Vishakhapatnam (2550.3 t), Cochin (1353 t) and Kakinada (1054.8 t). Species diversity was higher along the east coast where *Saurida micropectoralis* and *S.longimanus* were landed in addition to *S.tumbil* and *S.undosquamis* along the west coast.
- At Veraval, the highest landings were during November – December. *S. tumbil* was in the length range 171 – 469 mm. Spawning period was October – December. At Mumbai, an increase of 13.6 % was recorded in the trawler landings. *S.tumbil* in the length range 130-450 mm (mean size 255.78 mm) formed the dominant species (78.5%) in the fishery. August - November was the peak spawning period off Maharashtra. At Cochin, length range of *S. tumbil* in the fishery was 230 –460 mm, with the bulk of the landings in the length range 310 – 330 mm. In *S. undosquamis*, length range was 110 – 330 mm, with the bulk landed in the length range 190-260 mm. The peak spawning period for *S. tumbil* and *S. undosquamis* were September and October, respectively at Cochin.
- At Chennai, the entire catch was constituted by a single species *Saurida undosquamis*. Length range of the species was 100-269 mm with the bulk of the catch in the length group 190-199 mm. Peak spawning period was during September – October. At Kakinada, the length range of *S. undosquamis* was 101 – 359 mm. Fishes with ripe/spent ovaries were obtained during November/December indicating that this could be their spawning period. At Visakhapatnam, length range of *S. undosquamis* in the fishery was 100 – 319 mm. Peak spawning season was observed during December.



Species composition of Lizard fishes at different centres

*Though maximum landings of lizard fishes were observed at Veraval, species diversity was more off the east coast where species such as **Saurida micropectoralis** and **S.longimanus** were observed in addition to **S.tumbil** and **S.undosquamis** of west coast.*

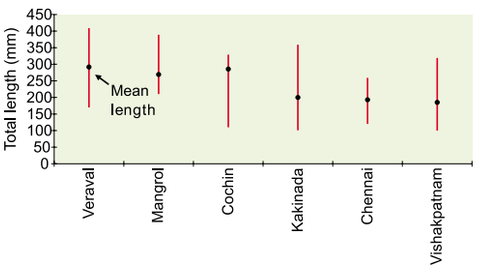
***P.hamrur** the major species of Bull's eye landed was in the immature stage off Mumbai while they were in the spawning / spent stages at Cochin thus indicating a probable southward spawning migration.*

Bull's eye

- Bull's eye contributed 0.4 to 4.3 % of the total marine fish landings at the various centres. Estimated landings of Bull's eye were the highest at Cochin (1649 t; 83 % increase over the last year), followed by Veraval with an estimated 1526 t. The estimated landings at Mumbai

were 439.25 t, 402 t at Kakinada, 145.22 t at Visakhapatnam and 65.42 t at Chennai. An increase was also recorded in CPUE at all centres.

- *Priacanthus hamrur* was the major species landed with stray occurrence of *P. tayenus* reported off Kakinada. Mean size of the species caught off Mumbai was 196 mm, while at Cochin the length range was 130-360 mm. At Veraval, *P.hamrur* in the size range 141-299 mm were caught by trawlers. Length range of the species landed at Chennai was 111- 299 mm while off Kakinada, the size range was 115 – 295 mm.
- The presence of immature specimens of *P.hamrur* throughout the year off Mumbai and presence of only adult fishes off Cochin, point to a possible southward breeding migration of the species. Off Cochin, March – April and October is the spawning season of the species.

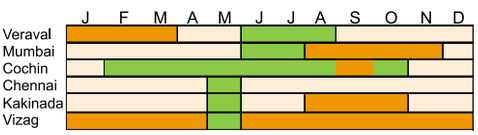


Length distribution and mean length of *Saurida undosquamis* in the fishery at different centres

Pomfrets

- Vishakapatnam with a total estimated landing of 1234 t was the major contributor, followed by Kakinada with 645 t, Chennai with 473 t and Mumbai (Satpati) with 429 t. The landings at the other centres were 123 t at Veraval and 19 t at Cochin. Around 50 % decrease in the catch was recorded at Veraval and Mumbai.
- Peak landings were during August-September at Kakinada.*Pampus argenteus*, *P. chinensis* and *Parastromateus niger* were the dominant species in trawl and gill nets. *P. argenteus* of length range of 81 – 279 mm and 101-389 mm were obtained in trawl and gill net, respectively. *P. niger* obtained were of size range 101-269 mm in trawl and 81-559 mm in gill net.

Seasonal distribution of *Priacanthus hamrur* at different centres



Seasonal abundance of Pomfrets at different centres

Polynemids

- Polynemid landings at Mumbai were estimated as 436 t, 19 Kg/E, which indicated a decline over the previous year. Males dominated the landings at Mumbai; the landings of *Polynemus heptadactylus* was in the length range 80 – 240 mm with mean at 130.84 mm. Two species contributed to the fishery – *Polynemus heptadactylus* dominating over *P.indicus* at Veraval. At Kakinada, *P.indicus* dominated.

PROJECT CODE	**DEM/CAP/06**
PROJECT TITLE	**Biology and fishery of Flatfishes, Flatheads, Goatfishes and White fish.**
SCIENTISTS	**E. Vivekanandan,** K.V.Somasekharan Nair, P.U Zacharia, V.Gandhi, Rekha J Nair, P.P Manoj Kumar, U.Rajkumar
CENTRES	Chennai, Veraval, Mangalore, Mandapam, Cochin, Calicut, Visakhapatnam

Flatfishes

- All India estimated landings of flatfishes during 2002 amounted to 41800 t. Along the west coast, Mangalore recorded good landings of 3005 t, followed by Calicut (742 t), Cochin (695 t), and Karwar (520 t). Off the east coast along Mandapam, the estimated flatfish landing was 242 t.
- Along the south west coast, *Cynoglossus macrostomus* dominated the fishery contributing to 97.2 % of the catch. Four other species

*Of the estimated 41800 t of flatfishes landed, **Cynoglossus macrostomus** dominated the fishery along the south west, while along the east coast, **C.macrolepidotus** was the major species.*

that contributed to the commercial landings were *Cynoglossus bilineatus*, *Psettodes erumei*, *Cynoglossus arel* and *Pseudorhombus arsius*. Along the east coast, *C.macrolepidotus* was the major species followed by *C.bilineatus*, *C.punticeps*, *Pseudorhombus* spp and *Psettodes erumei*. Off Cochin, an estimated flatfish landing of 694 t (2.02%) was represented by thirteen species with *Cynoglossus macrostomus* dominating the fishery and contributing to 56 % of the total catch. *C. macrolepidotus* formed 18 % of the flatfish landings.

Biological characteristics of dominant species of flatfishes at various centres

Dominant species	Locality	Length range (mm)	Sex ratio	Spawning season	Modal size (mm)
C.macrostomus	Karwar	70 – 145	1: 0.5		
C.macrostomus	Mangalore	60 – 169	1: 1.9	Apr - May Oct - Dec	
C.macrostomus	Calicut	32 – 148	1: 2.6	Jul - Aug	85–89, 115- 119
C.macrostomus	Cochin	65 – 165	1: 1.8	Feb - Apr Aug - Oct	105
C.macrolepidotus	Mandapam	120 – 420	1: 3.2		

Flat heads

- An estimated 60.5 t of flatheads (1.3 Kg/E) were landed at Mandapam and 0.5 t at Cochin (0.02% of the trawler landings). Two species *Cociella crocodila* and *Platycephalus maculipinna* (72 %) were obtained in the samples. Length range of *Cociella crocodila* in the fishery was 80-415 mm with 190 – 200 mm group dominant; of *P.maculipinna* was 55 – 405 mm with group 285-305 mm dominant. Sex ratio for *C. crocodila* was 1:2.7 and for *P.maculipinna*, 1:1.3.

Goat fishes

- All India goatfish landings amounted to 12412 t, amounting to 0.47 % of the total marine fish landings. At Madras, an estimated 1362 t of goatfishes were landed. Major species of goatfishes contributing to the fishery were *Upeneus taeniopterus* (64.32 %), *U. sulphureus* (26.7%), *U. moluccensis* (8.48%) and *U. vittatus* (0.5%). An estimated 484.3 t were landed at Mandapam contributing to 1.27 % of the total catch. Species recorded in the landings were *Upeneus sundaicus* (84.2 %), *U. sulphureus* (9.11%), *U. tragula*, *U. vittatus* and *Parupenaeus indicus.* At Visakhapatnam, the estimated landing of goatfishes were 214 t. Four species contributed to the fishery; *U. vittatus* dominated the fishery, others being *U. sulphureus, U.moluccensis* and *U.vittatus* (0.5 %).

Biological characteristics of dominant species of goatfishes at various centres

Dominant species	Locality	Length range (mm)	Dominant mode (mm)	Sex ratio
U.sundaicus	Mandapam	90 - 195	125	1:6.1
U.sulphureus	Pamban	95 - 185	145	1:3.2
U.taeniopterus	Chennai	90 - 169	139	1:1
U.vittatus	Vishakapatnam	75 - 185		1:2

Whitefish

- At Mangalore, an estimated 345 t of whitefish were landed during the year. Post –monsoon period was the season of peak abundance. Length range of *Lactarius lactarius*, the only representative species in the fishery was 40 – 259 mm.
- An estimated 20.9 t of whitefish was landed at Calicut.

PROJECT CODE	**DEM/BIOD/01**
PROJECT TITLE	**Taxonomy of Demersal fishes of India**
SCIENTISTS	**K.K. Joshi,** Rekha J. Nair, Shoba J.Kizhakudan, P. P. Manoj Kumar.
CENTRES	Cochin, Veraval, Calicut

- The project work was initiated at Cochin, Calicut and Veraval during this year. Taxonomic studies were attempted in the demersal finfish families such as *Gerreidae, Sciaenidae, Cynoglossidae* and *Soleidae*.
- Under Family *Sciaenidae*, specimens belonging to 14 species were collected and morphometric and meristic data recorded. These are *Nibea semiluctuosa, Johnius carouna, Atrobucca nibe, Pennahia macrohpthalmus, Nibea soldado, Johnius belangerii, J.carutta, J.glaucus, J.dussumieri, Johnieops sina, J.vogleri, Otolithes cuvieri, O.ruber and Otolithoides biaurites*.

PROJECT CODE	**DEM/CUL/01**
PROJECT TITLE	**Marine finfish culture**
SCIENTISTS	**P.Nammalwar,** D.C.V Easterson, A.Raju, G.Gopakumar, L.Krishnan, Grace Mathew, Molly Varghese, R.Paul Raj, K.C George, D.Noble, Imelda Joseph, K.S Shobana, N.K Sanil.
CENTRES	Chennai, Tuticorin, Mandapam, Vizhinjam and. Cochin

Groupers

Broodstock development:

- Husbandry of the brood stock of groupers maintained at Tuticorin, Vizhinjam, Mandapam, Chennai and Cochin was continued. The brood stock maintained in the RCC tanks at Mandapam attained an average size of 741 mm/ 6480 g in December 2002 (in 12 months). The estimated monthly growth rate was 10.2 mm or 217g.

Maturation, spawning and larval rearing

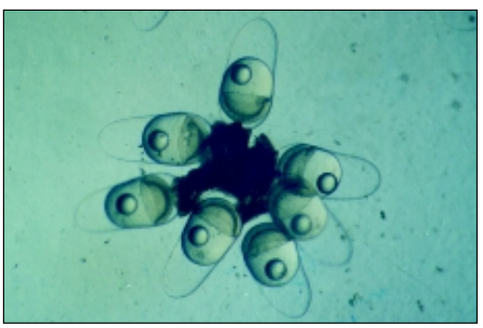
- At Mandapam, induced maturation of groupers by hormone injection using LHRHa at a dose of 100 mg/kg for females and 60 mg / kg body weight for males was conducted. Natural spawning of *Epinephelus tauvina* and *E.polyphekadion* was observed under captive conditions. In *E.tauvina*, two spawnings occurred resulting in a total of 3.9 million eggs. However, fertilization did not take place due to absence of the males. In *E.polyphekadion* four spawnings were observed with the release of 5.4 million eggs. Fertilization rate was 95%. Due to lack of space, 2 million fertilized eggs were sea ranched. During larval rearing, larvae hatched out in 20-22 hours. A total of 2.7 million larvae were produced from the rest of the eggs .A maximum period of survival of 21 days was achieved by feeding the larvae with a diet of rotifers and *Artemia* nauplii.

- At the Fisheries Harbour Laboratory of CMFRI, Cochin, a pair of *E.malabaricus* (4 kg and 9 kg.) and a pair of *E.tauvina* (2.75 kg and 3 kg.) were specially conditioned for spawning. Biopsy studies showed that these fishes were in the stage II of maturity with an ova size of 200 µm. In an attempt to get males, females were fed with 17α methyl testosterone through feed at weekly intervals.
- At Vizhinjam, one female of *E.malabaricus* was observed to release eggs on capture. The eggs were of the size of 805-878 µm. However, because of lack of males, fertilization could not be effected. In the hatchery at Cochin, in preliminary experiments feeding primary females of *E.diacanthus* with hormones through two doses of 0.5 mg and 1 mg Methyl testosterone/kg, sex reversal was initiated in 25 days and completed in a period of 40 days. However functional maturity could not be attained even after a period of 80 days. A female underwent natural sex reversal without any inducement under laboratory conditions.
- Mass cultures of live feed organisms were maintained at all centres. The species used were *Nannochloropsis oculata*, *Chlorella salina* and *C.vulgaris*, *Tetraselmis*, sulphur bacteria, *Artemia*, *Moina* and two species of rotifers.
- At Fisheries Harbour laboratory of CMFRI, Cochin, pure cultures of the rotifer *B.rotundiformes* were developed and enlarged to mass cultures. A smaller strain of the species 98-168 µ is being maintained for feeding the grouper larvae.

Snappers

- At Mandapam, effort to rear brood stock of the snapper *Lutjanus argentimaculatus* in a 5-tonne circular FRP tank is being continued.

Ornamental fishes



A bunch of freshly laid eggs of *Chrysiptera unimaculata*

- Work related to the ornamental fish was concentrated at Vizhinjam and Mandapam. Success in brood stock development, breeding and larval rearing of the one spot damselfish *Chrysoptera unimaculata* was achieved in captivity. The number of eggs ranged from 3500 to 5000. The average size of the egg capsule was 1.15mm and that of the larvae was 2.7mm. The larvae were reared on micro algae, ciliates, rotifers and copepods and later *Artemia*. The duration of metamorphosis ranged from 26 to 34 days and the larvae attained an average size of 15 mm. Rearing the larvae of the peacock damsel was continued. The spawning periodicities of *P.pavo and C.unimaculata* were investigated which ranged from 98 spawnings in one year to 40 spawnings in 9 months respectively.
- At Mandapam, third generation babies of the seahorse *Hippocampus kuda* were produced from a one-year-old second generation breeders.

CRUSTACEAN FISHERIES DIVISION

The Crustacean Fisheries Division implemented 6 in-house and 7 funded projects during 2002-03. By monitoring the exploited crustacean resources, the division generated a strong database on catch, effort, species composition, size distribution and other biological parameters of commercially important crustaceans. Research on domestication and breeding of penaeid shrimps were carried out. Breeding and larval rearing experiments on lobsters and crabs with the objective of developing a hatchery technology were also successfully conducted.

Salient findings

- The estimated landings of crustacean resources (prawns, lobsters, crabs and stomatopods) amounted to 4,33,200 t, which accounted for 17% of the total marine fish production in India.
- Total crustacean landings improved over the previous year by 45038 t (11.6%).
- The increase has been mainly due to improved landings of penaeid prawns, lobsters, crabs and stomatopods.
- Penaeid prawns formed 48% of the total crustacean landings followed by non-penaeid prawns (32%), lobsters (1%), crabs (8%) and stomatopods (11%).

PROJECT CODE	**CRU/CAP/01**
PROJECT TITLE	**Investigations on the fishery and biological characteristics of exploited penaeid shrimp stocks**
SCIENTISTS	**G.Nandakumar**, Josileen Jose, K.K.Philippose, P.T.Sarada, A.P.Dineshbabu, V.S. Kakati, V.D.Deshmukh, Joe K. Kizhakudan, M. Rajamani, K. R. Manmadhan Nair, K. Asokakumaran Unnithan, G.Maheswarudu, Miriam Paul and K.N.Saleela.
CENTRES	Cochin, Veraval, Mumbai, Karwar, Mangalore, Calicut, Neendakara, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam.

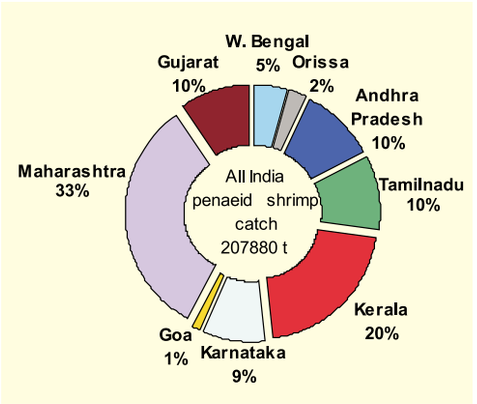
- The west coast contributed to 72% of penaeid shrimp landings. Trawl net was the main gear of exploitation of this resource.
- The estimated shrimp landings at Veraval during 2002 were 856 t with catch rate of 21.6 kg/unit. The catch and catch rate decreased by 76% and 68%, respectively when compared with 2001. *Solenocera crassicornis* (54%) and *S. choprai* (21%) together formed two third of the catch.
- At New Ferry Wharf, Mumbai, the shrimp catch (11886 t) and cpue/hr (8.6 kg) increased by 17% and 19%, respectively over the previous year. *S. crassicornis* (27%) and *Parapenaeopsis stylifera* (21 %) were the major contributors to the fishery. About six times increase in *P. hardwickii* landings from 189 t in 2001 to 1240 t during this year was noteworthy. Better recruitment due to decreased monsoon rains and consequently higher salinity of coastal water might be a probable reason for increase in catch of *S. crassicornis* and *P. hardwickii.*
- Size ranges of *S. crassicornis* and *S. choprai* along the northwest coast were 41-130 mm and 61-135 mm, respectively. Peak spawning periods were January-May and October-December for these species.
- The shrimp landing at Karwar remained almost same as that of 2001

*The major contributor to the penaeid shrimp fishery along the northwest and South Kanara coast was **Solenocera crassicornis** and **S. choprai,** respectively.*

Increase in deep sea shrimp catch from 'Quilon Bank' indicated possibility of revival of the fishery.

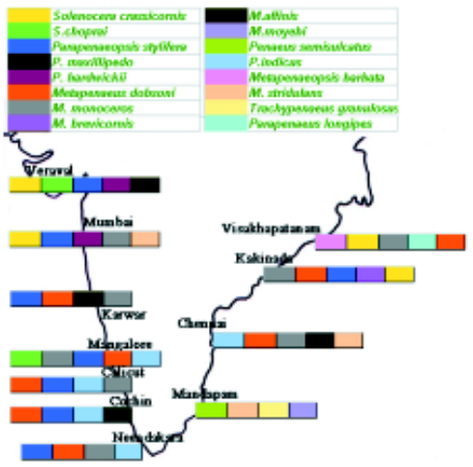
*Exploitation of juveniles of **Penaeus semisulcatus** from the nursery grounds along the southeast coast continued, causing depletion of the adults in the usual fishing grounds.*

***Metapenaeopsis barbata** emerged as an important constituent of penaeid fishery at Visakhapatnam.*



State-wise penaeid shrimp landings during 2002

Solenocera crassicornis the dominant component of the prawn fishery along the northwest coast



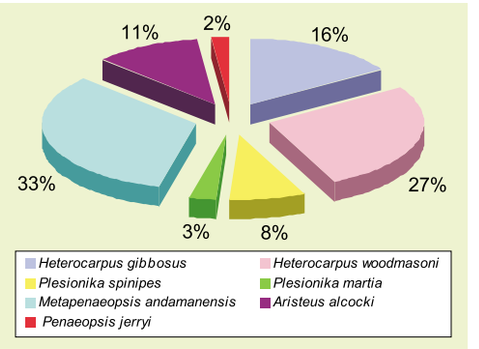
Centrewise availability of penaeid shrimps in order of abundance (Left to Right)

at 553 t with a reduction of 8% in catch rate per hour (7.63 kg/hr). *P. stylifera* formed 50% of the catch followed by *Metapenaeus dobsoni* (29%).

- At Mangalore, *S.choprai* constituted 57% of the penaeid landings mainly due to operation of trawlers in the 70-90 m depth range. The estimated shrimp landings at Mangalore and Malpe were 5631 t with catch rate of 3 kg/hr. Size range of *S. choprai* was 51-120 mm and the peak spawning seasons were January-April and November.
- At Calicut, the catch (1227 t) and catch rate/unit (58 kg) showed an increase of 31% and 8.4%, respectively. *M. dobsoni* (48%), *P. stylifera* (28%) and *Penaeus indicus* (11%) were the major species observed in the shrimp catch.
- The estimated shrimp catch at Cochin was 4892 t with a catch rate of 9.41 kg/hr. The catch and catch rate improved by 64% and 20%, respectively over the last year. *M. dobsoni* (56%) and *P. stylifera* (36%) dominated the shrimp fishery.
- Recorded marginal increase of 8% in shrimp catch (9218 t) at Neendakara-Sakthikulangara. The cpue/hr also improved by 23 % (9.93 kg) in comparison to the previous year. *P. stylifera* (65%) was the predominant species followed by *M. dobsoni* (26%).
- The green tiger prawn, *Penaeus semisulcatus* was the main contributor to the shrimp fishery along the southeast coast at Tuticorin and Rameshwaram. The size range of *P. semisulcatus* in the fishery was 81-235 mm. January-April and June-September were peak spawning periods.
- The estimated shrimp landings at Chennai amounted to 5394 t with catch rate of 5 kg/hr. The catch and catch rate increased by 117 % and 51%, respectively over the previous year. *P. indicus* (17%), *M. dobsoni* (15%) and *M. monoceros* (13%) were the important species observed in the fishery.
- Size range of *M. dobsoni* along the Indian coast was 41-115 mm. January-May and July-August were the peak breeding seasons for the species along the west and east coasts, respectively.
- Size range of *P. stylifera* was 51-140 mm. Larger size groups were available along the north west coast. There were two peak season for breeding for *P. stylifera*, January-April and November-December.
- At Kakinada 5458 t of shrimps were caught with cpue of 120.4 kg/ unit. The catch and catch rate decreased by 27% and 30%, respectively in comparison to 2001. Even though more than 20 species were encountered in the shrimp fishery, *M. monoceros* (28%) and *M. dobsoni* (24%) were the major contributors. Size range of *M. monoceros* was 51-170 mm.
- The prawn catch landed by small trawlers at Visakhapatnam was 1199 t with catch rate of 2.26 kg/hr. The important constituents in the fishery were *Metapenaeopsis barbata* (18%), *S. crassicornis* (11%) and *M. monoceros* (11%). *Penaeus* spp. formed about 6% of the shrimp catch. Size range of *M. barbata* was 46-120 mm. December-February was the peak spawning season. Sona boats landed

5050 t of penaeids with catch rate of 4.4 kg/hr. June-December was the productive fishing season.

- The deep sea prawns caught by trawlers from 'Quilon Bank' were landed at Sakthikulangara, Cochin and Munambam. The catch was estimated to be 17888 t, which showed an increase of 52% over 2001. The cpue/hr also improved by 35% from 36.9 kg to 49.9 kg. Pandalids (55%) and penaeids (45%) contributed to the fishery.
- *Metapenaeopsis andamanensis* measured between 56 and 130 mm in total length. Size ranges of *Heterocarpus woodmasoni* and *H. gibbosus* were 71-130 mm and 76-145 mm, respectively.
- During January-April and December, 964 t of deep sea prawn catch was landed at Tuticorin harbour. *Heterocarpus* spp. (47%), *Plesionika* spp. (36%) and *Solenocera hextii* (13%) constituted the bulk of the catch.
- Ring seine operated along the Mangalore coast yielded 241 t of shrimps during monsoon months of June and July. *M. dobsoni* (88%) and *P. indicus* (12%) were the contributors. At Calicut 7 t of shrimps were caught by this gear during monsoon consisting of *M. dobsoni* (55%) and *P. indicus* (45%).
- Pair trawl operation at Calicut during June-August resulted in 31 t of shrimps, which composed of *M. dobsoni* (74%), *P. stylifera* (14%) and *P. indicus* (12%).
- At Vizhinjam, trammel nets landed 45 t of shrimps during May-August in which *P. indicus* of size range 91-180 mm formed 96%. During June-July, 43 t of *P. indicus* (128-180 mm size) was caught by bottom set gill nets at Manakudy. All females were in advanced stage of maturity thus showing the peak spawning season.
- 'Thallumadi' catch (17 t) at Tuticorin consisted mostly of *P. semisulcatus* and females in mature condition were rarely encountered. At Chinnapalam, in the Gulf of Mannar region, 'thalluvalai' landed 10 t of juvenile green tiger shrimps with monthly mean size ranging from 86 mm to 114 mm.



Catch composition of deep sea shrimps from 'Quilon Bank'

PROJECT CODE	**CRU/CAP/02**
PROJECT TITLE	**Stock assessment and management of non-penaeid shrimp resources of India**
SCIENTISTS	**V.D.Deshmukh,** Joe Kizhakudan and K. Asokakumaran Unnithan.
CENTRES	Mumbai, Veraval and Kakinada

Fishery

- Fishery for non-penaeid shrimps was investigated from Veraval in Gujarat, Kakinada in Andhra Pradesh and Versova and New ferry wharf (NFW) at Mumbai in Maharashtra. Traditionally operated 'dol' nets in Maharashtra and Gujarat, in addition to shrimp trawlers in all the three states were the common gear.
- Estimated catch of 2,966 t, 10,958 t and 2,989 t werelanded by trawlers at NFW, Veraval and Kakinada landing centres by expending 1.27, 1.49 and 0.7 million trawling hours at the catch rates of 2.32, 7.37 and 4.29 Kg/hr, respectively. These shrimps contributed 6.2%, 14.9% and 8.7%, respectively to the total fish landings at the three centres.

- The trawling effort declined by 8.3% and 9.8% and the catch decreased by 29.4% and 35.1% at NFW and Veraval, respectively over 2001. However, at Kakinada the effort increased by 13.1% while the catch improved by 211%.
- Dol nets operated from Nawabundar, Jaffarabad and Rajpara landing centres in Gujarat together recorded a catch of 27,084 t at the rate of 31.3Kg/haul. In Mumbai, 617 t of non-penaeids at the catch rate of 15.38 kg/haul registered 47% decline over 2001
- Non-penaeid shrimps contributed 35.1% and 62.9% to the dol net landings in Gujarat and at Versova.

Species composition

Gear: Dol net

Species	Versova	Nawabundar
Acetes spp.	94.2%	68.1%
Nematopalaemon tenuipes	5.1%	25.2%
Exhippolysmata ensirostris	0.7%	6.7%

Nematopalaemon tenuipes, an important non-penaeid prawn resource in Maharashtra

Gear: Trawl

Species	N.F.Wharf	Veraval	Kakinada
Acetes spp.	——	97.0%	38.5%
N. tenuipes	100%	2.9%	45.6%
E. ensirostris	——	0.1%	5.6%
Plesionika spinipes	——	——	9.0%
Others	——	——	1.3%

Summary of biology of two important species

		Mumbai	Nawabundar	Kakinada
N. tenuipes				
Size range (mm)	M	30-63	26-64	31-70
	F	27-72	26-70	31-80
Dominant modal class	M	41-46	37-43	41-55
(mm)	F	44-53	46-53	46-60
Berried females		41.2%	16.96%	42.8%
Peak month of breeding		March, August	April	June
Sex-ratio		1:2.5	1:2.2	1:2.4
E.ensirostris				
Size range (mm)		---	31-95	31-95
Dominant modal class (mm)		---	76-80	41-55
% of mature females		---	23.2	55.4
Peak month of breeding		---	January	July

Non-penaeid prawn landings at Veraval

- Recruits of *N. tenuipes* entering the fishery in December-January matured for the first time in March-April along the Gujarat-Maharashtra waters but the subsequent spawning peak observed during monsoon (August) was the period of massive maturation which was largely responsible for the heavy recruitment of the species in December-January.
- Stock assessment of *N. tenuipes* at Mumbai and Navabundar showed exploitation ratio of 0.72 and 0.69, respectively.

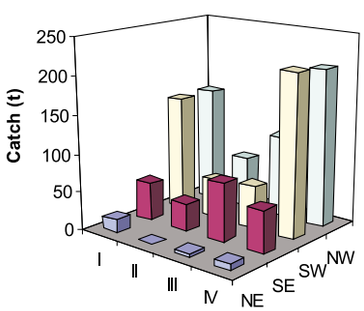
PROJECT CODE	**CRU/CAP/03**
PROJECT TITLE	**Investigations on the resource characteristics development of management strategies for lobsters and crabs**
SCIENTISTS	**Mary K.Manisseri,** V.D.Deshmukh, M. Rajamani, K.R. Manmadhan Nair, K. Asokakumaran Unnithan, K.K.Philippose, P.T.Sarada, A.P. Dineshbabu, Joe K. Kizhakudan, S.Lakshmi Pillai and K.N. Saleela.
CENTRES	Cochin, Veraval, Mumbai, Mangalore, Calicut, Vizhinjam, Tuticorin, Mandapam, Kakinada and Chennai.

- The total estimated landing of lobsters during 2002 was 1364 t as against 1389 t during 2001. In Maharashtra, the landing decreased from 506 t during 2001 to 402 t during 2002 and in Gujarat, from 297 t to 241 t. On the east coast, Tamil Nadu, Andhra Pradesh and West Bengal showed marginal increase in the catch. Statewise, Maharashtra, Kerala, Gujarat and Tamil Nadu contributed to 29.5%, 29%, 17.7% and 14.3%, respectively.
- At Veraval, lobster catch decreased by 49%, landing 23 t. 77% of the catch was constituted by *Thenus orientalis* and the remaining by *Panulirus polyphagus*. In *T. orientalis*, the size ranged from 31 mm to 95 mm (CL) with the modal class at 66-75 mm length group. In *P. polyphagus*, the modal class was at 71-90 mm length group. Female sex predominated the catches with 41% in berried stage.
- At Mumbai, 75 t of *P. polyphagus* were landed showing 20% increase over the landing of the previous year. Maximum landing was reported in September when about 49% of the females were in ovigerous condition. The sizes ranged from 58 mm to 385 mm with those belonging to 100-170 mm length group forming the mainstay of the fishery. Statistical analysis shows that exploitation rate (E) of this species has reached an alarming level of 0.87 in males and 0.8 in females. A programme has been undertaken by the Division under an externally funded project for creation of awareness among fishermen on the harmful effects of indiscriminate exploitation of lobsters.
- At Tuticorin and Mandapam, bottom-set gill nets landed 4 t and 13 t of lobsters, respectively. *P. homarus* and *P. ornatus* constituted the fishery. Trawlers landed 33 t of *T. orientalis* and bottom-set gill nets 2 t of *P. homarus* at Chennai. In Kerala, the lobster landing improved from 238 t during 2001 to 395 t during 2002. The deep sea lobster, *Puerulus sewelli*, dominated the fishery. The season lasted from September to April with maximum landing in October. Sizes ranged from 76-80 mm (TL) to 186-190 mm in males and 196-200 mm in females. Females predominated the catches with about 9% in berried stage.
- The total estimated landing of crabs showed an increase from 29,900 t during 2001 to 36,400 t during 2002. The fishery showed a trend of increase in all the states except Gujarat. 39% of the total landing was contributed by Tamil Nadu, 14% by Andhra Pradesh, 13% by Kerala and 12% by Gujarat.
- At Veraval, the crab landings decreased by 50%, yielding 1480 t whereas at Mumbai, the catches (197 t) showed 7% increase. *Charybdis feriatus* dominated the edible crab fishery at both the

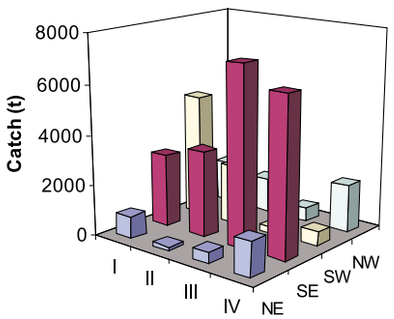
Thenus orientalis *dominated the lobster landing at Veraval and Chennai,* ***Panulirus polyphagus*** *at Mumbai,* ***P. homarus*** *at Calicut and Vizhinjam and* ***P. ornatus*** *at Tuticorin and Mandapam.*

The edible crab ***Charybdis lucifera*** *emerges as a fishery of importance at Kakinada.*

Panulirus polyphagus landing at New Ferry Wharf, Mumbai



Regionwise quarterly landing of lobsters during 2002



Regionwise quarterly landing of crabs during 2002

centres. The dominant species at Mangalore, Calicut and Cochin was *P. sanguinolentus*. Maximum number of ovigerous females of this species was landed in March. 1371 t of crabs were landed at Munambam, Cochin, Neendakara and Sakthikulangara together. Maximum landing (409 t) was reported in April. At Cochin about 50% of the catch was constituted by *P. sanguinolentus*, 35% by *C. feriatus* and 15% by *P. pelagicus.*

- Bottom-set gill nets landed 182 t of *P. pelagicus* with size ranging from 64 mm to 185 mm at Tharuvaikulam near Tuticorin. The species predominated trawler landings (730 t) at Rameswaram also. At Kakinada, 621 t of edible crabs were landed by trawlers with *P. sanguinolentus* as the dominant species and 63 t by bottom-set gill nets with *P. pelagicus* as the dominant species.

PROJECT CODE	**CRU/CAP/04**
PROJECT TITLE	**Taxonomy of important crustaceans**
SCIENTISTS	**K. Asokakumaran Unnithan,** Miriam Paul, Josileen Jose A.P. Dineshbabu and Joe K. Kizhakudan
CENTRES	Visakhapatnam, Kakinada, Chennai, Cochin, Mangalore and Veraval

- 50 species of shrimps including 32 species from the family Penaeidae, 4 from Solenoceridae, 1 each from Aristeidae, Sicyonidae and Hippolytidae, 2 from Sergestidae, 4 from Palaemonidae and 5 from Pandalidae were recorded and identity confirmed.
- 39 species of crabs, including 17 from Portunidae, 4 each from Calappidae and Maiidae, 3 from Leucosiidae, 6 from Xanthidae, 1 each from Dorippidae, Ocypodidae and Goneplacidae and 2 from Parthenopidae were recorded and identity confirmed.
- 9 species of lobsters, including 6 from Palinuridae and 2 each from Nephropidae and Scyllaridae were recorded and identity confirmed.
- 4 species of stomatopods belonging to the family Squillidae were recorded and identity confirmed.

PROJECT CODE	**CRU/CUL/01**
PROJECT TITLE	**Broodstock development, selective breeding and restocking of marine shrimps**
SCIENTISTS	**K.R.Manmadhan Nair,** G.Maheswarudu, Miriam Paul, U. Rajkumar, Chandrakant Pandit Tayade, E.V. Radhakrishnan P.E.Sampson Manickam and V.S. Kakati
CENTRES	Mandapam, Visakhapatnam, Cochin and Karwar

*Successful domestication of the tiger shrimp **Penaeus monodon** achieved using both pond reared and tank reared F_1 generation. Two generations produced by application of artificial insemination and unilateral eyestalk ablation technique. Administration of testosterone at 5 mg/g body weight increased male vigour.*

- Hatchery production and searanching of postlarvae of the green tiger shrimp *Penaeus semisulcatus* were carried out. Percent survival from egg to PL_1 is 87%.
- 1.32 million postlarvae searanched in the Gulf of Mannar.
- F_3 generation *Penaeus monodon* were reared up to adult and maturation experiments conducted.
- Inbreeding of males and females of F_3 generation (8 females and 8 males) was carried out. Due to the absence of natural mating, electroejaculation of spermatophore was attempted but no spermatophore could be obtained. Gradual mortality of males and females occurred due to weakness possibly due to inbreeding depression.

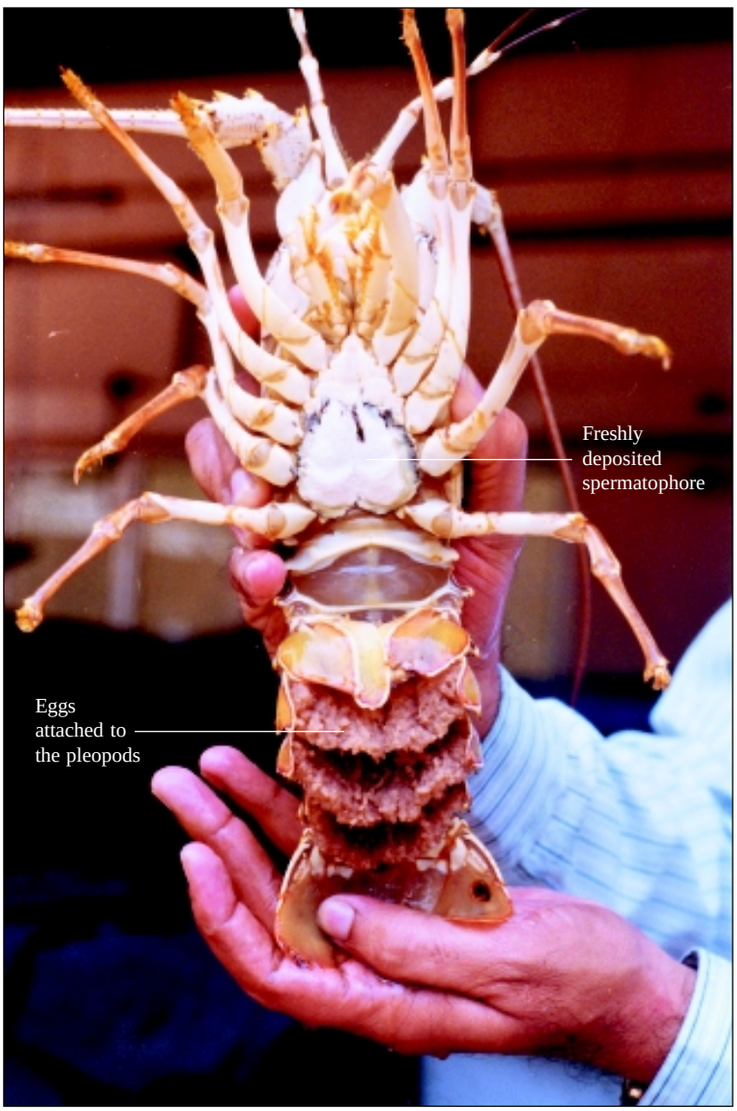
- Testosterone injection administered to F_3 males @ 5 µg/g bodyweight at every 5th day to induce spermatophore production and mating.
- Artificial insemination and eyestalk ablation did not induce maturation and spawning and therefore, F_4 generation did not materialize.
- Mating with wild males attempted on the second group of F_3 generation females. No response was obtained.
- Experiments to increase male vigour by administration of testosterone were conducted. A control group with saline injection was maintained. Natural mating occurred in both control and experimental group with higher percent of mating by injected group (60%) compared to control (52.6%).

Broodstock of *Penaeus semisulcatus*

PROJECT CODE	**CRU/CUL/02**
PROJECT TITLE	**Breeding and seed production of lobster and crabs**
SCIENTISTS	**E.V.Radhakrishnan,** S. Josileen Jose, K.R. Manmadhan Nair, P.T.Sarada, S. Lakshmi Pillai , V.S.Kakati and K.N. Saleela
CENTRES	Cochin, Mandapam, Calicut, Karwar and Vizhinjam

- Established a broodstock holding, maturation and spawning system at Cochin. Adult females and males of the spiny lobster *Panulirus homarus* stocked at a ratio of 2:1 in the recirculation system were fed on a mixed diet of mussels, clams, squid and small shrimps.
- Repetitive maturation and spawning of viable eggs were observed. Two batches of eggs were produced by a single female within a moult cycle.
- Interval between hatching and the next spawning varied from 2-17 days.
- Fecundity of captive females weighing an average 500g ranged from 3.5 to 4.5 lakhs per brood. Total number of eggs released during second spawning was 20% less. Eggs were also smaller in diameter and on hatching produced weaker larvae.
- Incubation period ranged from 20-23 days at a temperature of 28-29 ° C.
- Phyllosoma larvae stocked at 10 nos/l attained stage 4 in 17 days on a diet of freshly hatched *Artemia* nauplii. For the first time, faster growth of the larvae was observed.
- At Calicut, the phyllosoma of *P. homarus* larvae attained stage 6 in 43-50 days.
- *Artemia* nauplii and ground mussel meat embedded in agar agar showed better acceptance by stage 5 larvae compared to gelatin embedded feed. Feeding late stage larvae with 'SELCO' enriched *Artemia* was also attempted.
- Initiated breeding of the mud crab *S. serrata* obtained from the wild. Heavy infestation of egg mass of wild caught crab with ciliates and fungus was observed. The average intermoult duration between the zoea stages is 4 days. Studies conducted on rotifer production at different salinities and pH showed highest rotifer density at a salinity

*Developed and standardized the technology for maturation and breeding of **P. homarus** in captivity by environmental regulation and feed control. The broodstock was stocked @ 1.5 lobster/m^2 in a recirculation system with coarse sand substratum. By maintaining average light intensity of 40 lux, salinity ranging from 32 to 35 ppt, pH 8.0-8.2, DO level >4 ppm and on daily feeding with fresh feed comprising mussel, clam, squid and small shrimps, the lobsters matured, mated and regularly oviposited viable eggs with 95% hatchability.*



Panulirus homarus matured and bred in the laboratory

of 30 ppt and pH 7.5-7.6. Rotifers fed on *Nannochloropsis* sp. had higher carotenoid content (14.72 µg /g) compared to those fed on *Chlorella* sp. Survival during zoea was higher in larvae fed on *Nannochloropsis* sp. enriched rotifers (60%) compared to those fed with *Chlorella* sp. (45%).

- Achieved hatchery production of the mud crab *Scylla serrata*. $Zoea_1$ metamorphosed to megalopa after 17-18 days.

MOLLUSCAN FISHERIES DIVISION

During the year 2002 the Molluscan Fisheries Division implemented seven Institute projects, two on fishery resources characteristics, four on mariculture and one on taxonomy. The Division also has implemented two National Agricultural Technology Projects, four AP Cess Fund projects, one ICAR Revolving fund project and two projects funded by the International Foundation for Science.

PROJECT CODE	**MOL/CAP/01**
PROJECT TITLE	**Fishery and biological characteristics of exploited cephalopod resources**
SCIENTISTS	**M.M. Meiyappan,** R. Sarvesan, G.S. Rao, A.C.C. Victor, K.S. Mohamed, V. Kripa, P.K. Asokan, Sujitha Thomas, Geetha Sasikumar, M.K. Anil, Boby Ignatius
CENTRES	Mumbai, Karwar, Mangalore, Calicut, Kochi, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam

Investigations were taken up during this year from five centres along the west coast of India viz., Mumbai (New ferry Wharf), Mangalore (Mangalore & Malpe), Calicut (Calicut & Beypore), Cochin (Cochin, Vypeen, Munambam, Neendakara & Sakthikulangara) and Vizhinjam and five centres along the east coast, Tuticorin, Mandapam (Mandapam, Pamban & Rameswaram), Chennai, Kakinada and Visakhapatnam. Trawl units undertaking daily and multi-day voyages contributed to more than 90% of the cephalopod catch. At Vizhinjam hooks and lines operated from mechanized and non-mechanized crafts and boat seines accounted for entire landings. The landings along the west coast accounted for the bulk of the production. The all India production of cephalopods is estimated at 1, 04,354 tonnes. The production estimates, catch rate, percentage in all fish catch and percentage of squids, cuttlefishes and octopus from different centers are shown below.

Table. Cephalopod production estimates, catch rate and group percentage from different centres

Centre	Catch(t)	C/U(kg)	% inAF	Squids(%)	Cuttlefishes(%)	Octopus(%)
Mumbai	2427	118	5	61	38	1
Mangalore	3944	106	8	75	23	2
Malpe	1732	66	6	71	20	9
Calicut						
Puthiyappa	1410	66	9	42	52	6
Beypore	1762	126	13	26	62	12
Cochin	1772	155	8	32	55	13
Munambam	1552	56	7			
Vypeen	2182	109	12			
Neendakara	6333	117	11			
Sakthikulangara	6511	159	18			
Tuticorin						
Trawl net	894		5	17	83	0
Hooks & lines	301	16	100	43	57	0
Mandapam	317	10	3	29	55	16
Rameswaram	70	12	2	27	56	17
Pamban	617	5	1	18	65	17
Chennai	2388	45	7	37	62	1
Kakinada	855	19	3	11	89	0
Visakhapatnam	894		2	13	87	0
Vizhinjam						
H&L (mech)	149	4	7	46	54	0
H&L (Non-mech)	5	2	11	82	18	0
Boat-Seine	230	4	2	100	0	0
Shore-seine	1	18	23	100	0	0
All India	104354		3.95			

Multi-day trawlers contributed to the major portion of the catch at all the centres. Along the Karnataka coast purse seines harvested the squids during post-monsoon. At Vizhinjam, 60% of the catch was caught by boat-seines and 40% by hooks & lines operated from mechanized (39%) and non-mechanised crafts (1%). Shore-seines caught only very small quantities.

When compared with production statistics of the previous year, the estimated catch at Mangalore increased by 8%, Malpe 25%, Beypore 25%, Tuticorin 1%, Chennai 182%, Kakinada 37%, Visakhapatnam 122%, Vypeen 157%, Sakthikulangara 35% and Neendakara 12% but declined by 14% at Cochin, 25% at Puthiyappa, 28% at Mandapam, 9% at Rameswaram and Vizhinjam by 15%. The catch rates at Mangalore increased by 7%, Malpe 8%, 31% at Beypore, Chennai 100%, Kakinada 33% and but decreased by 38% at Puthiyappa, 4% at Tuticorin, 57% at Mandapam, 8% at Rameswaram, 7% at Cochin and 84% at Visakhapatnam. At Vizhinjam the yield from boat seines increased by 231%, hooks & lines (non-mechanised) by 40% but declined by 43% for hooks & lines (mechanised).

Species composition (in %) at different centres

Group / Species	Cochin	Mangalore-Malpe	Calicut	Tuticorin	Mandapam-Rameswaram	Chennai	Kakinada	Visakhapatnam	Vizhinjam	Mumbai
Cuttlefishes										
Sepia pharaonis	82.4	79	37		42.7	70	28	40	100	30.7
S. aculeata	0		62		44.3	18	43	48		53.6
S. prashadi	4.6	3			2					
S. elliptica	2.4	16.5								
S. brevimana						3	2			
S. trigonina	0.8									
Sepiella inermis	9.8	1.5	1		13	7	27	12	15.7	
Squids										
Loligo duvauceli	80.6	89.5	100	7	31.4	69	88	100	55	100
L. uyii						3	3			
Doryteuthis singhalensis	17.8								45	
D. sibogae	1.2	10.5		28		28	3			
Sepioteuthis lessoniana	0.4			65	68.6					
Octopus										
Octopus membranaceaous	61.3	89								
O. dollfusi	33.6					74				
O. lobensis	2.1									
Octopus sp.	0.6									
Hapalochlaena maculosa		7.5								
Cistopus indicus	2.4	3.5				26				

Species composition

Among cuttlefishes, *S. pharaonis* was the dominant species along the west coast, while it was *S. aculeata* in Andhra Pradesh. Among squids *L. duvauceli* was the dominant species along both west and east coast,

excepting at Mandapam, Rameswaram and Pamban, where *S. lessoniana* was the dominant species. At Cochin, there was a remarkable decrease in the catch of the siboga squid *D. sibogae* and the octopus catch, especially that of *O. membranaceaous. O. dollfusi* showed a notable increase.

Biology of key species

Loligo duvauceli

At Calicut the dorsal mantle length ranged from 40 to 220 mm with modes at 80-100mm with mean sizes varying between 76 and 118mm in the case of males, 50-150 mm with modes at 80-100 mm, with mean sizes ranging from 80 to 107 mm in the case of females. The M:F ratio ranged from 33:67 to 59:41 and immature squids dominated the fishery except during December. Along Kakinada coast the size range of males was 40-149 mm with dominant mode at 80-89 mm. Its mean size ranged between 67.4 and 116.7 mm. The size range of females was 40-159 mm with dominant mode at 90-99 mm. The mean size was between 66.6 and 121.6 mm. Juveniles occurred in the range of 20-49 mm during February-April and August-September. Males were generally dominant in the fishery. Mature squids occurred through out the year with peaks during June-October. The DML varied from 40 to 159 mm for males and 50-159 mm for females in the fishery along the Visakhapatnam coast.

Sepia pharaonis

The length range at Cochin was 40-480mm with multiple modes throughout the year. Peak recruitment was noticed during January-February. Population parameters were L∞ 387mm, K 0.63, Z 1.57, M 1.1, F 0.47 and F/Z 0.3. The stock did not show any sign of over-fishing. Along Vizinjam coast the size of this species was 180-429 mm with mean sizes ranging from 250 to 303 mm. Males were dominant during March, September, November and December. Mature animals were dominant during January-March period.

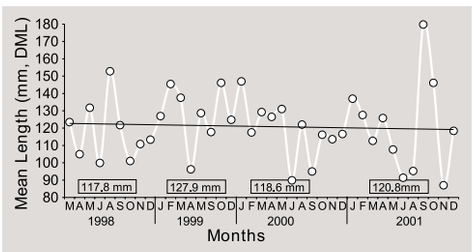
Stock dynamics

At Cochin, the exploitation rate of *L. duvauceli* showed a drastic decline from 0.72 in 2000 to 0.48 during 2002, while the exploitation rate of *O. membraneaceous* showed increase. The decreased abundance of *L. duvauceli* in the grounds off Cochin was noteworthy. The increase in Z values of *O. membraneaceous* is a pointer towards exercising caution in exploitation.

Analysis of monthly mean lengths of *L. duvauceli* during 1998-2001 showed fluctuations. The trend line showed marginal decline. Since the catch rate of the species did not show a concomitant declining trend with increased effort, there may not be any over fishing in the stock at present.

Centre	Period
Mumbai	January-April
Mangalore	February-April, June, August
Malpe	February, March, May, August
Puthiyappa	March, August, September
Beypore	January, April, August, September, November
Cochin	January, April, August, October
Vizhinjam	August, September, October
Tuticorin	January – March for trawl nets & March, June, July for hooks & lines
Mandapam	April, June, July-September
Rameswaram	April, June, July, November, December
Pamban	January, June, September
Chennai	June - October
Kakinada	July-October
Visakhapatnam	August-October

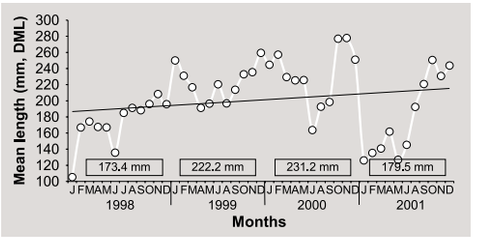
Seasonal abundance of cephalopods at different centres



Variation in monthly mean lengths of *Loligo duvauceli* at Cochin (annual mean lengths in box)

Destruction of Cuttlefish eggs by trawlers

Along Munambam-Ponnani coast during post monsoon period, hooks & line crafts deployed indigenously designed cuttlefish aggregating devices using coconut flower bunches bundled together and suspended in mid-water column using sand bags as anchors at depths ranging from 30-50m. The position of these devices was marked with GPS. Cuttlefish which aggregated in these areas for laying eggs are caught by hand lines. These devices were hauled up by trawlers. Each of the flower bunches had about 1000 eggs and 150 flower bunches formed one unit. It has been estimated that about 1.5 lakhs of eggs were destroyed by this method.



Variation in monthly mean lengths of *Sepia pharaonis* at Cochin (annual mean lengths in box)

Exploitation rates of major cephalopod stocks exploited at Cochin Fisheries Harbour during 2002

SPECIES	Z Estimate	M Estimate	F Estimate	Exploitation Rate (F/Z)
Loligo duvauceli	4.00	2.09	1.91	0.48
Sepia pharaonis	1.57	1.10	0.47	0.30
Doryteuthis sibogae	2.74	1.30	1.44	0.53
Octopus membranaceous	6.24	2.07	4.17	0.67

A similar analysis on *S. pharaonis* showed an increasing trend until 2000 and decline in 2001. However, the trend line fitted showed an overall increasing trend. It is concluded that the stock is healthy without any sign of over fishing.

PROJECT CODE MOL/CAP/02

PROJECT TITLE **Assessment of bivalve and gastropod resources**

SCIENTISTS **G.Syda Rao,** R.Sarvesan, P.V.Sreenivasan, A.C.C. Victor, A. Chellam, T.S. Velayudhan, V.Kripa, ShojiJoseph, Geetha Sasikumar, P. Laxmilatha, P.K. Ashokan, Sujitha Thomas N. Ramachandran, M.K. Anil and Boby Ignatius

CENTRES Mumbai, Karwar, Mangalore, Calicut, Kochi, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Vishakhapatnam

The fishery of bivalves and gastropods at 36 main landing centers was monitored and based on this the total landing was estimated as 60,307 tonnes with bivalves forming 97 % of the landing. Among bivalves, major contribution was by clams (63%), followed by mussels (34%) and oysters (3%). The details of fishery of the bivalves and gastropods at Karnataka, Kerala, Tamil Nadu and Andhra Pradesh are given below.

Six species of clams viz., *Villorita cyprinoides*, *Paphia malabarica*, *Sunetta scripta* , *Meretrix casta*, *M. meretrix*, *Marcia opima*, and the cockle *Anadara granosa* contributed to the commercial fishery. Among mussels, the green mussel *Perna viridis* and the brown mussel, *P. indica* contributed to the fishery. *Crassostrea madrasensis*, *Saccostrea cucullata* were the major exploited edible oysters and *Placenta placenta* is the major window pane oyster species.

Villorita cyprinoides was the major clam landed (20,666 tonnes) and Vembanad Lake in Kerala continued to be the major fishing centre for this resource. It was also fished from Korapuzha and Chaliyar estuaries in north Kerala. While fishery was prevalent throughout the year in Vembanad lake, in north Kerala it was observed only during April in Korapuzha and from April to June in Chaliyar.

Meretrix casta landings in Moorad estuary, Kozhikode

Paphia malabarica was the second dominant clam resource and Ashtamudi Lake in Kerala was the major fishing area. This clam was also fished from Dharmadam estuary in Kerala. In Karnataka, 622 tonnes of *Paphia malabarica* was landed mainly from the backwaters in Gangoli (340 tonnes) and Kali estuary (282 tonnes). In Andhra Pradesh, 4 tonnes *Paphia malabarica* was landed from Kakinada bay.

About 4486 tonnes of *Sunetta scripta* were fished from the coastal areas of Cochin and utilized mainly for the shell. *Meretrix casta* was fished

from the major estuaries of Kerala and Karnataka and the total landing was estimated as 3,571 tonnes. The meat was utilized mainly in the domestic market. In Kerala, *Meretrix casta* fishery was more prevalent in the northern region especially from Kottakal and Moorad region (940 tonnes), Chaliyar (491 tonnes) and Dharmodam (41 tonnes.) In central Kerala the significant observation was the depletion of the stock in Chettuva estuary. The fishermen shifted the fishing activities from *Meretrix casta* beds to *Villorita cyprinoids* beds from October 2002 onwards due to depleted stock. In Karnataka, 1477 tonnes of *Meretrix casta* were landed mostly from Mulki estuary. Good fishery was observed at Bhimili near Visakhapatnam in Andhra Pradesh.

Mussel fishery landings in Karwar

Meretrix meretrix fishery was observed in Aghnashini estuary (200 tonnes) in north Karnataka and at two regions Bhimili (70 tonnes) and Kakinada Bay (16 tonnes) in Andhra Pradesh. The fishery for *Marcia opima* was seen only at Gangoli in south Karnataka where 5 tonnes were landed.

With a total estimated landing of 20, 213 tonnes, mussel fishery showed an increasing trend. The main reason was the intense fishing activity along the Gangoli-Byndoor coast of Karnataka where 10,297 tonnes were landed. The main mussel landing centres in Kerala were Elathur, Kadalundi and Thikkodi. Apart from this, mussel fishery was observed in Ashtamudi Lake where 550 tonnes were landed during the period January to March 2003. From Tamil Nadu, 63 tonnes of green mussel were landed from Uppanaru estuary (63 tonnes) and Thangaittu. These were targeted towards the mussel market in Kerala. The brown mussel fishery was restricted to southeast and southwest coasts and about 420 tonnes were landed mainly from Mulloor, Vizhinjam and Pulinkudi.

The major oyster species landed was *Crassostrea madrasensis* (1456 tonnes), followed by *Saccostrea cucullata* (87 tonnes). 146 tonnes of the windowpane oyster *Placenta placenta* was landed. The fishing centers

Estimated bivalve landing of the major bivalve resources during the period 2002-2003

	Resource	Karmataka	Kerala	Tamil Nadu	Andhra Pradesh	Total (in tonnes)
Clams & Cockles	*Sunetta scripta*	0	4486	0	0	4486
	Paphia malabarica	622	6277	0	4	6903
	Meretrix casta	1447	1600	0	524	3571
	Meretrix meretrix	210	0	0	86	296
	Villorita cyprinoids	0	20666	0	0	20666
	Anadara granosa	0	0	0	873	873
	Marcia opima	5	0	0	0	5
	Total	**2284**	**33029**	**0**	**1487**	**36800**
Edible Oysters & Windowpane Oyster	*Crassostrea madrasensis*	110	1007	0	339	1456
	Saccostrea cucullata	87	0	0	0	87
	Placenta plancenta	0	0	0	146	146
	Total	**197**	**1007**	**0**	**485**	**1689**
Mussels	*Perna viridis*	10471	9259	63	0	19793
	Perna indica	0	420	0	0	420
	Total	**10471**	**9679**	**63**	**0**	**20213**
	Total Bivalves	**12952**	**43715**	**63**	**1972**	**58702**

for edible oysters were Dharmadam estuary, Vembanad and Ashtamudi Lakes in Kerala, Agnashini and Kali estuaries in Karnataka and Kakinada and Bhimili estuaries in Andhra Pradesh. The entire quantity of *P. placenta* was from Kakinada bay.

Gastropods were landed mainly by the trawlers. About 116 tonnes of sacred chank, *Xanchus pyrum* was landed along the south east coast mainly at Ramaeswaram, Mandapam, Keelakarai and Tuticorin. The size of chanks ranged from 90 to 240 mm. Significant quantities of gastropods such as *Babylonia* sp., *Conus* sp., *Bursa* sp., *Murex* sp., were landed from Kakinada Bay (893 tonnes) and Thangaithittu estuary in Pondichery.

PROJECT CODE	**MOL/CUL/01**
PROJECT TITLE	**Technological feasibility studies and up-gradation of molluscan mariculture**
SCIENTISTS	**K.K.Appukuttan,** A.C.C. Victor, V.Kripa, R. Sarvesan, P.V. Sreenivasan, G. Syda Rao, A. Chellam, P. MuthiahT. S. Velayudhan, K.S. Mohamed, Geetha Sasikumar, P. Laxmilatha, P.K. Asokan, Sujitha Thomas and I. Jagadis
CENTRES	Mangalore, Calicut, Kochi, Tuticorin, Mandapam, Chennai, Kakinada, & Vishakhapatnam

The total bivalve production through farming was estimated as 1600 tonnes with 1250 tonnes of green mussel, *Perna viridis* and 350 tonnes of oyster, *Crassostrea madrasensis*. The production of the green mussel was mostly in the northern and central regions of the Kerala state while oyster farming was more prevalent in central and southern regions. However, due to scarcity of seed of both these resources in the natural beds, progress was slightly hampered.

Along with this, efforts were made to refine the clam culture technology and onshore pearl culture of *Pinctada fucata.*

Mussel and Oyster Farming

Mussel farm at Padanna, Kasargod, Kerala

The Aquaculture Development Agency in Kerala (ADAK) initiated a new programme on mussel farming with scientific support from CMFRI. Under this, sites for mussel farming were selected and training programmes were conducted in North Kerala. 15 groups were selected by ADAK and they were given free material such as bamboo poles (25 nos.), nylon rope (13 kg) and other necessary items for setting up mussel farms.

A training manual in Malayalam on mussel farming for farmers was prepared and distributed to the trainees. Training was provided to 340 fishers including 180 women in the coastal villages. Training was conducted at Atholi, Chaliyar, Kannur, Beypore, Elathur, Padanna, Pattuvam, Payyanur and Purangara.

Shri. Gul Mohamed, the first mussel farmer in the state who was encouraged to start mussel farming by CMFRI was awarded 'Karshaka Siromony' for the year 2002 by the Ministry of Agriculture, Govt. of India. Three of mussel farmers at Atholi, Mr K.T.Gopalan, K.V.Rarichakutty and K.T.Chandran were awarded Karshaka award at Peruvananmuzhi KVK center of IISR (Indian Institute for Spices research) for the contribution towards developing mussel culture in the Korapuzha backwaters. Their effort inspired many villagers to take up mussel culture. Apart from these two mussel farmers; Mr. D.L. Xavier from Narakkal, Mr. P.V. Rassak from Chettuva and one oyster farmer Shri Vincent

Mukkadan from Kollam were awarded the best farmer award by CMFRI in collaboration with KVK on Kisan Divas.

A one-day seminar was organised on 'Mussel culture in Malabar-prospects and constraints' at Calicut on 14 th May 2002. A booklet containing various aspects of Mussel mariculture was released by the MLA of Calicut and received by the former Mayor of Calicut.

At Kayamkulam and Ashtamudi Lakes, oyster farming in estuaries progressed through farming by Women Self Help Groups with 10 to 15 members per group and with financial aid from BFFDA. The ADAK and the BFFDA jointly organized the harvest with scientific support from CMFRI. For the benefit of planners and state fisheries officials, a manual on oyster culture was prepared.

Mussel harvest at Vallikunnu, Malappuram, Kerala

Oyster culture experiments were initiated at Korapuzha estuary in Kerala. The intensity of spat fall was found to be 5 spat per ren. Along the east coast, at Muttukadu backwaters, the spatfall was high in February with an intensity of 3 to 34 spat per tile (average 17.7 spat).

Oyster farm at Kayamkulam managed by a women self help group

The average monthly condition index (CI) of the farmed oysters ranged between 3.9 and 6.2 and the average monthly meat percentage (MP) of a ren with average 35 oysters ranged between 7.8 and 16.3. The CI and percentage of meat to total weight could be related to the reproductive activity of the oysters. The high CI and MP in February, March, May and September, October was related to the mature gonad and subsequent lowering in April, November and December to the spawning phase. The spawning phase in summer is short while in late monsoon and early pre-monsoon it is prolonged .The condition index of oysters showed moderate (r = 0.48) correlation with salinity and negative correlation (r= -0.46) with gross productivity. The meat percentage showed moderate correlation (r= 0.47) with nitrate. The Condition index and meat percentage did not show significant correlation with other physico – chemical parameters like ammonia, phosphate, nitrite, total suspended solids, dissolved oxygen and net primary productivity. The harvesting of farmed oysters can be scheduled with the peak values in CI and meat percentage.

Pearl Culture

In the on-shore pearl farms of CMFRI at Vishakapatnam, 650 pearl oysters, *Pinctada fucata* were implanted with 5 to 7 mm nuclei. The rejection was 50 % at the end of 40 days with negligible post implantation mortality.

Clam Culture

At Tuticorin, *Marcia opima* seed of 4.8mm length and 0.03gm weight grew to 23.5 mm with 3.5 gm indicating a growth rate of 1.6mm in length and 0.29 gm per month. In another experiment conducted to study the effect of substrata on the growth and survival of *Paphia malabarica*, it was observed that the growth rate was highest, 5.1mm/month in fine clay followed by 3.8 mm in coral sand and 3.6 mm in clay sand during the same period. The survival was 84.3 %, 46.9% and 32.5%, respectively in the three substrata.

Experiments on farming of the clam *Meretrix casta* were done at Chitrapau and Bappandu in Mulky estuary. Seed clams of average length 20.5 mm and weight 2.25g were stocked in an inter-tidal site after clearing and

raking the site. The site was protected by a pen enclosure made of bamboo poles and old synthetic fish nets. The clams were harvested after 78 days. At Chitrapu, the clams reached an average length of 27.5mm and weight 7.29 g indicating an average monthly growth rate of 2.67mm. At Bappandu, the clams with an average growth rate of 2.18mm /month attained an average length of 26.2 mm with a total weight of 7.02 g.

PROJECT CODE	**MOL/CUL/02**
PROJECT TITLE	**Selective breeding of pearl oyster *Pinctada fucata***
SCIENTISTS	**T. S. Velayudhan,** P. C. Thomas, P. Muthiah, G. Syda Rao, N. Ramachandran, S. Dharmaraj, V.Kripa, Shoji Joseph, Boby Ignatius, U. Rajkumar and C.P. Tayade
CENTRES	Kochi, Vizhinjam, Tuticorin, Mandapam and Vishakhapatnam

Studies on trait selection in pearl oyster

A total of 40 selected adult pearl oysters were induced to spawn and the spats were segregated into three groups based on growth performance. After a period of one month**,** each group was again segregated into two groups based on the growth pattern as > 10 mm size and < 10 mm. Thses oysters are maintained in the farm for the selection of different traits and studying the growth performance for conducting selection experiments. Electrophoretic studies were conducted to identify the specific proteins responsible for each trait.

Black band on the shell of *Pinctada fucata* (Gould) spat produced in the hatchery selected for trait studies

- A preliminary selection trial was made according to shell colouration such as black band, green band and red plain band from 700 spats.
- In the transplanted spats from Vizhinjam to Kollam, the maximum average growth was observed in black band followed by green band & red plain band where black band attained 50.02- 53-06 mm in DVM from an initial size 20.40 - 23.76 mm with in a period of one year in westcoast.
- In the Tuticorin hatchery the pearl oysters with bigger body cavity and smaller body cavity were selected and inbred and found that the progeny of bigger cavity animals retained this character. Further attempts were made to segregate and inbreed this group.

Studies on the electrophoretic profile of various tissues of pearl oyster

- Proteins in its native nature were isolated from mantle tissue, adductor muscles, foot and digestive system of the pearl oyster *Pinctada fucata*. Initial studies showed individual tissue specific proteins and few common bands shared in all the tissues.

PROJECT CODE	**MOL/CUL/3**
PROJECT TITLE	**Technological upgradation of molluscan seed production**
SCIENTISTS	**P. Muthiah,** P. Laxmilatha, S. Dharmaraj, A. Chellam, P.K. Asokan, Sujitha Thomas, I. Jagadis, Boby Ignatius and M.K. Anil
CENTRES	Calicut, Vizhinjam, Tuticorin and Mandapam

- 11 spawning experiments were conducted by thermal stimulation and the larvae of *Crassostrea madrasensis* were reared in Tuticorin Shell Fish Hatchery for triploidy induction. All the eggs after fertilization were treated for 2 minutes in 32° C. Only 7 experiments were

successful. The percentage of settlement varied from 0.11 to 2.3. Totally 49,392 spat were produced.

- 98,500 seed of *P. fucata* were produced at Tuticorin hatchery of which 40, 000 were supplied to Kollam, Vizhinjam and Lakshadweep farmers for location testing experiments and the rest were transferred to the farm at Tuticorin.

- Experiments were conducted for induced breeding of adult green mussels *Perna viridis* at the shell fish hatchery at Calicut. Mixed algae *Tetraselmis*, *Isochrysis galbana* and *Nannochloropsis* (ratio 1:2:1) was provided at the rate of 30, 000 – 40, 000 cells /ml/day to brooders. Spawning trials were made but could not succeed as the gonads did not develop well.

- In one spawning 24.36 lakhs 'D' shape larvae of *Paphia malabarica* were reared providing *Isochrysis galbana* as food and 1, 74,400 spats were produced in the Tuticorin Shell Fish Hatchery. The clam seeds on 64th day attained mean size of 2.6 mm and on 87th day attained mean length of 3mm; the seeds were ranched in Tuticorin bay. *P. malabarica* seed of 3 mm grown for a month in sandy substratum had more growth increment of 5.1 mm with 84.3% survival than those reared in clay sand and in coral sand.

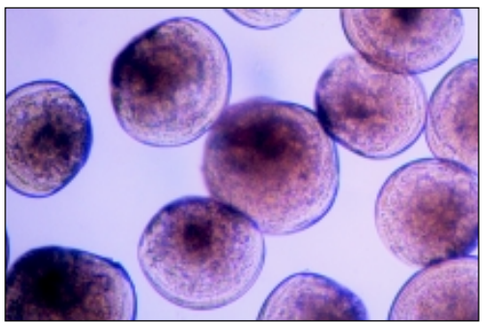
- Six egg capsules were released by sacred chank *Xancus pyrum* brood stock in the hatchery at Mandapam Camp. The baby chanks released did not survive beyond day 3. The baby chanks released from the egg capsules collected from wild and maintained in the hatchery, were healthy and reared by feeding initially with small earthworms and small clams after 5th month. After 11 months, they attained average length of 64.8 mm from an initial length of 29.17 mm and av. weight of 38.45 gm from initial weight of 2.55 g with monthly growth rate of 3.23 mm in length and 3.26 g in weight.

- Cuttlefish, *Sepiella inermis* fed with live feed, had grown to 42.6 mm (ML) and laid eggs on 122nd day whereas growth was less in the juveniles fed with frozen-feed; and total mortality occurred on 75th day at Tuticorin hatchery.

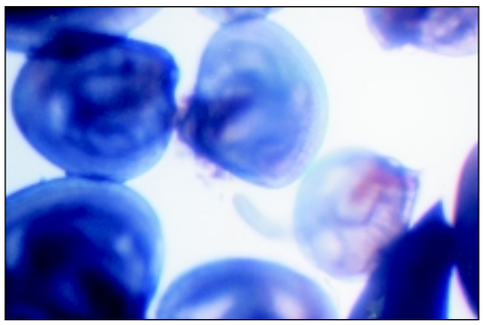
- Adults with average ML 77.6 mm from F11 generations and 1,540 juveniles with ML 4 mm from F-14 generation of *Sepiella inermis* were sea ranched.

- The egg capsules of *S. pharaonis* collected in April'02 from Vizhinjam bay started hatching after 12 days at 28^0 C. The hatchlings were fed with mysids and later with Artemia and small fishes. In 5th month, they attained average size of 150 mm (ML) with av. weight of 30 gm. On 6th month the av. weight of 523 gm was obtained.

- Egg mass of S. *lessoniana*, was collected by suspending 8 –10 coconut inflorescences from the pearl oyster raft the Vizhinjam bay. Egg masses thus collected were used for rearing experiments. The hatchlings increased from 8.2 mm (TL) to 24 mm in 44 days.



Umbo stage larvae of *Paphia malabarica*



Spats of *Paphia malabarica*

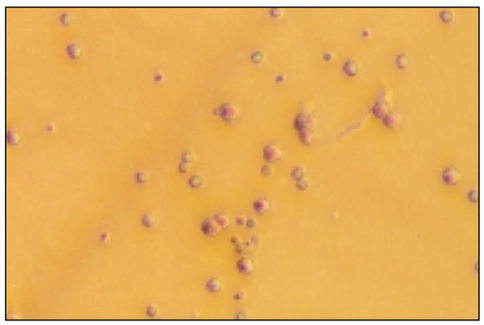
Egg mass of *Sepia pharaonis* in the Vizhinjam hatchery

PROJECT CODE	**MOL/CUL/04**
PROJECT TITLE	**Marine pearl production through tissue culture and disease investigations of farmed bivalves**
SCIENTISTS	**S. Dharmaraj,** P.K. Asokan, P. Laxmilatha, N.K. Sanil, K.C. George, P. Muthiah, T.S. Velayudhan, K.S. Mohamed
CENTRES	Tuticorin, Calicut, Cochin

Marine pearl production through tissue culture

The explant culture of pearl oyster mantle resulted in good growth of cells in-vitro and formed a thick cell sheet. The cells had coloured granules, which were the precursors for crystal formation. Experiments were conducted to test the feasibility of pearl production through injection of free cells. The free cells, which proliferated from the explant culture of the mantle tissue of *Pinctada fucata* were injected at the gonad region of nucleated oysters and reared in out door pearl farm for 115 days. The results were not positive. The rejection rate was 78.2 % and without any nacre coating on the nucleii.

Two different methods were tried to improve the quality of graft used for pearl implantation viz. treatment in medium 199 and processing of graft tissue by sterilizing and antibiotic treatments.



The granules - the precursors for nucleation of crystals being released out of the mantle cell of abalone

Effect of graft treated in medium 199 on pearl production

After the routine preparation of graft mantle pieces (2mm x 2mm size) for implantations, these were soaked in the culture *medium 199* till nucleation. The mortality was 30.6 % and pearl production 15.5% at the end of 160 days. An evaluation of quality of pearls indicated that 'A' quality pearls produced were 15.5%.

Effect of pre-treated graft tissue on pearl production

Modifications were made in the preparation of graft tissue in pearl oyster. The mantle strip taken from surface - sterilized pearl oysters and washed in 10ml sterile seawater (SSW) twice for 5 minutes each. These were treated in 35% alcohol for 15 seconds and washed twice in antibiotic solution containing 1000 µg/ml streptomycin and 2000 IU/ml penicillin, each for 5 minutes, washed in SSW twice and soaked in *medium 199*. The mantle strip was cut into 2 x 2 mm pieces and used for implantation. After 155 days the mortality was 33.5% and pearl production 8.8% with 'A 'grade pearls forming 16 %.

Investigations on disease prevalence in bivalves

Mortality due to diseases was not observed in oyster farms. Larval mortality occurred in 4 larval rearing sets out of 11 in the hatchery. Among the four, the mortality was due to copepods and ciliates in two experiments and the other two were due to fungal attack. The treatment of parathion @ of 0.05 ppm reduced the larval mortality due to copepods and ciliate attack on the larvae.

Lysosozyme activity pattern in the digestive gland of green mussel *Perna viridis* was studied using the turbidometric assay for lysozyme. The mussels were exposed to copper and mercury at 0.5, 1.0 and 2.0 ppm. Samples were collected at the end of 24 hrs and 48 hrs. The results are expressed as the unit of lysozyme activity which causes a decrease in the absorbance of 0.001 per minute per g of tissue. The lysozyme activity in

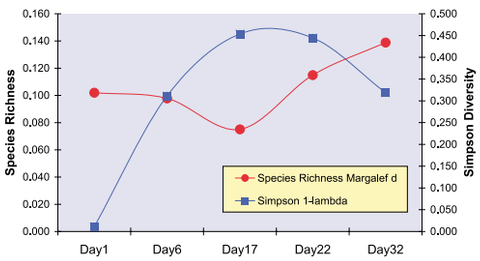
the digestive gland control group was 1641.13 units per minute per gram of tissue while in the copper and mercury treated groups it was 666.66 units and 1403.18 units, respectively.

The haemolymph lysozyme activity was 250 units per minute per gram of protein for control and 50 units for copper and 100 units for mercury. It was found that the lysozyme activity was lowest in copper treated mussels followed by the mussels exposed to mercury when compared to the mussel that were not exposed to either copper or mercury.

Probiotics in bivalve larval rearing

Axenic cultures of *Chaetoceros* sp were set up in the laboratory and total bacterial counts on seawater agar (SWA) were made on day 1, 5, 15, 19 and 29. Results showed that with the growth of the diatom culture, the species richness declined and then increased with the age of the culture and subsequent crashing.

The species diversity as exemplified by Brillouin, Shannon-Weaver and Simpson indices showed an increase with increasing age of culture until final crashing.



Bacterial taxa biodiversity in *Chaetoceros* culture

Diversity indices of *Chaetoceros* culture during different days

	Tot Spp	Tot Individ	Species Richness Margalef d	Species Evenness J'	Brillouin H	Shannon-Weaver diversity H'	Simpson Diversity 1-lambda
Day1	2	18067	0.102	0.049	0.034	0.034	0.011
Day5	2	27666	0.098	0.707	0.490	0.490	0.311
Day15	2	613333	0.075	0.932	0.646	0.646	0.454
Day19	2	6000	0.115	0.918	0.636	0.637	0.445
Day29	3	1800000	0.139	0.552	0.607	0.607	0.319

The relationship between species richness (Margalef's d) and Simpson diversity (1-lambda) is shown in Figure.

The PCA and cluster analysis revealed that the bacterial diversity in Day1 is separate from the bacterial diversity during Day5, 15 and 19 which are during the log phase of the diatom culture. Further, Day29, which is close to the period when the culture crashed has an entirely different bacterial diversity, which is dominated by bacterial taxa, which are *phytophagous*.

PROJECT CODE	**MOL/BIOD/01**
PROJECT TITLE	**Biodiversity of marine molluscs**
SCIENTISTS	**Shoji Joseph,** K.K.Appukuttan, R. Sarvesan, P. Muthiah, P.V. Sreenivasan, T.S. Velayudhan, V. Kripa, P. Laxmilatha, P.K. Asokan, Sujitha Thomas and I. Jagadis
CENTRES	Kochi, Calicut, Mangalore, Chennai, Tuticorin and Mandapam

- Gastropods & bivalves were collected from Kollam, Kochi, Malabar Coast, Chennai and Cudallore.
- 230 specimes belonging to 30 genera 25 families were collected and identified from 4 stations.

FISHEY ENVIRONMENT MANAGEMENT DIVISION

During the period under report, FEMD conducted research to achieve the targets through 6 Inhouse projects, 2 funded projects, 2 NATP and one ICAR Revolving fund project. In addition to this 7 Consultancy programmes related to environment were also implemented.

PROJECT CODE	**FEM/01**
PROJECT TITLE	**Monitoring the environmental characteristics of the inshore waters in relation to fisheries.**
SCIENTISTS	**C.P.Gopinathan**, G.S.D. Selvaraj, V.Chandrika, T.S.Naomi, Gulshad Mohammed, P.K.Krishnakumar, S. Jasmine, V.V.Singh, P.S.Asha, K.Vijayakumaran, Rani Mary George and Bindu Sulochanan.
CENTRES	Cochin, Calicut, Mangalore, Karwar, Mumbai, Minicoy, Veraval, Tuticorin, Mandapam, Chennai, Visakhapatnam.

In order to study the various hydro-biological parameters of the west and east coasts, regular water samples were collected from 10 m and 20 m depth stations and analysed for various hydrological properties. The various physico-chemical parameters studied were water temperature, salinity, dissolved oxygen content, pH and nutrients such as nitrite, nitrate, phosphate and silicate. Both light and dark bottle oxygen technique and chlorophyll '*a*' estimations were carried out at selected centres for the determination of primary production. The biomass of zooplankton was also estimated by the displacement volume method.

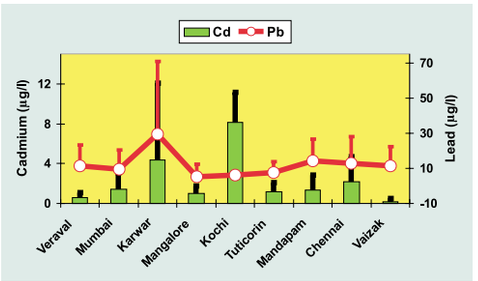
- Water temperature ranged from 22.5-32.5ºC on the west coast and 25.8-36.3ºC on the east coast.
- Salinity ranged from 8.5-37.3 ppt in the west coast while it was 21.4-38.0 ppt in the east coast.
- Dissolved Oxygen content ranged from 1.88 – 6.9 ml/l in the west while it was 1.4 – 7.3 ml/l in the east coast.
- pH ranged from 7.1 – 8.5 for both the coasts without much variations.
- Nitrate and Phosphate levels ranged from 0.03 – 14.7 and 0.3-4.0 µg at/l in the west coast and 0.002-18.5 and 0.02-5.77 µg at/l along the east coast respectively.
- The value of Silicate ranged from 0.68 – 87.2 µg at/l in the west coast and 0.25 – 18.5 µg at/l in the east coast.
- The gross primary production ranged from 150 – 1359 mgC/m^3/day in the west coast when compared to 84 – 4706 mgC/ m^3/day in the east coast.
- Biomass of zooplankton recorded was 1.1 – 33.0 ml/100m^3 in the west coast while the range in the biomass of the east coast was 0.2 – 40.0 ml/100 m^3.

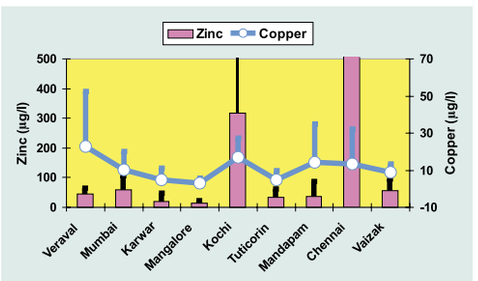
Hydrobiological properties studied from the inshore waters

Centres	Tem. (ºC)	Salinity ppt	DO ml/l	pH	NO_2 µg at/l	NO_3 µg at/l	PO_4 µg at/l	SiO_3 µg at/l	GPP (mg C/m^3/ day	NPP (mg C/m^3/ day)	Chl *a* mg/m^3	Zoopl. Biomass ($ml/100m^3$)	Rainfall (mm)
Cochin	26.1-30.0	11.5 – 34.8	3.1-4.6	-	0.36-1.10	0.03-1.07	0.3-3.5	-	685- 1359	548- 1087	0.25-2.45	1.1- 33.0	-
Calicut	22.8-30.2	29.8 – 35.5	2.4-4.7	7.3-7.9	0.04-1.06	0.15-4.40	0.12-1.63	-	309- 1158	-	-	-	-
Mangalore	23.0-31.3	19.7-35.0	2.2-4.6	7.7-8.4	0.14-2.91	0.17-14.7	0.22-1.40	4.5-87.2	-	-	0.14-2.01	4.3- 8.7	3333
Karwar	24.7-30.7	8.5-36.7	1.8-4.5	-	-	-	-	-	257- 1031	-	-	2.6- 13.5	149-1030
Mumbai	22.5-32.5	24.7-36.5	1.9-3.8	7.5-8.2	-	-	-	-	-	-	0.01-2.01	1.5- 15.4	-
Minicoy	26.3-29.5	32.01-34.59	2.9-4.9	-	0.46-2.58	0.66-2.85	0.88-4.0	0.69-4.10	230 - 560	120- 460	-	-	43 - 242
Veraval	27.0-32.0	34.0 - 37.3	2.5 - 6.9	7.4-9.2	-	-	-	-	150 - 330	-	-	-	-
Tuticorin	26.0 36.3	26.5-36.2	1.8-6.1	7.1-8.4	0.41-5.77	0.03-18.5	0.41-5.77	0.33-18.5	84 - 4706	-	-	0.2- 40.0	-
Mandapam	25.8-32.6	21.4-34.8	2.2-5.3	7.5-8.5	-	-	-	-	137- 1332	221- 949	-	1.0 - 5.8	-
Chennai	27.0-30.0	28.0-38.0	1.4-6.7	6.4-8.0	-	0.8-2.5	0.8 – 2.0	-	212- 1319	67- 768	-	-	-
Visakha-patnam	26.0-29.7	24.0-36.3	5.1-7.3	-	0.001-1.7	0.002-0.014	0.02-0.70	0.25-1.78	-	-	0.33-4.01	-	-

PROJECT CODE	**FEM/02**
PROJECT TITLE	**Monitoring the state of health of the sea**
SCIENTISTS	**P.K. Krishnakumar,** Rani Mary George, P. Kaladharan, D. Prema, J.P. George, K. Vijayakumaran, V.V. Singh, S. Jasmine, D.C.V. Easterson, P.S. Asha and Bindu Sulochanan
CENTRES	Veraval, Mumbai, Karwar, Mangalore, Cochin, Tuticorin, Mandapam, Chennai, Visakhapatnam.

From each centre, seawater samples for heavy metal analysis were collected from a relatively clean site (reference) and a relatively contaminated site (*hot spot*). Heavy metal concentration in marine organisms was measured using AAS at Cochin and the concentration in seawater was measured using anode stripping voltametric technique (VA 757, Metrohm) at Mangalore.





- Mean Cadmium concentration in seawater samples collected from the west coast of India was 2.95 mg/l, and from the east coast it was 1.53 mg/l. Mean Lead concentration in the samples from the west coast it was 12.35 mg/l, and from the east coast it was 12.47 mg/l. Mean Copper concentration in samples from the west coast it was 9.11 mg/l, and from the east coast it was 12.27 mg/l. Mean Zinc concentration in the samples from the west coast it was 74.83 mg/l, while in samples from the east coast it was 792.3 mg/l.
- Highest concentration of Cadmium was observed in the seawater samples collected from Cochin (8.14 mg/l) followed by Karwar (4.33 mg/l) and Chennai (2.16 mg/l). Lowest concentration of Cadmium was observed in the seawater samples collected from Visakhapatnam (0.13 mg/l) followed by Veraval (0.58 mg/l).
- Highest concentration of lead was observed in the seawater samples from Karwar (29.5 mg/l) followed by Mandapam (14.24 mg/l) and Chennai (12.71 mg/l). Lowest concentration of Lead was observed in the seawater samples from Mangalore (5.20 mg/l) followed by Cochin (5.94 mg/l).
- Highest concentration of Copper was observed in the seawater samples from Veraval (23.02 mg/l) followed by Cochin (17.14 mg/l) and Mandapam (14.4 mg/l). Lowest concentration of Copper was observed in the seawater samples from Mangalore (3.03 mg/l) followed by Karwar (4.81 mg/l). Highest concentration of Zinc was observed in the seawater samples from Chennai (1893 mg/l) followed by Cochin (317.9 mg/l) and Mumbai (60.1 mg/l). Lowest concentration of Zinc was observed in the seawater samples from Mangalore (12.8 mg/l) followed by Karwar (20.9 mg/l).
- By analyzing the pooled data for all the centres, significant negative correlations were observed between primary productivity and concentration of metals such as Cd, Pb, Cu and Zn in seawater. Multivariate techniques were used to evaluate the among-site patterns in overall metal distribution in seawater collected from six sites. Seawater from Chennai and Cochin were found to be having similar metal levels (cluster 1) followed by the seawater samples from Mandapam, Veraval, Visakhapatnam and Mumbai (cluster 2) and Tuticorin, Karwar and Mangalore were forming different clusters (clusters 3, 4 & 5).
- Generally, the mean metal concentration observed from Indian coastal waters was within the safe level given for marine organisms, except for Zinc from east coast.

Seawater analysis with voltametric analyser

PROJECT CODE	**FEM/03**
PROJECT TITLE	**Resource assessment of seaweeds and their culture**
SCIENTISTS	**N. Kaliaperumal**, P. Kaladharan, Reeta Jayasankar and Gulshad Mohamed
CENTRES	Mandapam, Cochin, Calicut

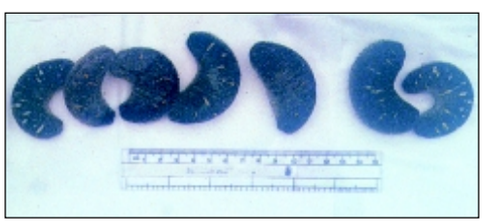
- Data on the quantity of seaweeds exploited from the natural beds were collected from 10 seaweed landing centres in Tamil Nadu. Total landings were 2821 tonnes (dry weight) constituting 1798 tonnes of Alginophytes (1537 tonnes of *Sargassum* spp.; 261 tonnes of *Turbinaria* spp.) and 1023 tonnes of Agarophytes (579 tonnes of *Gelidiella acerosa* ; 444 tonnes of *Gracilaria edulis*).
- Outdoor culture of *Gracilaria edulis* was carried out in FRP tanks after pretreating the seed material for 12 hours at different concentrations of fertilizers namely Potash, Ammonium chloride and Calcium nitrate. Maximum growth (66%) was obtained in the plant treated with 30 mg/l of Potash during 39 days of culture period.
- DNA extraction and genetic diversity of *Gracilaria verrucosa* collected from Chennai, Quilon and Chilka were carried out using two different primers OPA02 and OPA13. Marked genetic variation was observed in all the samples.
- Brackishwater red algal species from Kerala coast was identified as *Gracilariopsis lenaeneiformis* (Bony) Dawson. Peak growth in this species was recorded during December-January. Biomass ranged from 300 to 1200 g/m^2 and agar yield was 22%.
- Experimental field cultivation of *Kappaphycus alvarezii*, *Gracilaria corticata* and *G.foliifera* was carried out in the intertidal area of Elathur (Calicut) by vegetative propagation method using longline coir ropes. Five fold increase in 48 days of culture period during February and March was found in *K. alvarezii*. Four fold increase in 43 days during October and November was found in *G.corticata* and four fold increase in production after 51 days of culture period during December and January for *G.foliifera*.

Gracilariopsis lenaeneiformis - a new record of brackishwater red algae from Kerala

PROJECT CODE	**FEM/04**
PROJECT TITLE	**Development of strategies for sea turtle and sea cucumber conservation**
SCIENTISTS	**M. Rajagopalan**, S. Krishna Pillai, K. Vijayakumaran and P.S. Asha
CENTRES	Cochin, Vizhinjam, Visakhapatnam, Tuticorin

The annual phenomena of the occurrence of mass nesting of olive ridley *Lepidochelys olivacea* along the north Orissa coast was monitored. Compared to the occurrence of 7.0 and 7.4 lakhs of olive ridley nested during 2000 and 2001, mass nesting was a failure during 2002 along the Indian coast. With regard to incidental mortality of sea turtles, a total of 10,000 dead turtles were estimated during 2002 season along the coastal Districts of Balasore, Cuttack, Puri and Ganjam of Orissa when compared to a total of 12,000 dead turtles during 2001.

- The preliminary experiments showed that *H.scabra* juveniles of less than 0.7 mm size were not sturdy and susceptible to high mortalities.
- The *H.scabra* juveniles of mean length 6.5 mm fed with *Sargassum* powder filtered through 40µ sieve attained 15 mm in 7 days.



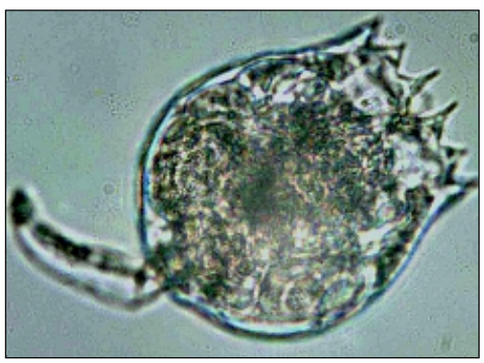
Hatchery produced six months old juveniles of *Holothuria scabra*

*Under sea cucumber conservation strategy, 10,000 juveniles of **Holothuria scabra** of mean length 3mm produced from Tuticorin hatchery were sea ranched in the sea grass beds of Van Island, Tuticorin at a depth of 7m during April 2002.*

- The *H.scabra* juveniles less than 20 mm required *Sargassum* alone as feed and mortality occurred when fed with *Sargassum* and mud.
- The *H.scabra* juveniles above 20mm survived when fed with *Sargassum* and mud and when grown from the mean length of 6.8 mm and weight of 1.2 gm to 55.4 mm and 31.0gm over a period of 90 days exhibited weight increment of 0.26 gm per day.
- In culture systems the *H.scabra* juveniles of mean length 56 mm and weight 8.29g attained 77 mm and 19.7 g in 48 days when reared with 10% of body weight of *Sargassum* powder.
- In cage culture experiments to find out the effect of 3 different substrata on the growth of *H.scabra* juveniles, increase in growth rate of juveniles was observed in the prawn farm soil.
- In the culture experiments conducted in concrete tanks, the *H.scabra* juveniles of mean weight 43.3 g grown to 98.43 gm in four months exhibited a growth rate of 0.46 g/day.
- Four lakhs of auricularia were produced in the induced spawning experiment conducted in March 2003 and showed fast growth at 32 ℃.

PROJECT CODE **FEM/05**
PROJECT TITLE **Mariculture of live feed organisms**
SCIENTISTS **Rani Mary George,** Reeta Jayasankar, Molly Varghese, Gulshad Mohamed
CENTRES Chennai, Cochin, Calicut, Tuticorin, Mandapam

- Culture of 12 species of microalgae at Tuticorin and Cochin, five species at Chennai, four species at Calicut and 5 species at Mandapam were maintained by repeated subculturing method.
- Stock culture of rotifer (*Brachionus* sp.), Cladocerans (*Moina micrura and Ceriodaphnia cornuta)* have been carried out by feeding suitable microalgae. Small strains of *Brachionus rotundiformis* were isolated from Cochin backwater and maintained. Stock of *Artemia* strains from California and Vietnam were also maintained at Mandapam.
- Mass culture of *Isochrysis galbana* was carried out and supplied to Molluscan, Crustacean and Holothuria hatcheries at Tuticorin. Mass culture of *Chlorella, Tetraselmis* and photosynthetic bacteria were carried out at Mandapam and supplied as feed for Rotifer, *Artemia* and *Moina*.
- Phyto and zooplankton were supplied as feed for larval stages of shellfish; larvae, juvenile and adult of finfishes (Groupers, Sea horse and other ornamental fishes) at Mandapam.
- Large scale production of resting eggs of rotifers through environmental manipulation are in progress at Mandapam.
- Culture of microalgae are sold to different hatcheries and a revenue of Rs.9,950/- and Rs.18,250/- were generated from Tuticorin and Cochin, respectively.
- Experimental culture of *Chlorella* and *Nannochloropsis* in different concentration of Sodium bicarbonate showed improvement in growth and protein content.

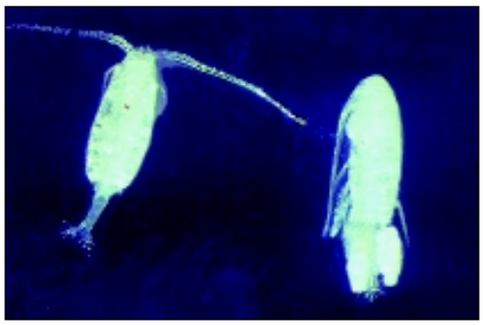


Small rotifer used as feed for grouper larvae

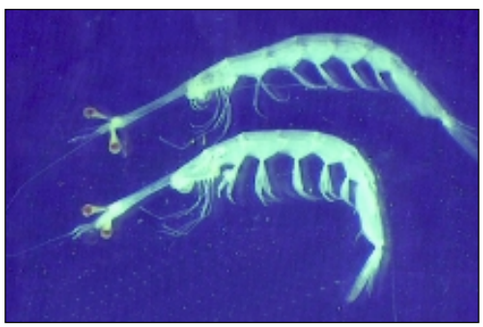
PROJECT CODE	**FEM/BIOD/01**
PROJECT TITLE	**Taxonomy of marine zooplankton**
SCIENTISTS	**T.S.Naomi**, Rani Mary George and S.Jasmine
CENTRES	Chennai, Cochin and Karwar

The taxonomic status, validity, synonyms, nomenclature, descriptions, illustrations, spatial distributions and other related aspects of the species, genera and family of selected groups were being carried out with the objective of creating taxonomy monographs on marine zooplankton from the Indian EEZ for research workers in the country. Two families were chosen namely, the Calanoid copepod family Pseudodiaptomidae under the super family Centropagoidea and the Decapod family Sergestidae of the non-penaeid pelagic shrimps.

- Initially the format of data entry was planned highlighting classification, geographical location, environment, salient features of morphological and diagnostic characteristics, sex attributes, descriptive characters, size composition and distribution of each species.
- Out of the twenty-four species of the predominantly warm neritic family Pseudodiaptomidae of the Indian Ocean, eighteen occur in the coastal waters and the Andaman-Nicobar Island system. *Pseudodiaptomus annandalei* enjoys the most wider distribution in the coastal waters around India followed by *P.serricaudatus* and *P. aurivillii;* the latter two are very common in the Andaman – Nicobar Island system.
- Photomicrographs of the most common species of *P.annandalei* and *P. serricaudatus* were taken in fresh condition from the 10 m depth zone off Cochin. *P. aurivillii, P. mertoni P.annandalei, P.tollingerae, P.binghami malayalus, P.serricaudatus* and *P.jonesi* are reported from the shallow areas of the sea off Cochin.
- Four species of *Lucifer* are reported in the Indian waters, namely, *Lucifer hanseni, L. typus L. penicillifer* and *L. chacei* .
- Collected literature on the taxonomic details of Pseudodiaptomidae and the genus *Lucifer* (Sergestidae).



Pseudodiaptomus annandalei a widely distributed copepod in Indian waters



Lucifer penincillifer belonging to the family Sergestidae

PHYSIOLOGY NUTRITION PATHOLOGY DIVISION

The Division implemented six in-house projects, five sponsored projects and three NATP projects in the frontier areas of nutrition, pathology, physiology, genetics and biotechnology. The Division also actively collaborated in the NATP sponsored - IVLP and ATIC and pearl culture projects. Besides, the scientists of the Division were actively involved in the M.F.Sc and Ph. D programmes of PGPM. The scientists of the Division published 7 Research papers in peer reviewed journals; 4 papers have been accepted for publication in International journals. The scientists also made 16 presentations in symposia and conferences during the year.

The major achievements of the Division during the year were:

- Development of a Duplex PCR Assay of White Spot Syndrome Virus (WSSV) which is cost-effective, faster and reliable compared to the nested PCR kits which are currently in use.
- A break-through in development of a formulated pellet feed for mud crab fattening for the first time.
- Development of an ornamental fish feed enriched with fermented oilcake.
- Organization of a TTC sponsored training programme on Fish and Shellfish Diseases and their Management' from 23rd September to 1st of October 2002.
- Organization of 21 day Winter School on ' Recent Advances in Diagnosis and Management of Diseases in Mariculture' sponsored by the Education Division of ICAR.
- Organization of the First National Conference on Aquaculture Nutrition from 12-14 March 2003 sponsored by the NATP Sub-Project Nutrition and Pathology in Mariculture.
- Four scientists of the Division attended the meetings on formation of networks on fish nutrition, health management, biotechnology and molecular biology.

PROJECT CODE	**PNP/NUT/01**
PROJECT TITLE	**Development of cost-effective and eco-friendly feeds for cultivable marine crustaceans and finfish by biotechnological interventions**
SCIENTISTS	**R. Paul Raj,** D.C.V.Easterson, D.Kandasami, P.Vijayagopal, Imelda Joseph, Margaret Muthu Rethinam,and Preetha Panikkar
CENTRES	Kochi, Madras, Tuticorin, Mandapam and Calicut

Fermented soybean flour as fishmeal substitute in the diet of *Penaeus monodon* post larvae:

- One experiment (50 days) was conducted in *Penaeus monodon* juveniles to study the performance of 5 test diets incorporated with fermented soybean flour at levels 5, 10,15,20 and 25 as fish meal replacement and one control. The diets containing 35% CP, were fed to 18 groups of juveniles (each of the diet to three groups, n=20 for each group) of *Penaeus monodon* of average weight 0.1± 0.06g. The shrimp were fed @ 12% of body weight per day.

- Growth (weight gain 1.14± 0.3g) showed significant differences between treatments (P<0.01). Shrimps fed the 10% fishmeal replacement diet grew faster and longer than those in other treatments and the control. Protein efficiency ratio (PER) and food conversion ratio (FCR) did not differ significantly among the treatments. The results demonstrated that up to 15% fishmeal could be replaced by fermented soybean flour in the diet of juveniles of *Penaeus monodon* diet, without affecting growth and feed efficiency though 10% inclusion gave better performance than the control diet. It was observed that no mortality occurred in any of the treatments or in the control during the experimental period, which proves that the feeds as well as the experiment conditions as satisfactory for the shrimp.

Fermented oilcakes as fishmeal substitute

- Eight pelleted diets (FI to FVIII) were prepared by incorporating varying levels of bacterial *(Bacillus coagulans)* and fungal (*Aspergillus niger* strain 616) fermented products by replacing equal proportions of fishmeal based control diet. The feeding trial was conducted in *Penaeus monodon* postlarvae (mean wt 32. ± 0.06 mg) in 20 ppt salinity at a stocking density of 10 animals per tank (50 L round Perspex tank with lid) with three replicates for each treatment. The shrimp were fed with the diets twice daily at 0930 h and 1600 h at a feeding rate of 15% body weight per day. The results showed that fishmeal could be replaced in the diet of postlarval *P. monodon* upto 100% with bacterial and 43% with fungal fermented products with 100% survival and better growth performance.

Bioenriched ornamental fish feed

- A bioenriched pellet feed (35% protein) has been developed for ornamental fish using locally available ingredients and a fermented product derived by solid-state fermentation process with a food grade bacterium.
- The process enhances bioavailability of nutrients as well as growth and survival of the fish.
- Twin-screw extrusion technology improves the texture, digestibility, stability and shelf life of the feed because of reduced microbial load.
- Feed size ranging from 1 mm to 3 mm can be produced to suit the different growing stages and species.
- The feed has been released and marketed through the Agriculture Technology Information Centre, CMFRI for the use of aquarium keepers, aquarists and farmers and the feed back received is highly encouraging.
- The feed is available in quantities ranging from 50 g and 200 g. Special packing of 500 g, 1 kg and 2 kg are also available as per requirement of the buyer.

The feed is targeted for domestic and commercial aquarium keepers and ornamental fish farmers and breeders.

Bioenriched ornamental fish pellet feed prepared using twin-screw extrusion technology

PROJECT CODE	**PNP/PAT/01**
PROJECT TITLE	**Disease monitoring and management in mariculture**
SCIENTISTS	**A.P.Lipton,** K.C.George, K.S.Sobhana, N.K.Sanil, Chandrakant Pandit, S.R.Krupesha sharma, Margaret Muthu Rethinam
CENTRES	Madras, Kochi, Vizhinjam, Visakapatnam and Calicut

Finfish

- Bacterial infections with symptoms such as haemorrhages on body surface, erythemia and fin and tail erosions were recorded in 371 cases.
- Among the ornamentals, *Chaetodon* sp, was found to be highly susceptible as this species was the largest group with 21.3% mortality. This was followed by the damsels (10.5%), marble fish (9.7%), parrot fish (6.5%) and clown fish and goatfish (with 4.8% mortality for each species, respectively). The maximum mortality occurred during February 2003 (80 cases) followed by March 2003 with 72 cases. The microbial load ranged between $6.8X10^3$ and $3.15X10^5$ CFU/ml of water.
- In Calicut, aquarium fishes had infestation of the anchor worm, *Lernaea* in carp and gold fishes. Fin rot of the caudal fins was noted in Trigger fishes and *Vibrio* sp. was isolated from the lesion. Unilateral pop eye was observed in Koran angel, which was due to injury. Severe infestation of the lion fishes with A*rgulus* sp., the fish lice was noticed which was successfully treated with oragnophosphorous compounds.
- During April to December 2002, collections were made from various farms in Vypeen and adjoining areas. Examination of the collected fishes revealed parasitic infections caused by metacercarcial larval stages, *Caligus* sp., *Myxobolus* and peritrich ciliates, mainly *Zoothamnium*. Tissues infected with myxosporean were being processed for electron microscopic studies.

Crustaceans

- In a shrimp farm, minor tail (telson) erosion problem was noticed after 90 days of culture which coincided with the phytoplankton crash. In the second crop period, bacterial infection was noted after 27 days of culture with antenna cut among 2.0% of the samples. Similar infection to the tune of about 40% of the stock after 75 days of culture. The infections subsided after application of Benzalkonium Chloride (BKC).
- The microbial load was high in the rearing water as well as in the feed (ranging from $5x10^4$ and $7x10^4$ as well as $9.0x10^3$ and $1.2x10^4$ respectively) during the infection period. Using standard biochemical procedures, the causative bacteria was identified as *Vibrio alginolyticus*.
- A total of 29 lobsters (*P. homarus*) were examined for tail rot disease. Among them 7 were brooders, 10 were large animals (1.5 kg and above) and 12 were small animal (below 1 kg). Total 33% of the lobsters were affected by tail rot disease in the laboratory condition. 28.6 % of the brooders, 40 % big animals and 33 % small animals were affected. Eggs were also sometime discarded due to infection

Lysozyme activity in mussel

*Lysozyme activity pattern in the green mussel, **Perna viridis** was studied in different organs in order to know the anatomical distribution of the enzyme in the mussel. Crystalline style was found to contain highest activity of the enzyme followed by digestive gland, gills and mantle. Least activity was found in the hemolymph and adductor mussel. The study emphasised potential commercial exploitation of the enzyme for the use in pharmaceutical industry.*

*Lysosomal activity in **Perna viridis** was studied after exposing the mussels to copper and mercury at 25 µg/litre for one and two weeks. Lysozymal activity was highest in copper exposed mussels than in mercury-exposed mussels.*

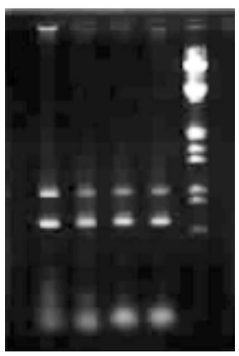
of *Vibrio parahaemolyticus.* Antibiotic assay of *V. parahaemolyticus* isolated from the diseased animal were done. They were found sensitive against oxytetracyclin and penicillin G. Eighty five percent of the *Vibrios* in lobster hatchery were *Vibrio harveyi.*

- Mortality in *Penaeus indicus* having erosions on the carapace was diagnosed as brown rust and the causative agent *Vibrio alginolyticus* was isolated and identified from the moribund specimens.

PROJECT CODE	**PNP/BIOT/01**
PROJECT TITLE	**Development of molecular and immunodiagnostic kits for marine finfish and shellfish pathogens**
SCIENTISTS	**P.C.Thomas,** K.C.George, K.S.Sobhana, N.K.Sanil, Chandrakant Pandit Rao
CENTRES	Kochi and Visakapatnam

Development of cost-effective Duplex assay based PCR kits for detection of White Spot Syndrome virus

- Developed duplex assay based PCR technique which is cost effective and fast compared to the nested PCR for detection of WSSV have been developed wherein PCR screening of different segments of the viral genome can be carried out simultaneously.
- The protocol for duplex PCR was standardized. Template DNA preparation which is quick, simple and inexpensive, is by simple boiling after homogenization of the tissues in a homogenizing solution. Removal of the heat denatured proteins and other cellular debris is through centrifugal sedimentation, and 300-400 nanogram DNA extracts consisting of both viral and host tissue is used for amplification in a 30-cycle programme.
- Detection of the presence of virus in the sample by 1.5% agarose gel electrophoresis of the PCR products. Presence of virus is indicated by two bands of 0.9 kb and 0.6 kb resolved in the gel .



Resolution of WSSV in agarose gel electrophoresis (lane 1 and 4)

Isolation and characterization of bacterial pathogens of finfish/ shellfish

- Eleven isolates of *Aeromonas* and 14 isolates of *Vibrios* have been collected from diseased shrimps, crabs, groupers and pearl spot from coastal aquaculture systems and they are at various stages of characterization based on biochemical tests.

Pathogenecity evaluation

- A highly virulent strain of *Vibrio parahaemolyticus* isolated from haemolymph of *P. indicus* was tested for pathogenecity by challenge experiments. While there was 100% mortality in the 10^7 and 10^8 cells/ animal dosages on the second day itself, there was no mortality in the lower dosages (10^3, 10^4, 10^5 and 10^6 cells/animal) even after one week.
- The minimum lethal dose of the tested *Vibrio parahaemolyticus* strain in juveniles of *P.indicus* is 10^7 cells/animal.
- Processing of *Aeromonas hydrophila* cells were carried out for the ultra-structure study using electron microscope.

Raising of polyclonal antisera for immunodiagnosis

- Formalin killed *Vibrio parahaemolyticus* has been injected in rabbits followed by sera collection for raising polyclonal antiserum to be used in the agglutination test.

Economical PCR kit developed for WSSV detection

PCR kit based on the duplex assay has been made and released after trials.

Successful detection of WSSV using the same has been demonstrated to the prospective users.

Practical training on the use of the kit have been imparted to the technical / scientific personnels from different parts of the country.

Diagnostic service to the hatcheries and shrimp farmers using the kit is currently being provided. Sale of the kit on a trial basis has also been initiated.

The cost of the kit is about 30% cheaper than the other WSSV-PCR kits.

PROJECT CODE	**PNP/BIOT/02**
PROJECT TITLE	**Cryopreservation of marine fish spermatozoa**
SCIENTISTS	**D.Noble,** L. Krishnan and Grace Mathew
CENTRES	Kochi

- Investigations on ultra-structure of untreated spermatozoa, percentage of live and dead spermatozoa and the ultrastructural changes due to cryoprotectants in mullet *Liza parsia* have been made.
- The percentage of live spermatozoa in raw milt of *L. parsia* was estimated to be 90. The sperms were uniformly shaped with intact plasma membrane when DMSO was used as cryoprotectant at concentration of 7.5%. On cryopreservation and subsequent thawing 56.4% of the spermatozoa were found to be injured.
- About 80% of the spermatozoa exhibited near normal structure on dilution with 10% DMSO, but 62% of spermatozoa were completely deformed, on exposure to 12.5% DMSO. When DMSO alone was used as cryoprotectant, 10% appeared to be the optimum concentration.
- Mitochondria and plasma membrane were intact in almost 86% of the spermatozoa when DMSO and glycerol was employed as cryoprotectant. A combination of 5% DMSO and 5% glycerol in V2E extender accorded better protection than 10% DMSO alone. Combining with glycerol can minimize the toxic effects of high concentrations of DMSO.

PROJECT CODE	**PNP/PHY/01**
PROJECT TITLE	**Development of cost effective low-stress methods for live transport of fish and crustaceans**
SCIENTISTS	**R.Paul Raj,** D.Noble,G.Gopakumar, D.C.V. Easterson and Imelda Joseph
CENTRES	Kochi, Madras, Vizhinjam and Tuticorin

- Seven experiments were conducted on the transportation of the fish sergeant major *Abdefduf vaigensis (*Family: Pomacentridae), which is one of the popular marine aquarium fishes. In the first two experiments in which individual live fish (total length 7.8 to 11.5 cm) were packed in polythene bags of 7.5 l capacity filled with filtered sea water and air/oxygen in the ratio 1:3 at 28°C with an initial DO content of 4.36 ml/l, the fish survived in the bag upto 94 h with a final oxygen concentration of 1.98 ml/l. In the third experiment, 2 specimens (total length 11 cm and 8 cm) were introduced into each bag. The fish survived upto 45 h. The dissolved oxygen levels declined from 3.77 ml/l to 0.
- Ornamental fishes from Minicoy were transported to Vizhinjam Centre in plastic bins of 50 l capacity under continuous aeration with 2-3 pieces of live rocks of branched coral skeletons in each bin. 100% survival obtained after 33 h of boat, ship, rail and road transport. One very significant observation was that the branched coral skeletons may have acted as water conditioner to maintain water quality besides providing shelter to fishes.
- With a view to identifying suitable sedatives for transportation of grouper *Epinephelus tauvina, E.malbaricus*, methane tricainesulphate

(MS222) concentration 200-300mg/l and clove oil (50-200 ppm) were tested. Clove oil gave promising results. An exposure time of 3 min in seawater containing 100 ppm clove oil appears to be the optimum sedative dose for fish of 500 g weight.

- The optimum temperature range for grouper transportation is found to be 15-20°C which can be maintained beyond 18 h by placing 3 gel ice sachets and 3 frozen brine bottles in the thermocol box. Groupers (2 Nos.@700g) could remain alive and active on unpacking. The salinity of water was 35 ppt.

  During the experiment ammonia level showed an increase from 0.089 mg/l at 0 h to 3.85 mg/l at 12 h and 4.79 mg/l at 18 h; dissolved oxygen showed a sharp decline from 4.28 mg/l at 0 h to1.50 ml/l at 12h; temperature of the water did not show any significant change upto 12 h (17^0 C) from that of initial (15^0 C) but showed a sharp increase at 18 h (24^0 C).

Mud crab

- Harvested crabs *Scylla serrata* of 60mm size were found to survive upto 8 days in room temperature kept individually in the wicker baskets. In a tank with wet sandy bottom, the crabs survived for 12 days when starved. When kept in captivity under regular feeding, the left-overs spoiled the water and the crabs died with in 6 days.

PROJECT CODE	**PNP/GEN/01**
PROJECT TITLE	**Population genetic studies in threadfin breams and sardines**
SCIENTISTS	**P. Jayasankar** and U. Rajkumar
CENTRES	Kochi and Visakhapatnam

Truss Net Work analysis

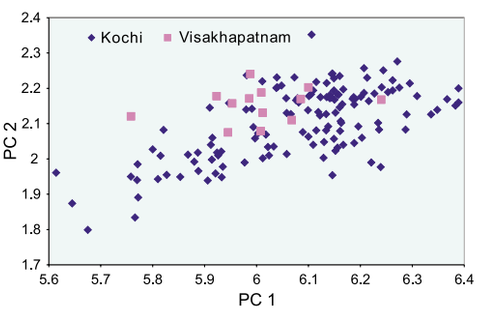
Truss landmarks of a total of 141 *Sardinella longiceps* from Kochi in the length range 140-197 mm and 39 from Visakhapatnam in the length range of 140-195 mm were collected during September, 2002 – March, 2003. Truss landmarks of a total of 60 *Nemipterus japonicus* (160-205 mm TL) and 41 *N. mesoprion* (140-200 mm TL) from Kochi, and those of 116 specimens of *N. japonicus* (148-173 mm TL) and 40 specimens of *N. mesoprion* (143-186 mm) from Visakhapatnam were collected during August 2002 – March 2003.

Separation of clusters is not apparent in oil sardine from Kochi and Visakhapatnam. However, with the strengthening of sample size from the east coast, a clearer picture of population difference in oil sardine based on truss morphometry could be obtained.

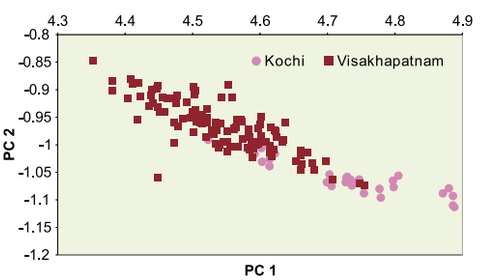
The present results unambiguously indicate that samples of *N. japonicus* from Kochi and Visakhapatnam are separated based on body shape difference. The results indicate that the samples of *N. mesoprion* from Kochi and Visakhapatnam are phenotypically homogenous.

Protein polymorphism

Protein profiles were studied in threadfin breams, *Nemipterus japonicus* (n=9) and *N. mesoprion* (n=9) and oil sardine after standardization of the protocol.Generation of protein profiles of more numbers of these species from different locations for genetic analysis is progressing.



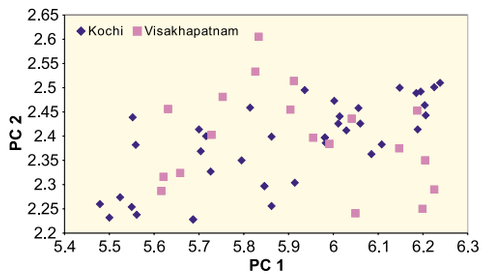
Sheared principal component analysis of truss landmarks in oil sardine showing relatively homogenous nature of Kochi and Visakhapatnam samples



Sheared principal component analysis of truss landmarks in *N. japonicus* showing clear phenotypic separation of Kochi and Visakhapatnam samples

Genetic information from RAPD fingerprinting on the two species of threadfin breams sampled during 2002-2003.

Species	Sample size		Genetic distance between Kochi & Visak	% polymorphism		Gene diversity	
	Kochi	Visak		Kochi	Visak	Kochi	Visak
N. japonicus	18	16	0.8757	72	48	0.22	0.19
N. mesoprion	17	15	0.8409	73	50	0.29	0.19



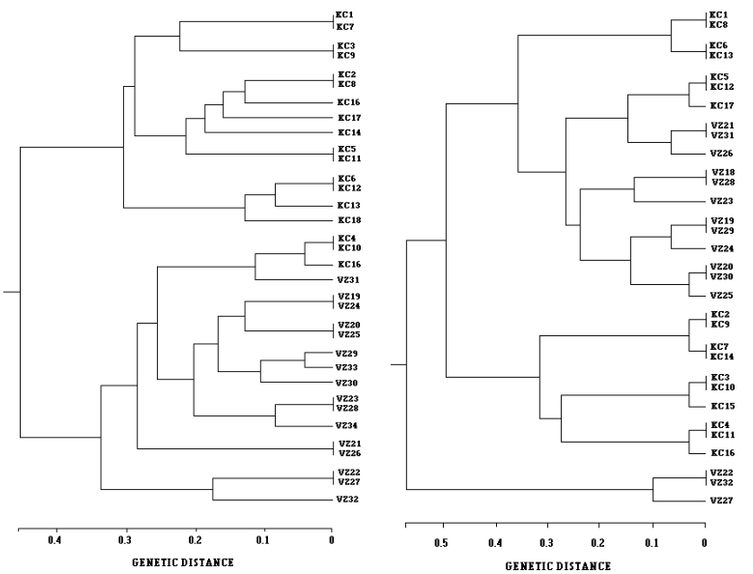
Sheared PCA of truss landmarks in *N. mesoprion* showing phenotypically homogenous nature of Kochi and Visakhapatnam samples

RAPD polymorphisms

Samples were drawn from Visakhapatnam and Kochi for genetic analysis. Total genomic DNA was extracted from muscle using the standard phenol-chloroform method from a total of 66 threadfin breams, *Nemipterus japonicus* (n=34) and *N. mesoprion* (n=32) and RAPD fingerprinting was done. Several arbitrary primers from kits A and F of Operon Inc were screened in order to determine (a) amplification and (b) level of polymorphisms; based on these results, primers OPA 05, OPA 08, OPF 02 and OPF 03 were selected for further analysis, and they had generated 25 and 30 scorable loci in *N. japonicus* and *N. mesoprion*, respectively. Phylogenetic relationships between individuals of threadfin breams were constructed using cluster analysis (UPGMA, PHYLIP ver 3.57c).

The dendrograms show that in *N. japonicus*, almost two distinct region-specific major clusters are formed, thereby indicating the population distinctness of the locations in question.

Unlike *N. japonicus*, in *N. mesoprion*, the region-specific clusters are not clear, which could be indicative of free intermixing of populations. Greater genetic polymorphism was exhibited by both species at Kochi. Genetic distance of *N. japonicus* was relatively more between the locations.



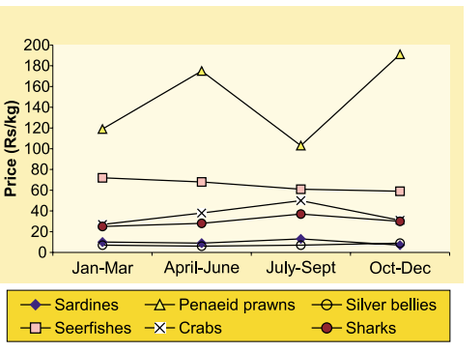
UPGMA dendrogram of different individuals of *N. japonicus* (left) and *N. mesoprion* (right) from Kochi (KC) and Visakhapatnam (VZ)

SOCIO-ECONOMIC EVALUATION AND TECHNOLOGY TRANSFER DIVISION

- The division has undertaken 9 research projects - 4 in house, 4 NATP and one funded by the Ministry of Environment and Forests (MoEF) for the year 2002-2003. The efficiency of marine fish marketing system in India was worked out by estimating the price spread of commercially important varieties. The productivity and profitability of different marine fishing operations were also assessed on the basis of key economic indicators. The economic loss due to juvenile fishing was also estimated using an econometric model.
- The major Indigenous Technical Knowledge (ITK) prevalent in marine fisheries sector from Kerala, Karnataka, Tamil Nadu and Andhra Pradesh were identified and documented. Under the Institution-Village-Linkage-Programme (IVLP), 32 techno-interventions pertaining to Fisheries, Agriculture and Animal Husbandry were implemented in Elamkunnapuzha village, covering 726 families.
- The Agricultural Technology Information Centre (ATIC) was commissioned and introduced a single window delivery system for all the technological inputs, products and services. The FAO Code of Conduct for Responsible Fisheries was translated to Malayalam and an animation film on prevention of juvenile fishing was developed and released.
- Two "fishermen-farmers-industry- institution meets", two training programmes, one each at Kannur and Panambukadu, the KisanDiwas at Njarakkal and three exhibitions at Thrissur, Muttom and Narakkal were co-ordinated by the Division.

PROJECT CODE	**SEE/PMS/01**
PROJECT TITLE	**Marketing and price structure of marine fisheries in India**
SCIENTISTS	**R. Sathiadhas,** R. Narayanakumar and N.Aswathy
CENTRES	All regional and research centres of CMFRI

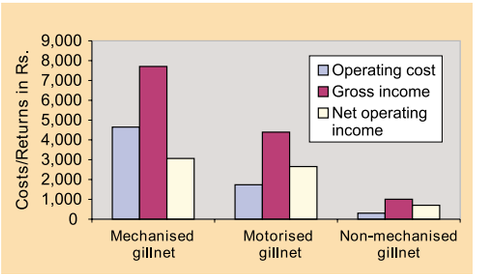
- The annual average price for different species of marine fish was worked out at landing centre, wholesale and retail level for all maritime states.
- At landing centres, the average fish price varied from Rs.5/kg for oil sardines in Gujarat to Rs.450/kg for lobsters in Tamil Nadu.
- At wholesale level, the fish price varied from Rs.6/kg for oil sardines in Gujarat to Rs. 625/kg for lobsters in Tamil Nadu.
- At retail level the price varied from Rs.8/kg for oil sardines in Gujarat to Rs.850/kg for lobsters in Tamil Nadu.
- The price was comparatively low in Andhra Pradesh for almost all species of fish, varying from Rs.7/kg for silverbellies, oil sardines and Bombay duck to Rs.46/kg for pomfrets.
- Oil sardines received the minimum price and the price realised at landing centre was minimum in Gujarat (Rs.5/kg) and maximum in Maharashtra (Rs.15/ kg). At wholesale level the price was least in Gujarat (Rs. 6/kg) and highest in Maharashtra (Rs.20/ kg) and at retail level the minimum price was Rs.8/kg in Gujarat and maximum (Rs.21/ kg) in Maharashtra.



Seasonal price fluctuations at first sales

PROJECT CODE SEE/ECO/01
PROJECT TITLE **Economics of marine fishing operations**
SCIENTISTS **R. Narayanakumar,** R. Sathiadhas and Aswathy, N.
CENTRES All regional and research centres of CMFRI

- The annual operating costs and returns for various craft-gear combinations were worked out for the year 2002 for all maritime states and at all India level.
- The capital productivity analysis indicated that, in the mechanized sector for trawlers, the operating ratio ranged from 0.49 for single day trawling to 0.68 for multi-day trawling and for gill-netters the operating ratio varied from 0.60 for single day trip to 0.55 for multi-day trip.
- In the motorised sector, the operating ratio for gill-netter worked out to 0.39 and for Hooks & Lines operation it was 0.47.
- For the non-mechanised sector, the operating ratio for gill net operations worked out to 0.30 for Hooks & Lines 0.65 and for shore seines 0.69.
- The analysis of costs and returns of dol-netters in the Northwest coast revealed that the operating cost per trip was lower in Maharashtra (Rs.1,548) than in Gujarat (Rs.3,385) with fuel and wages sharing 70% of it.
- The analysis of economic performance of the purse seiners indicated that the operating cost per trip of a multi-day fishing of 2-5 days was higher in Maharashtra (Rs.99,189) than in Goa (Rs.38,150) with the crew wages accounting for the maximum share (46.96%) followed by fuel (32.8%).



Comparison of costs and returns for different categories of gillnets

PROJECT CODE SEE/TOT/01
PROJECT TITLE **Evaluation of transfer of technology programmes in marine fisheries**
SCIENTISTS **Sheela Immanual,** R.Narayanakumar, C.Ramachandran, S.Ashaletha and V.PVipin kumar
CENTRES Cochin, Mangalore, Tuticorin and Kakinada

- Based on the discussions held with the various agencies and through field visits, transfer of technology programmes like installation of artificial reef by CMFRI, establishment of community peeling sheds by MPEDA in Kerala, programme of value addition of fishery products by M.S.Swaminathan Research Foundation in Tamil Nadu, small scale prawn farming by MPEDA& BFDA in Karnataka, mussel culture implemented in Maharashtra by Konkan Krishi Vidya Peeth were identified. Details of the programmes, mode of implementation, and method of technology transfer were documented. A total of 15 programmes were identified covering six states, Kerala, Tamilnadu, Karnataka, Maharashtra, Andhrapradesh and Orissa.
- The final questionnaire format was prepared, pre-tested and finalised for further detailed investigation.

PROJECT CODE	**SEE/ITK/01**
PROJECT TITLE	**Indigenous knowledge systems and community based resource management in marine fisheries**
SCIENTISTS	**S.Ashaletha,** C.Ramachandran, R. Narayanakumar and Vipin Kumar,V.P
CENTRES	Cochin, Tuticorin, Chennai, Mangalore, Karwar and Kakinada

- A pilot study was undertaken in Kerala, Karnataka, Andhra Pradesh and Tamil Nadu. The coastal villages were visited and information was collected on Indigenous Technical Knowledge (ITK) under the domains of pre-harvest, harvest and post harvest fisheries.
- Based on the nature of ITK identified, they were grouped under five main categories; harvesting techniques, boat and net making/ maintenance, pharmaceutical uses, conservation related beliefs and rituals and processing/preservation techniques.
- The interview schedules were finalised and translated to local languages of the study areas. Enumerators were identified in the study centres and trained. Model surveys were conducted in the selected locations along with enumerators. The final documentation is in progress.

Traditional catamarans beached along southwest coast of India

Treasure of the traditional wisdom is vanishing (out rigger canoe of Karwar, Karnataka)

SPONSORED PROJECTS

FUNDING AGENCY	**Department of Ocean Development, New Delhi**
PROJECT TITLE	**Investigations on Toxic Algal Blooms in the EEZ of India**
SCIENTISTS	**C.P.Gopinathan**
CENTRES	Kochi

During the year 2002, two cruises were conducted (Cruise No.203 and 206) along the west coast of India.

*Only one algal bloom (**Trichodesmium** sp.) was observed during these cruises (Position: Latitude 19º00.37 E, Longitude 71º59.31 N) at a depth of 72 m. But, no harmful effects were observed in this area.*

*Bloom due to abundance of **Hornellia marina** was observed in the coastal waters of Calicut. Heavy fish mortality was recorded in this area.*

In order to identify the toxic algal blooms, their nature and seasons of occurrence and their impact on fisheries, the project was functioning from 1999 onwards utilizing the facilities on board *FORV Sagar Sampada*. The project was completed in September 2002.

- The investigations on toxic algal blooms gave information about various types of blooms prevailing in the EEZ and this initiated in preparing a database on the same.
- This database will support to identify the potential algal blooming areas and the period of this occurrence.
- Precautions can be adopted in the case of an outbreak of algal bloom especially in shellfish growing areas all along the Indian coast.
- Identification and isolation of toxic algal species can be done based on this database for further studies on their application in various fields like research areas for the preparation of drugs and toxins, quality control of seafood products and exploitation of various algal diets and products.

FUNDING AGENCY	**AP Cess Fund**
PROJECT TITLE	**Studies on the incidence of toxic principles and parasites in seafoods**
SCIENTISTS	**C.P.Gopinathan** (FEMD), V.Kripa (MFD)
CENTRES	Kochi

Mass mortality of fishes due to *Hornellia marina* bloom at Calicut

In order to create a database on the main locations where harmful algal blooms are observed along the Kerala coast and the frequency of this occurrence, regular monitoring of hydrological properties and analysis of molluscan samples were carried out for the identification and presence of toxic materials.

- Qualitative and quantitative analysis of phytoplankton for the presence or absence of algal toxins.
- Microalgal blooms were observed whenever the concentration of nutrients was high.
- Seven algal blooms were observed during this period
- Large-scale destruction of marine fauna was observed due to bloom of *Hornellia marina* at Calicut in September 2002 and fish mortality due to *Noctiluca scintillans* at Calicut during the same period.
- No parasitic infestations were observed in Cephalopods (Octopus, Squid and Cuttlefish). Observed *Polydora* sp. in oyster samples.

Major algal blooms observed along the Kerala coast

Month	Location	Algal species	Harmful effects
May	Calicut	*Coscinodiscus asteromphalus*	Nil
June	Vizhinjam	*Chaetoceros eibenii*	Nil
June	Calicut	*Asterionella japonicum*	
July	Vizhinjam	*Thallassionema nitzchoides*	Nil
September	Calicut/ Mahe	*Hornellia marina*	Large scale destruction of marine fauna
September	Calicut	*Noctiluca scintillans*	Fish mortality
September	Vizhinjam	*Chaetoceros curvisietus*	Nil

FUNDING AGENCY **Department of Biotechnology**
PROJECT TITLE **Transfer of technology of seaweed culture for rural development**
SCIENTISTS **N. Kaliaperumal**
CENTRES Mandapam Camp

Technology for commercial scale culture of the agarophyte *Gracilaria edulis* by vegetative propagation method using coir rope nets and longline coir ropes was transferred to the fisherfolk/rural people of Vadakadu (Rameswaram) and Naalupanai (Thangachimadam) in Palk Bay.

- Seaweed culture was carried out in 0.2 ha area at Vadakadu. Totally 170 coir rope nets of 2 x 2m size with *Gracilaria edulis* seed material were introduced during April-July, 2002 in the nearshore area of 1 to 2 m depth of Vadekadu involving the fisherfolk/rural people in the seaweed culture activities.
- A training programme of five days duration during 16-20th April, 2002 on seaweed culture was conducted to 25 fisherfolk/rural people of Naalupanai. The trainees were given demonstration on commercial scale production of agar in the CMFRI Agar Plant, Mandapam Camp.
- Data on environmental and hydrological parameters were collected at fortnightly intervals from the seaweed culture site and correlated with the growth of cultured seaweed *Gracilaria edulis*. The suitable period for taking up large scale cultivation of *Gracilaria edulis* at Vadakadu was found to be between July and March.

Fisherfolk of Vadakadu, Tamil Nadu engaged in seaweed culture

Demonstration to fisherwomen trainees on processing of cultured *Gracilaria edulis* for agar production at Mandapam camp

FUNDING AGENCY	**ICAR Revolving Fund**
PROJECT TITLE	**Production of agar from the seaweeds of Gulf of mannar and Palk Bay**
SCIENTISTS	**N. Kaliaperumal**
CENTRES	Mandapam Camp

Bleaching of agar sheets

- Food grade agar was manufactured on commercial scale as sheets, bits and powder forms from the red seaweed *Gracilaria edulis.*
- The bleached and sun-dried agar was marketed by packing them in polythene bags.
- Totally 870 kg of agar was produced from April, 2002 to March, 2003.
- An income of Rs. 1,66,725 was generated by sale of 705 kg sheets and 220 kg bits.
- A training programme on "Agar production" from 21-27th January, 2003 to 10 fisherfolk of Ramanathapuram Fish Workers' Trade Union, Bharathinagar sponsored by M.S. Swaminathan Research Foundation, Chennai was organized.

FUNDING AGENCY	**Marine Products Export Development Authority**
PROJECT TITLE	**Participatory management and conservation of lobster resources along the southwest coast of India**
SCIENTISTS	**E.V.Radhakrishnan**
CENTRES	Cochin

A project on'Participatory management and conservation of lobster resources along southwest coast of India' was implemented at Khadiyapatnam, Kanyakumari District, Tamil Nadu. A CIFT designed lobster trap and lobster conservation stickers were released. The need for sustainable exploitation of lobster resources so as to conserve the resource for the future was popularized in the community through active participation of the local stake holders.

Sticker on lobster conservation

- The first phase of the project at Khadiyapatnam in November 2002, a lobster fishing village in Kanyakumari district, Tamil Nadu on the southwest coast of India was implemented.
- Leaflets and wall posters in Tamil highlighting the need for protection of egg bearing lobsters and juveniles were distributed/pasted in 10 fishing villages on the southwest coast of India.
- A participatory village level meeting involving fishermen, traders and village heads was held at Khadiayapatnam to create awareness among the fishermen on sustainable exploitation and lobster conservation. Fishermen were advised to release back the egg bearing lobsters into the sea during the peak breeding month and not to operate trammel net for fishing lobsters.
- At Khadiyapatnam 'V' marked and released 50 egg bearing lobsters procured from the fishermen to convey the message of protection of egg bearing lobsters. Wide publicity given to release back the marked lobsters if recaught in the net.
- Distributed 45 numbers of lobster traps designed by CIFT to the fishermen at Khadiyapatnam with the objective of weaning away the fishermen from using the destructive trammel nets.
- Slides on lobster conservation slogans were projected in the local movie theatres.

FUNDING AGENCY	**AP Cess Fund**
PROJECT TITLE	**Reproductive dynamics of penaeid prawns off Mumbai waters**
SCIENTISTS	**V.D.Deshmukh**
CENTRES	Mumbai

- Data on catch, effort, species composition and size distribution were collected from New Ferry Wharf and Versova in Mumbai and Harnai landing centre in Ratnagiri district for eight species of commercially important penaeid prawns, *viz. Penaeus merguiensis, Metapenaeus affinis, M. monoceros, M. brevicornis, Parapenaeopsis stylifera, P. hardwickii, P. sculptiltis* and *S. crassicornis,* which together constituted about 90% of the penaeid prawn catch.
- From the size at maturity, juvenile (recruits) and adult populations of the respective species were segregated to know the relation between spawning stocks and their recruits.
- Preliminary studies on population fecundity of *M. affinis* showed that although population fecundity index and egg production were maximum in September (PFI 72.7 x 10^{12}), the highest recruitment of juveniles came from spawning in April.

*The species exhibited Ricker's stock recruitment relationship, which indicated that the highest recruitment in **M. affinis** is possible with 13 million spawners or 193 t of biomass of spawners.*
Yield per recruit analysis suggested reduction in length at capture but this is not advisable, since it could result in reduction of Bm/R (biomass of spawning stock per recruit) below critical level of 20%. Therefore, size at capture (L_{50}) should be maintained at the present L_{50} of 115 mm or (9.3-9.7g) for the species.

FUNDING AGENCY	**Department of Fisheries, Govt. of Kerala.**
PROJECT TITLE	**Development of artificial reefs off Moodady-Thikkody**
SCIENTISTS	**K.K.Philippose**
CENTRES	Calicut

In continuation of the earlier reef modules launched at Moodady-Thikkodi, an additional 50 modules were fabricated and installed to augment the lobster habitat. The triangular modules made of concrete slabs with a central window were placed at 5 metre intervals. The reefs were enriched with coconut leaves to increase productivity. The lobster fishery in the area is being monitored and an increase in landing was reported after installation of the reef.

FUNDING AGENCY	**Department of Fisheries, Government of Kerala**
PROJECT TITLE	**Development of Artificial reefs off Muttom, Kannur**
SCIENTISTS	**K.K.Philippose**
CENTRES	Calicut

A 250 m long and 50 m wide artificial reef was established off Muttom, near Kannur. Triangular modules made of concrete with a 2' size central window were launched at a depth of 18 m. The reef was enriched with coconut leaves. The entire reef installation was carried out with the involvement of local fishermen. Observation on the fishery will be made from September 2003.

Triangular artificial reef modules ready for deployment off Muttom, Kannur

FUNDING AGENCY	**Department of Fisheries, Government of Kerala**
PROJECT TITLE	**Survey, assessment and breeding of the marine ornamental fishes along Malabar coast**
SCIENTISTS	**K.K.Philippose**
CENTRES	Calicut

During the year, 69 people in five batches were trained in ornamental fish culture at Calicut. Most of the trainees have established ornamental fish breeding and rearing farms utilizing the technical knowhow imparted to them.

Ornamental fish resource along the Kozhikode, Kannur and Kasargod districts of Kerala coast were surveyed. Fish traps were used for experimental fishing at Dharmadom, Chombal, Moodady and Thikkody areas. Large scale occurrence of the Butterfly fish *Chaetodon collaris* in the Moodady-Thikkody artificial reef area has been recorded. Other notable resources are bat fishes and parrot fishes. Ornamental fishes are available in inshore waters from September to May.

FUNDING AGENCY	**AP Cess Fund**
PROJECT TITLE	**Intensive culture of Brine Shrimp**
SCIENTISTS	**M. Rajamani**
CENTRES	Tuticorin

Production of exotic species of *Artemia franciscana* in both indoor and outdoor culture system was studied. In the outdoor culture system production at three salinity levels 60, 70 and 90 ppt was studied. Maximum production of 628.5 g biomass was recorded at 70 ppt. Maximum production of 40.8 g of cysts was recorded at 90 ppt. In indoor culture system production at salinities ranging from 69 to 74 ppt was studied. The biomass harvested in two experiments were 45.8 and 34.0 g, respectively.

FUNDING AGENCY	**Department of Ocean Development**
PROJECT TITLE	***S*tudies on deep scattering layer in the Indian EEZ**
SCIENTISTS	**N.G. Menon**
CENTRES	Cochin

- A total of six cruises (Cr 201, 202, 204, 205, 206, 207) were successfully completed during the year 2002 onboard FORV *Sagar Sampada* as a multi institutional programme on DSL.
- Two cruises (Cr 204 in the southwest and Cr 206 in the northwest coast) were operated. A total of 21 IKMT stations (4 Days and 17 Nights) were covered within the Lat. 8°00'N - 22°02'N and Long. 69° 00'E - 72° 30'E. Thickness of the DSL was 50-100 m recorded either as single or multiple layers. Station depth ranged from 328-1566 m and sampling depth varied from 20-145 m. Volume of IKMT varied from 200-300-ml/ haul. Hydrographical parameters were also recorded during the cruise.
- The percentage of the nektonic components was low when compared to the zooplankton in almost all stations except few stations which had a good collection of swarming crabs (*Charybdis* sp) (Cr 204, June). The DSL catch consisted of salps that dominated among plankton (Cruise 206,September) mainly at 20°N. Macrozooplankton like euphausids, alima, and amphipods were seen at a considerable lower percentage.
- Among the nekton, myctophids and *Bregmaceros* dominated. *Hemiramphus* & C*hampsodontidae* were also present.

- Along the east coast four cruises were undertaken (Cr 201, 202, 205, 207) of which three were (Cr 201, 202, 207) in the Andaman Sea. A total of 23 stations (8 Days and 15 nights) were covered within the area 6°-10°N and 80°-95°E. The Station depth varied from 232 – 1462 m and the sampling depth varied from 30–320 m. DSL thickness varied from 20-100 m recorded either as single or multiple layers.
- IKMT volume varied from 75 - 1000 ml/ haul. Important nektonic groups encountered during the above cruises were myctophids, photichthids, pelagic shrimps, and leptocephalus and among the plankton, the groups encountered were chaetognaths, euphausids, megalopa, siphonophore, salps and alima. Hydrographical parameters were also recorded during the cruise.

*The study on the trophic relations showed that **Priacanthus hamrur** fed mainly on myctophids and shrimps along with smaller percentage of fish larvae (**Neopilina orientalis, Apogon** sp., **Cubiceps caerulus**). **Cubiceps caerulus** fed mainly on salps. Family Photichthyidae (**Vinciguerria nimbaria, Ichthyococcus** sp.), family Myctophidae (**Diaphus** sp.) forms important forage of oceanic tunas, flying fishes, squids and pelagic sharks.*

FUNDING AGENCY	**Department of Ocean Development**
PROJECT TITLE	**Resource assessment and biology of deep-sea fishes along the continental slope of Indian EEZ**
SCIENTISTS	**V. Sriramachandra Murty**
CENTRES	Cochin

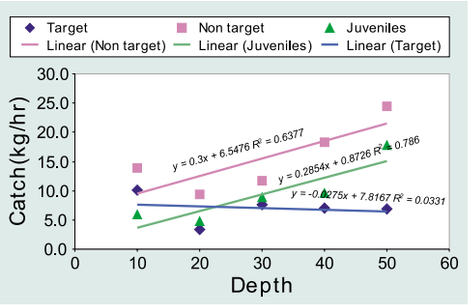
- The project started functioning at CMFRI, Kochi from 25-4-1998 and completed its first phase on 31-9-2002. During the period, nine cruises were operated along the Indian EEZ by FORV Sagar Sampada. During these cruises, 127 fishing stations were covered of which 80 stations were along the west coast, 17 stations along the east coast and 30 stations off Andaman Sea. The total catch during the above cruises amounted to 19140 kg. The fishing depth ranged between 50 and 750 m.
- Biology of important fishes such as *Cubiceps caeruleus, C.baxteri, C.pauciradiatus, Chloropthalmus punctatus, C.agassizzi, C.maculatus, Bembrops platyrhynchus, Neoepinnula orientalis, Psenopsis cyaenea, P.obscura, Polymixia nobilis, Priacanthus hamrur, Sphyraena obtusata* and *Saurida undosquamis* was studied.

FUNDING AGENCY	**Department of Ocean Development**
PROJECT TITLE	**Investigations on the effect of bottom trawling on the benthic fauna off Mangalore Coast**
SCIENTISTS	**P.U Zacharia**
CENTRES	Mangalore

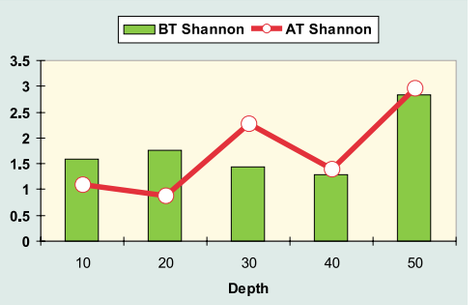
Commercial trawl

- Data were collected from 200 boats by participation (SDF) as well as by enquiry (MDF) and analysed. Non-target varied from 38.79% in SDF to 20.4% in MDF. Non-target group consisted of incidentals (23% in SDF and 9.9% in MDF) and discards (15.7 in SDF and 10.5% in MDF). Percentage of target was 61.2% in SDF and 79.6% in MDF). Juveniles formed 26.3% in MDF and 16.18% in SDF.
- Catch of target species and depth of operation showed negative correlation, Non-target species showed positive correlation and juveniles showed negative correlation

The biodiversity indices such as Shannon Weiner and Simpson indices from all depths of operations generally showed a decrease after trawling. In shallow water significant decrease was observed after trawling but in deep water changes were not significant. Species richness, evenness and number of species showed a decreasing trend after trawling.



Depth-wise percentage catch of different groups in various depths in experimental trawling and the linear relationship with depths



Changes in the biodiversity index (Shannon-Weiner Index) during experimental trawling (before and after) at different depths of operation off Mangalore coast

- Temperature and salinity at all depth stations showed negligible changes due to trawling. Total suspended solids in seawater increased after trawling. Dissolved oxygen content generally showed an increase after trawl at all depths. Chlorophyll *a* decreased after trawling at all depth stations. Nutrients such as phosphate and nitrate showed negligible changes before and after trawling. Silicate content generally showed a decreasing trend after trawling. Seawater transparency decreased after trawling at all depth stations.

Experimental trawl

- Percentage of target species in the catch was 21.86%, non-target was 48.62 % and juveniles 29.50%. Catch of target and depth of operation showed negative correlation (R^2=0.0331), while non-target and juveniles showed a positive correlation (R^2=0.6377 and R^2=0.786 respectively).

FUNDING AGENCY	**WorldFish Center, Penang, Malaysia**
PROJECT TITLE	**Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poor household in Asia (ADB-RETA 5945)**
SCIENTISTS	**N.Gopalakrishna Pillai**
CENTRES	CMFRI, Cochin (Co-operating Centre)

- Fishing practices and key aquaculture technologies in marine and brackish water sectors as well as post harvest technologies available in India were documented.
- Prioritization exercise was conducted to identify and finalize criteria and key indicators for prioritising pro-poor aquaculture technologies and fishing practices in India.
- Fish consumption surveys during peak and lean seasons covering the urban and rural areas were completed
- The final Country Report on component I *Aquaculture technologies and fishing practices in India* has been finalized as per guidelines and submitted to the Programme Leader, WorldFish Center.

FUNDING AGENCY	**Department of Biotechnology**
PROJECT TITLE	**Digitised Inventory of marine bio-resources (marine fishes)**
SCIENTISTS	**A.A.Jayaprakash**
CENTRES	Cochin

Inventorisation of 270 marine fishes belonging to families: Carangidae, Chirocentridae, Clupeidae, Cynoglossidae, Elopidae, Engraulidae, Harpadontidae, Megalopidae, Mullidae, Nemipteridae, Platycephalidae, Polynemidae, Sciaenidae, Scombridae, Stromateidae, Synodontidae, Tachysuridae and Trichiuridae has been completed.

FUNDING AGENCY	**Department of Biotechnology**
PROJECT TITLE	**Studies on biotechnological aspects of disease management in aquaculture using immunostimulants**
SCIENTISTS	**A.P. Lipton**
CENTRES	Vizhinjam

- The final report for the funded project was prepared and submitted to the DBT and presented during the Task Force Meeting held on January 7-8, 2003 at New Delhi.
- The THC of *Ulva* was 6725 cells/ml whereas in the normal shrimp it was 5437 cells/ml. Due to *Ulva* medication, the agglutination titre was considerably increased to 8192 against the formalin-killed *V. fischeri* and *A. hydrophila* antigens.
- As a single dose at 1000 mg/kg, *Ulva* gave 80% survival against the infection caused by the potentiated pathogen (*V. harveyi* 5 x 10^3 + *V. alginolyticus*, 5 x 10^3 CFU/shrimp). The mechanism of action of *Ulva* extract in the shrimp was evaluated after 7 days of appropriate medicated feed treatment.
- Enhanced total haemocyte count (THC), agglutination titre, bacterial clearance, bactericidal activity and phagocytic rates were observed in the *Ulva* treated shrimp.

*The influence of combined immunostimulation on the non-specific defence in **P. monodon** was evaluated. Feed incorporated with a mixture of 50mg of levamisole and 500 mg of **Ulva** extract /kg body weight gave 100% survival among the postlarvae of **P. monodon.** The average body weight and relative growth rate also enhanced significantly when compared to the control groups and other combinations.*

FUNDING AGENCY	**Ministry of Environment and Forests**
PROJECT TITLE	**Studies on the biology, captive spawning and sea ranching of the seahorse, *Hippocampus*** sp.
SCIENTISTS	**A.P. Lipton**
CENTRES	Vizhinjam

- Field data showed that except for a mild increase in targeted fishing for seahorse during August 2002, the seahorse fishing and export of dried seahorse had almost stopped during the year 2001 and 2002 in the major centres along the Palk Bay coast of Tamil Nadu.
- Analysis of samples and information collected indicated that three species of seahorses are available in the Palk Bay Coast compared to the earlier observations of one species, the *Hippocampus kuda*. *Hippocampus trimaculatus, H. kuda* and *H. fuscus*, were recorded from depths ranging from 3 to 8 m in areas rich in sea grass.
- The cost ranged from Rs.700/- to 800/- (for 500 to 600 dried seahorses/ kg) and Rs.1, 000/- to 1,500/- (for 300 to 350 dried seahorses /kg) depending on the size.

***Hippocampus trimaculatus** constituted 11.77% of the total species of seahorses obtained from the centre.*

This species is reported for the first time from this coast of India

FUNDING AGENCY	**AP Cess Fund**
PROJECT TITLE	**Studies on immune response in shrimp**
SCIENTISTS	**S.R. Krupesha Sharma** and E.V. Radhakrishnan
CENTRES	Calicut

Effect of stress factors on the immune response of shrimp was studied. The stress factors studied included chemical stressors like Copper and Cadmium at 0.5 and 1.0 ppm, decreased salinity and altered pH. Copper influenced by lowering the haemocyte count, haemolymph protein and

PO activity. No effect was found on agglutinin titre. In general, copper was more toxic than cadmium in *P.indicus*. Salinity stress decreased the haemocyte count after 72 h. While it had no effect on total haemolymph protein, the PO activity increased after 48 h and the activity again decreased after 72 h. Salinity stress also had no effect on agglutinin titre. pH induced stress at pH 8.5 had no effect on haemocyte count and total protein; it lowered the PO activity after 48h.

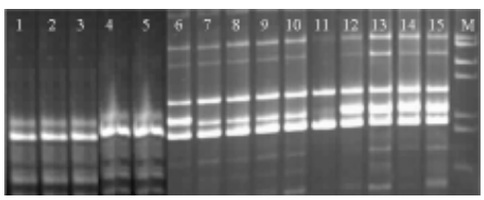
FUNDING AGENCY	**Department of Science & Technology**
PROJECT TITLE	**Studies on immune response during moult cycle in the spiny lobster *(Panulirus homarus)***
SCIENTISTS	**S.R. Krupesha Sharma**
CENTRES	Calicut

Immunological and haematological standards were developed for various moult stages

Immunological and haematological standards for various moult stages of *Panulirus homarus*

	Stage A	Stage B	Stage C	Stage D
Total haemocyte count (mean cells/mm^3)	14600	12800	16500	18400
Total haemolymph protein (mg/ml)	48	45	105	85
PO activity (OD/min/mg protein)	Not tested	Not tested	50	68
Total haemolymph volume (% body weight)	Not tested	Not tested	18	20

FUNDING AGENCY	**AP Cess Fund**
PROJECT TITLE	**Evaluation of genetic heterogeneity in marine ornamental fishes using molecular genetic markers**
SCIENTISTS	**P. Jayasankar** and Boby Ignatius
CENTRES	Kochi and Mandapam



RAPD fingerprinting of clown fish (*Amphiprion* sp) (Primer OPF03 - 5' CCTGATCACC 3') Lanes 1-5: 5 individuals of *Amphiprion chryosogaster.* Lanes 6-10: *Amphiprion sebae* from Marine Aquarium of Mandapam Regional Centre of CMFRI, Mandapam Camp, Tamil Nadu. Lanes 11-15: *Amphiprion* sp (?) from Marine Aquarium of Vizhinjam Research Centre of CMFRI, Vizhinjam, Kerala. Lane M: DNA size marker, Lambda *Hin*d III/*Eco* RI.

Unambiguous identification of the clown fish species domesticated at Mandapam and Vizhinjam aquariums of CMFRI

- Using Random Amplified Polymorphic DNA (RAPD), taxonomy of clown fish (Genus: *Amphiprion*, Family: Pomacentridae) which is domesticated in the aquariums of Mandapam Regional Centre and Vizhinjam Research Centre, was ratified. It was established that the species was the same at both the centres. The possibility that the species at Vizhinjam was *Amphiprion chrysogaster* (as reported earlier) was rejected by comparing the DNA profiles of the species from Mandapam and Vizhinjam aquariums with *A. chrysogaster* from Mauritian waters (see the accompanying figure). DNA of the latter was extracted from the liver tissues of 5 individuals obtained from Dr. Joel Elliot, University of Puget Sound, Biology Department, 1500 N. Waarner, Tacoma, WA 98416-0320 and identified as *A. chrysogaster* by Dr. Jerald Allen, an expert in the taxonomy of

pomacentrid fishes. Dr. Allen has also confirmed the identity of the species at Vizhinjam and Mandapam as *Amphiprion sebae*. Species specific diagnositic markers of *A. sebae* and *A. chrysogaster* have been developed using arbitrary primers OPA 05, OPA 08, OPA 10, OPF 02 and OPF 03.

- The similarity index between all possible pair-wise comparisons of individuals from all primers was calculated and phylogenetic relationship between individuals of Mandapam, Vizhinjam and Mauritian samples were constructed using cluster analysis (UPGMA contained in PHYLIP 3.57c package). The results (as depicted in the accompanying figure) showed clustering of Mandapam and Vizhinjam samples together, clearly separated from Mauritian samples.

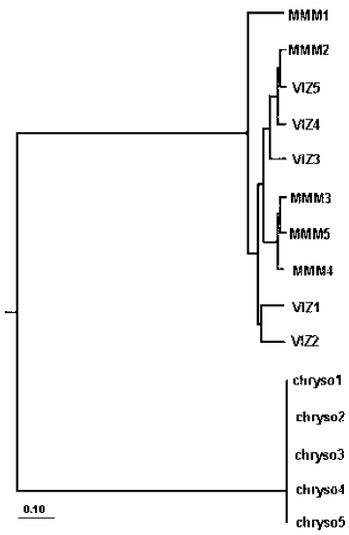
Study on the sex-specific DNA markers of *Amphiprion sebae*

- Generally, the larger fish in the group of clown fishes is female and the smaller male. However, sex change occurs and the dominant male can transform into a female if the female in the group dies. The present study was intended to search for any possible sex-specific RAPD markers in the species. Genetic profiles of a total of 20 *A. sebae*, including 10 females (total length, 94-117 mm) and 10 males (total length, 65-102 mm) were generated using arbitrary primers OPF 01, OPF 03, OPF 04, OPF 05, OPF 06, OPF 07, OPF 08, OPF 09, OPF 10, OPF 11, OPF 12, OPF 13, OPF 14 and OPF 15. Based on repeatability and robustness of loci generated, data from primers OPF 03, 04, 09 and 12 were only analysed (UPGMA contained in PHYLIP 3.57c package) and the resulting dendrogram did not show clear separation of female and male clusters. Further, no sex-specific markers could be noticed in any of the gels.

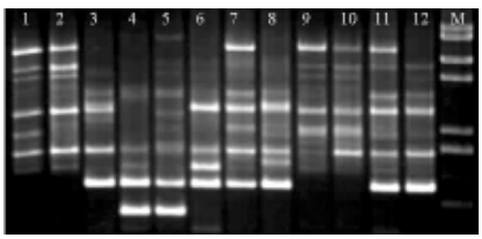
Genetic profiling of sergeant major species from Mandapam waters

- Number of dark bars across the body is one of the chief field identification marks in sergeant major (*Abudefduf* spp). During the reporting period, extensive sampling of sergeant major was made from Mandapam region, which is abound with coral reefs which are ideal habitats of sergeant major, an ideal marine ornamental fish. The species collected included *Abudefduf bengalensis*, *A. veigensis*, and two individuals of doubtful species status. Genetic profiles of 22 individuals were generated using arbitrary primers OPF 01, OPF 02, OPF 03, OPF 05, OPA 01, OPA 02, OPA 03, OPA 04, OPA 05, OPA 06 and OPA 07.

*Cluster analysis of RAPD profiles indicated unambiguous separation of **A. bengalensis** and **A. veigensis.** The two individuals of doubtful species identity were clustered with **A. veigensis.** Utility of RAPD for molecular taxonomic purposes is well demonstrated here.*



UPGMA dendrograms showing clustering of clown fish from 3 locations, confirming clear separation of *A. chrysogaster* from *A. sebae*



RAPD profiles of sergeant major species (1-2 & 9-10, *Abudefduf bengalensis*; 4-6, 8 & 11-12, *A. veigensis*; 3 & 7, doubtful species)

FUNDING AGENCY **ICAR Revolving Fund**
PROJECT TITLE **Commercial Production of cultured pearls adopting onshore culture technology**
SCIENTISTS **A.C.C. Victor**, A. Chellam, D. Kandasamy and I. Jagadis
CENTRES Mandapam

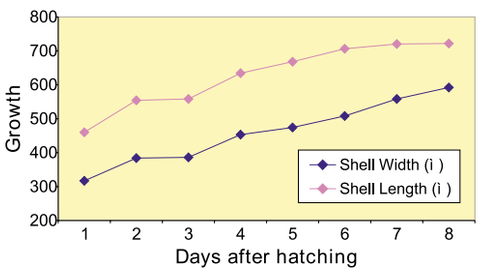
- **Maintenance and culture of spats and mother oyster under farm conditions:** A total stock of 2,12,200 oysters of different sizes are maintained in the farm. Among which there are about 1, 21,460 spats (10-20 mm), 52,640 medium sized oyster (20-30 mm) and 21,120 mother oysters (above 35 mm) are under rearing. Apart from this another 12,625 nucleated oysters are under rearing in the marine pearl farm.

A total of 4040 pearls worth Rs.3,66,592 were sold and revenue deposited to ICAR. The cumulative pearl sale yielded Rs.8,18,364 under the project.

Dr. M.S. Swaminathan examining the implanted pearl oysters at the grow-out site at Mandapam

- **Spawning, larval rearing and spat production:** 13 spawning was made and about 9.50-lakh initial settlement of spats obtained of which 4.2 lakhs spats were raised and transplanted to the farm. About 2.0 million larvae are under rearing.
- **Training:** Two training programmes of one week duration was conduced at RC of CMFRI, Mandapam Camp under ICAR Revolving Fund project for fisher folks of two villages identified & sponsored by MSSRF. Totally 20 men and 18 women were trained in marine pearl oyster farming.
- **Harvest:** About 7,242 oysters survived out of the 10,955 oysters implanted were harvested and a total yield of 1653 (Grade 'A' – 93 nos.; `B' – 287 nos. & `C' – 1,273) pearls was achieved during the period under report.
- **Nucleus implantation:** A total of 53,425 oysters were nucleated with 3,4 & 5 mm shell bead nuclei (29,760, 20,625 3,040 Nos.) and transplanted to open sea farm for maintenance. 40,800 oysters have already been handed over to the MSSRF by March 2003.

FUNDING AGENCY	**AP Cess Fund**
PROJECT TITLE	**Develoment of seafarming technology for the whelk, *Babylonia* spp.**
SCIENTISTS	**K. K. Appukuttan** and P. Laxmilatha
CENTRES	Kochi



Growth of *B. spirata* veliger larvae

Monitoring of fishery of the whelk *Babylonia spirata* and *B. zeylanica* at the Neendakara and Sakthikulangara Fishing harbour, Quilon was carried out. Biological aspects such as growth, sex ratio, and maturity stages were studied. Though there was no targeted fishery for Whelk during Sept. 2001 to March 2002, there was exclusive fishery for *Babylonia zeylanica* from April 2002 to June 15th. In other months, both the species of *Babylonia* landed as by-catch of shrimp trawlers.

Spawning: Successful spawning of *B. spirata* was obtained

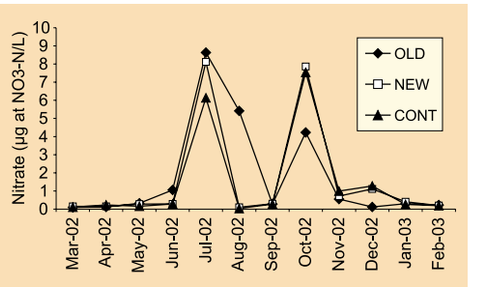
Settlement: The larvae hatched out from the capsules settled on the 12th to 16th day in all the months of September, October, November, January, February and March.

The survival rate: The survival rate after settlement was 80%. The average shell length of the juveniles of *B. spirata* ranged from 895.4µ to 2.43 mm on the 60th day after settlement.

FUNDING AGENCY	**International Foundation for Science, Sweden**
PROJECT TITLE	**Environmental Impact Assessment of suspended culture of bivalve**
SCIENTISTS	**V. Kripa**
CENTRES	Kochi

- The variation in the hydrographic parameters such as nutrients, salinity, dissolved oxygen and temperature of surface and bottom waters at the oyster farm and control was negligible at Ashtamudi Lake.

- The effect on the sediment characteristics and benthic faunal composition due to continuous farming at the same site for more than 5 years was studied and compared with that of a one year old farm and a non farm site at the area in Ashtamudi Lake. It was observed that due to continuous suspended culture of oysters at the same site the percentage of fine sand gets reduced from 70 to 55 % while that of coarse sand from 19 to 13 %. At the same time, percentage of silt and clay increased from 3 to 11% and 8 to 21%, respectively.
- The total organic carbon (TOC) content was found to increase due to continuous farming. The average TOC of the top 5 cm of the sediment was 0.76 at the control site while it increased to 0.81 and 0.93 in one year and 7 year old farms.
- The impact on benthic fauna was observed to be site specific with high seasonal variation. In Ashtamudi Lake, the density of benthic fauna in a one year old farm was higher (52,023 nos m^{-2}) than the control site (27,746 nos m^{-2}) while it was low (8,092 nos m^{-2}) at a seven year old farm.



Monthly variations of nitrate at a five year old farm, a new farm and in the open estuary (cont)

FUNDING AGENCY	**AP Cess Fund**
PROJECT TITLE	**Application of trophic modelling and MSVPA to formulate management options for the multigear marine fisheries of southern Karnataka**
SCIENTISTS	**K.S. Mohamed**, P.U. Zacharia, C. Muthiah, P. Rohit and P.K. Krishnakumar
CENTRES	Mangalore

- Data on L/F, diets and parameters necessary for biomass estimations with respect to 55 species of fishes were completed during the current year. The project data had a coverage of 86% of the total marine fisheries of Karnataka.
- The diet data were analysed using the index of preponderance and percentage occurrence and volume methods. The data were transferred to ECOPATH as a diet matrix for 21 ecological groups.
- A species life history sheet was designed to include growth, maturity, selection, population and ECOPATH parameters of each species.
- Aspect Ratios (which determines the speed of fish movement and ability to escape from predators) with respect to all groups have been determined. Aspect ratios of some important species are listed below.

Fish species	*Aspect ratio*	Fish species	*Aspect ratio*
Carcharhinus limbatus	**2.40**	*Decapterus russelli*	**2.46**
Scoliodon laticaudus	**1.05**	*Caranx calla*	**2.70**
Rhizoprinodon acutus	**1.61**	*Scomberoides tol*	**4.64**
Sphyrna lewini	**1.26**	*Lactarius lactarius*	**2.58**
Scomberomorus commerson	**4.74**	*Rhinobatos granulatus*	**0.77**
Epinephelus diacanthus	**1.22**	*Formio niger*	**2.75**
Grammoplites suppositus	**3.53**	*Escoulosa thorocata*	**2.2**
Sphyraena jello	**2.62**	*Dussumieria acuta*	**2.47**
Euthynnus affinis	**5.94**	*Chirocentrus dorab*	**3.20**
Auxis thazard	**5.11**	*Stolephorus devisi*	**1.11**
Auxis rochei	**4.94**	*Johnieops sina*	**2.69**
Sardinella longiceps	**2.96**	*Leiognathus bindus*	**2.13**
Sardinella fimbriata	**3.45**	*Megalaspis cordyla*	**5.16**

FUNDING AGENCY	**International Foundation for Science, Sweden**
PROJECT TITLE	**Effect of probiotic feeding on the rearing and production of penaeid shrimp larvae**
SCIENTISTS	**K.S. Mohamed**
CENTRES	Cochin

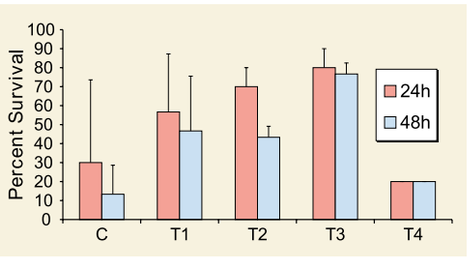
***Saccharomyces boulardii* –**
an innovative bio-therapeutic agent for shrimp larvae

*SB is widely used in humans for treatment of **Vibrio cholera** induced diarrhoea. Present research shows that it is equally effective in curbing **V. harveyi** induced mortality in marine shrimp larvae. The project has developed complete protocol for feeding of probiotic organisms to shrimp larvae up to PL_{20} and bio-encapsulation of probionts in **Artemia** metanauplii.*

The project was completed in June 2002 and the final report was submitted to the agency in July 2002. The summary of the project findings is given below.

Large-scale *Vibrio* induced mortalities are common in shrimp hatcheries and antibiotics are widely used as prophylaxis, but with the risk of selection of drug resistant strains. Probiotics have proved beneficial in fish larval rearing. This project envisaged use of probiotic organisms, particularly anaerobes with known probiotic effects like *Lactobacillus*, in the rearing of larval tiger shrimp *Penaeus monodon*. The success of such feeding was evaluated using a *Vibrio* challenge test.

None of the isolated strains were judged as promising for use as probionts. Therefore known probionts like the yeast *S. boulardii* and the anaerobic bacillus *L. plantarum* were selected for probiotic enrichment studies. Enrichment of *S. boulardii* in zoea and mysis stage larvae of *P. monodon* and *Artemia* nauplii proceeded in a dose dependant manner. In general, up to 1330 and 2300 CFU/ larva could be enriched into zoea and mysis stages of *P. monodon*, respectively and up to 3500 CFU/ larva could be enriched into *Artemia* nauplii. Shrimp larval survival was more in 10^4 and 10^5 enrichment concentrations and poor in 10^6 concentrations when compared to control. Results indicated that *S. boulardii*, as a probiotic did not influence the composition of other microflora in *P. monodon* larvae. Challenge studies showed that enrichment of S. *boulardii* into *P. monodon* zoea and mysis stage larvae helped the larvae to surmount an artificial *Vibrio* pathogen challenge. In general, it would appear that enrichment of at least 10^5 CFU/ml of *S. boulardii* is necessary to impart the resistance to *Vibrio harveyi* for *P. monodon* larvae. In the case of *Artemia* nauplii, challenge results showed that the resistance of the nauplii was significantly ($P<0.01$) improved in those fed with 10^4 CFU.ml^{-1} *S. boulardii* (90% survival rate after 48 h of challenge versus less than 40% for the infected control group without SB).



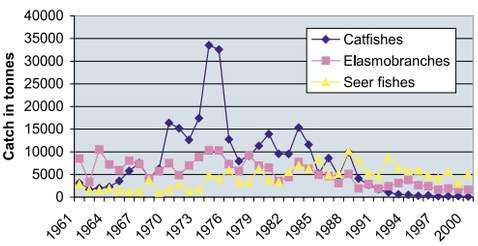
Survival of PL_1 *P. monodon* larvae after challenge with *Vibrio harveyi*

It was shown for the first time that the yeast *S. boulardii* is effective in *P. monodon* larval stages and in an aquatic live feed organism like *Artemia* nauplii to overcome *Vibrio* infections. At an enrichment level of 10^4 CFU.ml^{-1}, these *Artemia* nauplii can be used as a vehicle to deliver probiotic to other aquatic larvae feeding on them.

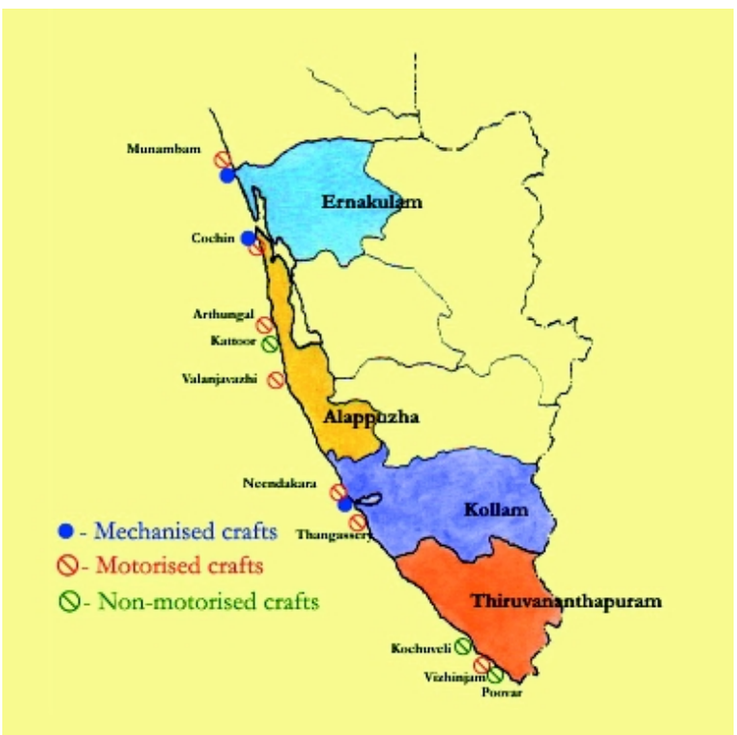
A survey on the use of probiotics by shrimp farmers in the state of Andhra Pradesh showed that farmers use both water and feed probiotics. Water probiotics are applied either directly or after fermentation and feed probiotics are applied along with the feed and a binder. When probiotics are used, the cost of production increases by 0.9-15.2 % for an average production of 1.3 t/ha. Water probiotics that are applied after fermentation and feed probiotics show lower cost of production when compared to others.

FUNDING AGENCY	**Indira Gandhi Institute of Development and Research**
PROJECT TITLE	**Environmental economic analysis of inshore fishery resource utilization of coastal Kerala**
SCIENTISTS	**R. Sathiadhas** and R.Narayanakumar
CENTRES	Cochin

- The economic loss due to over fishing estimated in terms of the Net Present Value of MSY for 30 years was Rs.160.6 crore for catfishes, Rs.458.5 crore for elasmobranches and Rs.3.9 crore for goatfishes.
- The economic loss due to juvenile fishing was estimated using the model developed in the project and the results showed that in the mechanised sector, for trawlers, the economic loss due to juvenile fishing was Rs.28.3 lakhs as against annual revenue of Rs.31.2 lakhs. In the motorised sector, for ring seines the loss was Rs.19.1 lakhs, which was higher than the annual revenue generated by the same unit (Rs.12.4 lakhs). Similar quantification were worked out for all other craft-gear combinations.
- Among the mechanised units, the average catch per day of operation was highest in trawler and lowest in gillnetter, but in terms of value realisation it was much higher in gillnetters.
- Among the different centres the highest economic loss due to juvenile fishing was at Neendakara harbour with Rs.239.1 crore/year followed by Cochin Fisheries Harbour and Munambam Fisheries Harbour.



Diminishing returns of catfishes, elasmobranches and seerfishes



Map showing the selected centres of southern Kerala for the study

National Agricultural Technology Projects

The Institute implemented 17 NATP schemes during the year under various research modes such as Production Systems Research (PSR), Competitive Grants Programme (CGP), Mission Mode (MM), Integrated Village Linked Programme (IVLP) and Agriuclture Technology Information Centre (ATIC). The salient findings of the projects are given.

FUNDING AGENCY	**NATP/PSR**
PROJECT TITLE	**Nutrition and pathology in mariculture**
SCIENTISTS	**R. Paul Raj**, D.C.V. Easterson, K. C. George, A.P. Lipton, Imelda Joseph
CENTRES	Cochin, Tuticorin and Vizhinjam

Different types of formulated feeds developed for grow-out and fattening of mud crab

- A formulated pellet diet (cost Rs.35/kg) with 47% crude protein 10% lipid, 18% total ash and 17.8 MJ/kg gross energy was developed with indigenous ingredients for fattening mud crabs of three grades (excel, big and medium) .The feed has been successfully used as a substitute for the traditional feeds such as trash fish, salted fish, clams and slaughter-house waste used for fattening by the farmers. On-farm trial conducted in a crab farm using plastic cages for the first time at Vypeen Island near Cochin showed that the pellet feed is commercially viable, eco-friendly, easy to transport, store and dispense.
- The juveniles (77-174 mm) of orange spotted estuarine grouper (*Epinephelus coioides*), a highly carnivorous fish, have been successfully weaned to a semi-moist compounded diet by adopting a weaning strategy with an amino acid mixture as a feeding stimulant.
- A product obtained by solid-state fermentation of soybean flour using *Bacillus coagulans* for 48 hours was successfully used as a partial substitute and can replace up to 60% of fish meal in the diets of juvenile *Penaeus monodon* without any adverse effect on growth, survival, FCR, PER, ANPU and body composition.
- The process of solid state fermentation of a mixture of soybean flour, wheat flour, groundnut oil cake and gingelly oil cake in the ratio 4:3:2:1 using the bacterium *Bacillus coagulans* and fungus *Aspergillus niger* strain 616 was standardized. The product obtained after 36 hrs using *B. coagulans* and 96 h using *A. niger* showed better nutritional profile compared to the unfermented mix.
- The larval mortality in the pearl oyster hatchery was closely associated with copepod infestation and *Vibrio* infection. The major pathogen in lobster hatchery causing mortality of phyllosoma larvae was *V. harveyi*.

FUNDING AGENCY	**NATP/PSR**
PROJECT TITLE	**Breeding and culture of pearl oysters and production of pearls**
SCIENTISTS	**K.K. Appukuttan**, K.S. Mohamed, T.S. Velayudhan, V. Kripa, D.C.V. Easterson, A.C.C. Victor, S. Dharmaraj, A. Chellam, N. Ramachandran and M.K. Anil
CENTRES	Cochin, Tuticorin and Vizhinjam

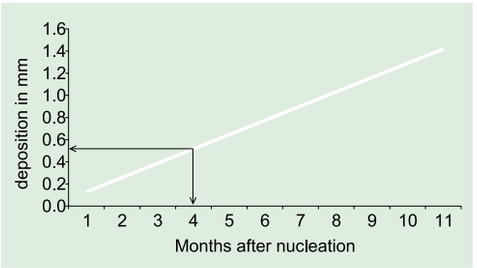
1. Large Marine Pearl Production

During October 2001, 730 adult *P. fucata* of sizes above 55 mm DVM were implanted with shell bead nucleus of diameter 4-6 mm. The surgery was carried out at Port Kollam on-site with the help of skilled nucleus

implanters from Mandapam. Pearls were harvested in August 2002 after 317 days of rearing.

The largest cultured pearl obtained was 7.88 mm weighing 0.679 mg. The average thickness of nacre was 1.37± 0.27 mm with a mean nacre deposition rate of 0.129 mm/month. Along the southeast coast of India, the thickness of the nacre coated on a shell bead of 5.81 mm was 0.26 mm in 5.3 months indicating a deposition rate of 0.025 mm/month. In Japan, in a shell bead nucleus of 6.1 mm diameter the thickness of nacre coated was 0.50 mm in 42 months (0.0103 mm/month)

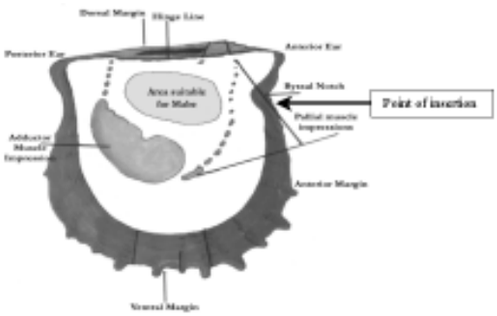
According to the grading done based on international standards, 20% of the pearls were of 'A' grade, 16% 'B' grade, 55% 'C' grade and the rest D. Baroque pearls were also produced.



Cumulative monthly nacre deposition in shell bead nuclei of 5 to 6 mm at Port Kollam

2. Mabe Pearl Production

Trials were made in *P. fucata* using base images (10 mm^2) made of shell powder and resin, plastic images and camel bone images for the production of Mabe pearls. Rearing of oysters was done at Port Kollam raft farm. The base images in plastic and bone material were rejected within a month. Only base image made with shell powder gave satisfactory results. Observations indicate that within 15-20 days, the nacre coating is initiated.



Fusing of the image to the shell was complete by day 20. By the end of 60 days it was possible to get complete and adequate nacre coating on the image so as to produce a mabe. Rejection and mortality was high (100%) when the image size exceeded 10 mm^2.

3. LC_{50} studies of metals on *Pinctada fucata*

In order to determine the process by which metals impart colour and hue to the pearls, the median lethal concentration (LC_{50}) of metals was determined for the purpose of administering the metals through feed. Pearl oysters were exposed in groups of 10 to each of several concentrations of various metal salts like Copper sulphate, Cobalt nitrate and Ferric chloride. Survival was assessed after 1,2,4,8,16,24,36,48,72,96 and 120 hours. The median survival time of each group of animals was determined from a graphical plot of raw data after a log-probit transformation. The study showed that copper sulphate is highly toxic as compared to cobalt nitrate and ferric chloride. The LC_{50} value obtained for copper was 2.1 ppm and for cobalt it was 9 ppm. In the case of ferric chloride no mortality was observed upto 15 ppm.

In the control, pearl oysters were fed with *Isochrysis galbana* and reared in normal filtered seawater (FSW). In the first experiment oysters were reared in FSW and fed with a balanced microparticulate diet with Ferric chloride at 10 ppm level (MPD-Fe). In the second experiment oysters were reared with *Isochrysis* and FSW containing 10 ppm Ferric chloride (FSW-Fe) and in the third oysters were exposed to both MPD-Fe and FSW-Fe. At the end of the study, performances were compared with that of the control. The percentage survival respectively for control and the above said three experiments was 42.5, 80, 50 and 35. The modified colour of the nacre deposition was bluish green. The percentage colour modification was observed to be 18.75% with MPD-Fe, 20% with FSW-Fe and 14.29% with MPD-Fe & FSW-Fe.

Highlights during 2002-03

At Tuticorin, preliminary trials indicated that it is possible to manipulate the colour of the nacre and thence the pearl.

CIFT designed and fabricated a longitudinal shell cutting machine for longitudinal cutting of irregular shaped molluscan shells with reciprocating cutting mechanism.

***In vitro** nacre formation from explant mantle tissues was obtained in abalones at Tuticorin.*

Pearl production using larger nucleus (5-6 mm) has been attempted along the west coast and more than eighty 7-8 mm pearls were produced at Port Kollam.

*Mabe pearl inserts were tried in **P. fucata** for the first time by scientists at Cochin and within 2 months mabe pearls were produced. The procedure is being standardised.*

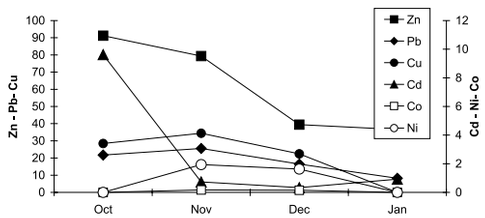
***P. fucata** hatchery was set up in Sikka, Gujarat and more than 5000 spats were produced.*

***P. margaritifera** was surgically implanted with nucleus at Port Blair for the production of black pearls.*

4. *In vivo* study on crystallization of nacre

In vivo study on crystallization of nacre was carried out in pearl oyster and abalone. This study formed basic information for *in vitro* study. A thick black strip of 2x10 mm size was inserted between the mantle and the shell in pearl oyster and abalone. Observations were made every day under a microscope. On day 1 numerous crystals were found deposited on the strip along with round and rod shaped cells. On day 3 cells formed groups and had short pseudopodia. From day 7 onwards intensity of crystals increased forming a thick layer and later additional layers were added. The strip was found to have fused on day 27 in abalones and day 30 in pearl oysters.

FUNDING AGENCY	**NATP/PSR**
PROJECT TITLE	**Mussel mariculture**
SCIENTISTS	**T. S. Velayudhan,** V. Kripa, K.K.Appukuttan, K. Sunilkumar Mohamed, P. Laxmilatha, N. Ramachandran, Sujitha Thomas, Geetha Sasikumar, P. K. Asokan, R. Sarvesan and P. V. Sreenivasan
CENTRES	Cochin, Chennai, Calicut and Vizhinjam



Monthly variation in trace metal concentration (ppb) in the sea off Kollam

Seedling of mussel spat using the new seeding device developed in the project

Dissemination of technology

Scientific guidance was continued for the farmers who had adopted the technology and the farms were harvested during April –May 2003. In the coastal villages harvest melas were organized and wide publicity was given to create public awareness.

A mussel farmer's meet was organized at Calicut in May 2002 and the farmers presented their problems. Group discussions were held. Training programmes on mussel farming were conducted in Kerala (3), Maharastra (5) and in Andaman and Nicobar Islands (1).

- Heavy metal concentration was much below the permissible limit. Mercury was completely absent in all the water samples analyzed from the three regions. In the estuary and sea at Kollam concentration of zinc was the highest while in the Kollam bay, copper was dominant. Silver content was below detectable level both in the open sea water and in the estuary while in the bay it was slightly higher, 0.0012ppm.
- Hydrocarbon content in the bay waters was low (0.00911ppm). In the estuary it was 52 times (0.4801ppm) more than the value in the bay.

Bioaccumulation of trace metals

The bioaccumulation of trace metals in natural bed in a bay was monitored. Among trace metals, accumulation of copper was higher. The Copper, Cadmium, Chromium, Nickel and Zinc concentration in mussels of size 90 to 95 mm was found to be 8.512, 0.681, 0.376, 2.715 and 2.915 ppm/kg of mussel meat. The mussel meat did not have lead and silver.

Seed collection of mussel by setting collectors

- The number of spat (avg. length 2.9mm, avg. wt 0.02 g) settled was

highest, 206137 numbers per 2500cm^2 on the tiles in August 2002.

- The seed settlement on velon screen, frilled nylon rope and old fish net were 5237, 2287 and 675 numbers per 2500 cm^2, respectively.

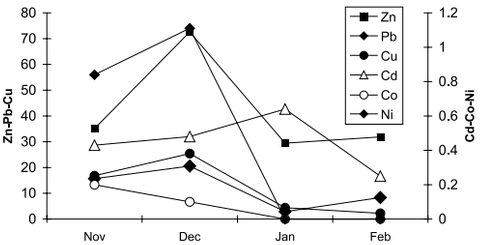
- Experiments on depuration of mussels were conducted. Low cost depuration and declumping unit was designed. Trials were conducted to study the effect of depuration on the reduction of bacterial load.

National level mussel resources survey and preparation of seed calendar

- The total mussel seed biomass estimated to 16130 t/7024345 sq.m from A&N Islands, Kerala, Karnataka, Tamilnadu, Pondicherry, Andhra Pradesh,Maharashtra, Goa and Gujarat.

Demarcation of areas suitable for mussel farming as per EEC guidelines

- The variation in the concentration of zinc, cadmium, lead, copper, cobalt and nickel present in the estuary (Ashtamudi Lake), in a Bay (Thankassery Bay) and in the coastal waters (sea) was studied. The water samples brought from the Andaman waters were also analyzed.



Monthly variation in trace metal concentration (ppb) in Ashtamudi Lake, Kerala

Shri G.S. Gul Mohammed, mussel farmer receiving the *Karshaka Siromani* national award from the Hon'ble Union Minister

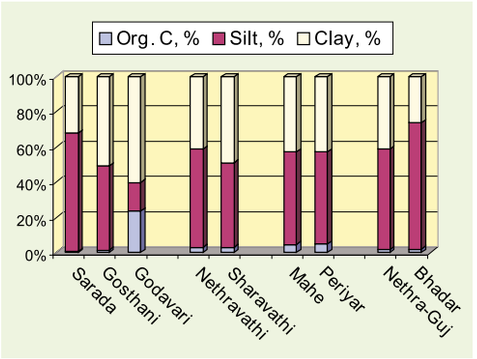
FUNDING AGENCY	**NATP/PSR**
PROJECT TITLE	**Impact of dams on river run-off into sea and changes in the nutrient and productivity profile of coastal waters**
SCIENTISTS	**P.K. Krishnakumar,** P. Kaladharan, D. Prema, K. Vijayakumaran and Shobha Kizhekudan
CENTRES	Veraval, Mangalore, Cochin and Visakhapatnam

Reduction of river runoff due to impoundments and dams may result in major environmental changes in the estuarine coastal sea ecosystem. The objective of the study was to assess the impact of altered river flow (due to dams and reservoirs) on the nutrient and productivity profile of coastal waters from west coast (Veraval, Mangalore and Cochin) and east coast (Visakhapatnam) of India.

- Influx of total suspended solids (TSS) and total dissolved solids (TDS) was found to be low in rivers having dams from Veraval, Mangalore, Cochin and Visakhapatnam. Significantly low concentrations of nutrients such as silicate and phosphate were observed in the coastal waters and estuary of rivers having dams compared to non-dammed rivers. Relatively high BOD values were observed from river systems having dams. Significant positive correlations were observed between river discharge rate and silicate input while negative correlations were observed between BOD values and river water discharge rates. Low primary productivity and chlorophyll '*a*' content was observed in the coastal waters and estuary of rivers having low water discharge.

- Sediment characteristics showed higher levels of pH, salinity and organic carbon in the marine stations than in the riverine stations. Presence of silt and clay content in the sediment registered an

increasing trend from the river stations to the seaward stations. Similarly, organic carbon content in the sediment increased from the river stations to the seaward stations.



Sediment characteristics in different river systems

- Damming of rivers has reduced the influx of sediment bound percentage organic carbon, silt and clay into the coastal waters. Similarly, influx of sediment bound available K and P also reduced in dammed rivers. However, the input of sediment bound total silica and sand into the coastal waters increased due to dams.
- Microbial parameters in Nethravathi and Sharavathi rivers were studied. The data so far, do not indicate any major differences in the bacteriological profile of these two rivers. Fecal contamination was observed in both the rivers and pathogens were also detected. *Salmonella* was occasionally observed in both the rivers. *Vibrio cholerae* belonging to non O1/O139 serotype and non-toxigenic strains were detected. Fecal coliform/fecal streptococcal ratio enabled detection of contamination from non-fecal source in the water. *Vibrio* spp were detected in both the rivers. The percentage incidence varied from 48-78%. Comparatively higher incidence of *Vibrio* spp was found in Sharavathi River.

Water sampling in Mulky river, Karnataka

- Generally, damming has negatively affected the normal influxes of the nutrients, sediment bound material fluxes and productivity of the river mouth, estuary and the adjacent coastal waters of smaller rivers such as Bhadar River, Periyar River and Gosthani River, which are having relatively low water discharge when compared to major rivers such as Godavari and Sharavathi.
- The frequent damming and freshwater impoundment of rivers of Saurashtra over the years have virtually stopped the output of rivers to the coastal waters and has led to the closure of river mouths. These river systems which were well known for commercially valued crustacean and fish resources have now been reduced to stagnating high saline creeks.

FUNDING AGENCY	**NATP/PSR**
PROJECT TITLE	**Mangrove ecosystem: Biodiversity and its influence on the natural recruitment of selected commercially important finfish and shell fish species in fisheries**
SCIENTISTS	**George. J.P.,** G.S.D. Selvaraj, P.Kaladharan, T.S. Naomi and D. Prema
CENTRES	Cochin

Reclamation by *Rhizophora* plantation

- The project initiated with the objective of documenting the biodiversity of mangrove ecosystems, especially Kerala, West Bengal, and Andaman & Nicobar Islands with special emphasise to selected commercially important finfish and shellfish seed resources and their distribution in relation to various ecological parameters besides qualitative and quantitative estimation.
- Among the 23 species of true mangrove plants, 31 species of mangrove associates and non-mangrove and 10 species of mesophytic bioinvasive plants, five species, such as *Acanthus ilicifolius, Bruguiera gymnorrhiza, Excoecaria agallocha, Rhizophora apiculata* and *R. mucronata* are found to be common in Kerala, West Bengal and Andaman and Nicobar Islands Mangrove Ecosystems.

- In the microflora, phytoplankton has been represented by species belonging to families Myxophyceae, Chlorophyceae and Bacillariophyceae. Diatoms dominated the phytoplankton with 92 littoral and benthic species followed by 12 species of blue green algae and 15 species belonging to other groups.
- The microfauna, zooplankton comprise species of Copepoda, Harpacticoida, Rotifera, Insect larvae and Tunicata in which Copepods dominated the fauna.
- Benthic fauna was dominated by polychaetes belonging to 15 species.
- Among the 154 species of ichthyofauna, 40 were found to be common to the mangroves of Kerala, West Bengal and A & N Islands.
- The finfishes represented by 70 species of which 23 were common to Kerala, West Bengal and A & N Islands mangroves. Among the 40 crustacean species, 11 were found to be common to Kerala, West Bengal and A & N Islands. Among shellfishes, molluscs were represented by 24 species of which 6 species were common to the three mangroves. Among the 10 reptile species, 3 were common to the mangroves.
- The avian fauna comprised 25 species of which 8 were represented in all mangroves. Among the 20 species of mammalian fauna, 6 species were common to all mangroves under investigations.
- During April 2002, a Working Group Meeting (WGM) was conducted with the CCPIs and SRFs at CMFRI, Cochin to compile a methodology for the investigations in mangrove ecosystem of Kerala, West Bengal, Andaman and Nicobar Islands.
- A workshop was conducted at Vidyasagar University, Midnapore, West Bengal (Co-operating Centre) during June 2002 for evaluating the progress of the project and releasing of the Manual on Research Methodology to be employed for the project.

*It was observed that large-scale seed collection of **Penaeus indicus, P. monodon** and **Metapeneaus dobsoni** continued in the Indian mangrove ecosystems. While approximately 22.93 seeds of different stages of other species are destroyed to collect one **Penaeus monodon** postlarva at Sunderbans, such destruction is not elaborate in Kerala mangrove ecosystems. However, the juvenile fishery of finfish and crustaceans resulted in the dwindling of brackish water fish landing in the Kerala coast. In general, the collection of seeds for aquaculture as well as for marketing affected the natural recruitment and the capture fishery resources of the country.*

Restoration and ecotourism

FUNDING AGENCY	**NATP/PSR**
PROJECT TITLE	**Studies on fisherwomen in coastal ecosystem of Andhra Pradesh, Karnataka, Tamilnadu and Kerala**
SCIENTISTS	**R. Sathiadhas**, H.Mohammed Kasim and R.Narayanakumar
CENTRES	Cochin, Chennai and Kakinada

- Women stakeholders, shrimp peelers, clam collectors and processors, fish traders, fish driers and fish curers and processing plant workers were identified in each of the five Centres.
- A diet survey using 24-hour recall method combined with weighing of raw foods was conducted among selected fisher households.
- A medical examination camp was conducted to know about the occupational illness of women stakeholders in each centre and was attended by 550 fisherwomen.
- The majority of the fisherwomen engaged in peeling (*Aroor* and *Neendakara*) were suffering with numbness of fingers and backache. Those who are engaged in clam collection and processing (*Theckumbhagam* and *Anjilickad*u) were found to have problems with ear and numbness of joints. Fish vendors (Poovar) were found to have lower-neck ailments, swelling of legs and impaired eyesight.

Medical camp at Anjilickadu

FUNDING AGENCY	**NATP/PSR**
PROJECT TITLE	**Augmentation of marine fish production in Lakshadweep**
SCIENTISTS	**K.P.Saidkoya,** K.S.Mohamed and M.Sivadas
CENTRES	Minicoy Island

The project has two major objectives:

a) Pearl culture b) FAD installation

Gain in length and weight of pearl oysters at two different locations

	Adult length (mm)	Spat length (mm)	Adult weight (g)	Spat weight (g)
Loc 1	0.31	2.89	0.16	0.48
Loc 2	1.05	3.94	2.61	3.65

a) **Pearl culture**: The experiments were initiated with the help of Tuticorin spats and adults of ***Pinctada fucata*** from April, 2002 onwards. The transportation/transit mortality was found to be very high, 78% in spats and 30% in the adults, in the first batch and the same was brought down to 0% by recondition at HQ hatchery in the second batch transferred in Jan, 2003. The growth studies conducted at two locations showed a much faster growth at location 2 about 300m off the fisheries jetty than the location 1 below the jetty. The second batch showed much more faster growth than the first batch.

- Ascidians were the major foulers on the cages and the oysters in both the locations. Spawning was observed at both the locations and the spats were collected using spat settlers and reared in the fruit baskets.
- Various types of images, beads etc. were implanted into 20 adult oysters of 64.69 mm mean sizes on 03.03.03. 20% mortality after 2-15 days and 25% rejection was observed. 6 implanted oysters in 2 serial pouches are growing well.

b) **FAD installation**: - The materials for the FADs were procured and are ready for deployment after the monsoon. Meanwhile, 2 low cost temporary FADs using the fresh coconut spikes, leaves, nylon rope , small anchors etc. were deployed in the Eastern side open sea and in the Western side lagoon. A bottom set FAD deployed at 3.5 mts. depth zone, was for the aggregation of live baits, ornamental fishes and other coral reef fishes. Aggregations of different types of ornamental fishes, small snappers and groupers and the live baits was noticed in considerable numbers. The second FAD in the open sea at 220 mts depth was for the aggregation of all types of pelagic and mid water fishes. The FAD drifted away after 5 days due to the misuse of the same by live bait fishing boats.

FUNDING AGENCY	**NATP/CGP**
PROJECT TITLE	**Broodstock development, breeding, hatchery production and restocking of mud crabs**
SCIENTISTS	**E.V.Radhakrishnan** and Mary K. Manisseri
CENTRES	Cochin

- Egg bearing crabs from the wild were found to be unsuitable for hatchery production due to prolonged time lapse between capture and arrival at hatchery. Mortality of eggs as well as egg shedding have been due to stress consequent to prolonged exposure outside water.
- Mated females with fully developed ovary are the most dependable source of breeder crabs. These crabs spawned naturally in captivity within 10-12days.

- Hatchery production of the mud crab *Scylla tranquebarica* using wild and captive broodstock was continued. Five breeding experiments were conducted of which postlarval crabs (crablets) obtained from two seed production trials. Larvae from wild breeders were weak.
- Achieved mass production of seeds of *Scylla tranquebarica* in the hatchery for the first time.
- Zoea larvae stocked at a density of 40 larvae/l were fed on *Chlorella* sp./*Nannochloropsis* sp. enriched rotifers for the first 4-10 days (Z_1 and Z_2 stages) and on a combination diet of *Artemia* nauplii and rotifers for the following 6-10 days (Z_3 and Z_4 stages).
- On reaching megalopa stage, larvae were fed exclusively on prawn-egg custard until metamorphosing to crablets. Feeding on *Artemia* nauplii was completely dispensed with.
- About 1% survival obtained from zoea to first crab stage. The critical stage in mud crab breeding and seed production is during metamorphosis of megalopa to postlarval crab (crablet). Higher survival of postlarval crabs obtained (50%) in tank bottom provided with molluscan shells compared to artificial weeds.

Hatchery produced baby mud crabs of *Scylla tranquebarica*

Larval stages and feeding schedule of the crab larvae reared in the hatchery

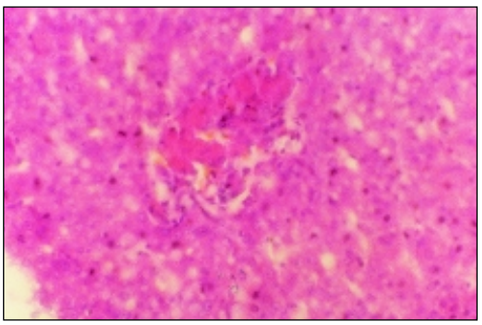
Larval stage	Time spent in each stage	Food
Z_1	3-5	Rotifer + *Chlorella*
Z_2	3-5	Rotifer + *Chlorella*
Z_3	2-5	*Chlorella* + Rotifer + *Artemia* nauplii fed 1 day after metamorphosing to Z_3)
Z_4	4-5	*Chlorella* + Rotifer + *Artemia* nauplii
Z_5	3-6	*Chlorella* + *Artemia* nauplii+ egg custard
Megalopa	6-8	Egg custard

FUNDING AGENCY	**NATP/CGP**
PROJECT TITLE	**Aquaculture, breeding and hatchery production of marine ornamental fishes with special reference to clownfishes and damselfishes**
SCIENTISTS	**G. Gopakumar**, J.K. Kizhakudan and B. Ignatius
CENTRES	Vizhinjam, Veraval and Mandapam

- The patterns of broodstock development and pair formation of the clownfish *Amphiprion sebae* was experimented and results obtained were successfully employed for broodstock development of clownfish. Several batches of clownfish young ones were produced in the hatchery and technology is being patented.
- Broodstock development of five species of damsel fishes *viz.*, the filamentous tail black damsel *Neopomacentrus cyanomos*, the yellow tail damsel *N. nemurus*, the blue damsel *Pomacentrus caeruleus*, the peacock damsel *P. pavo* and the Indian Dascyllus *Dascyllus carneus* were successfully developed.
- Larval rearing of four species namely, *Neopomacentrus cyanomos*, *N. nemurus*, *Pomacentrus caeruleus* and *P. pavo* was done. Experiments are continuing to enhance larval survival.

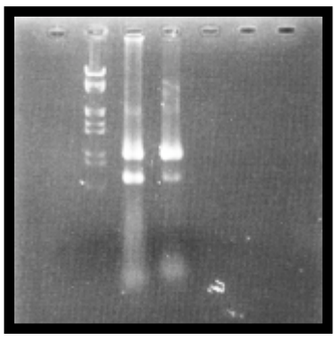
FUNDING AGENCY	**NATP/CGP**
PROJECT TITLE	**Development of a national referral laboratory for marine fish and shell fish microbial diseases**
SCIENTISTS	**K.C. George**, P. C. Thomas, N.K. Sanil and K.S. Sobhana
CENTRES	Kochi

- Field visits were conducted in different farms and diseased samples were collected. Isolates from diseased samples, Grouper (*Epinephelus tauvina and Epinephelus malabaricus), Etroplus suratens*is, shrimps (*Penaeus indicus* and *Penaeus monodon)* and Crab (*Scylla serrata*) were collected and are being identified.
- Thirty-seven isolates of *Vibrio*, 26 isolates of *Aeramonas* and 8 isolates of *Pseudomonas* were made from the diseased organisms. These isolates are being subjected to biochemical test to identify up to species level.



Focal necrosis of the liver due to *Aeromonas* infection in *Etroplus suratensis*

- Diseased septicemic *Etroplus suratensis* was subjected to histopatholgical analysis. The organs like liver, kidney, spleen, muscle, gills and heart were examined for pathological changes.
- Two species of *Aeromonas* were isolated from the heart blood of *Etroplus suratensis* and were identified as *Aeromonas hydrophila* and *Aeromonas salmonicida*.
- Microbial isolates collected from the haemolyph of *P. monodon*, and *P.indicus* are found to be different species of *Aeromonas* and *Vibrios.* Also *Vibrio* and *Aeromonas* species were obtained from water samples collected from the ponds. PCR test was conducted and found that the shrimps were positive for white spot syndrome virus .



PCR amplified WSSV DNA fragment

- Investigations were made on mortality reported from an *Etroplus suratensis* farm due to ulcerative disease. Bacterial isolates were obtained from the heart blood of the fish. *Aeromonas* species was the most dominant. Other bacteria such as *Vibrio, Pseudomonas* etc. were also obtained. The species level characterization of these bacteria is being done. A fungus (*Aphanamyces invadens* like) was isolated from the muscle near the ulcerative area.
- Diseased *Epinephelus malabaricus* was obtained and was subjected to histopathological examinations and microbiological examinations. Isolates collected from the heart blood are being characterized.
- A bacterial isolate from diseased lobster was received from Calicut Research Centre of CMFRI for biochemical characterization. The isolate was characterized as *Vibrio alginolyticus*. Stock culture of all the isolates collected are maintained in the laboratory.

FUNDING AGENCY	**NATP/CGP**
PROJECT TITLE	**Designing and validation of communication strategies for responsible/sustainable fisheries: A co-learning approach**
SCIENTISTS	**C.Ramchandran**, S.Ashaletha, V.P.Vipin kumar and R.Narayana Kumar.
CENTRES	Cochin

- Mass communication tools meant for the Responsible Fisheries Extension Module (RFEM) have been designed, validated and disseminated.

- The FAO Code of Conduct for Responsible Fisheries was translated to Malayalam and has been published as a book titled '*Utharavadithvapara Matsyabandhana Perumattachattam'* in collaboration with FAO, Rome.
- A booklet '*Utharavadithvapara Matsyabandhanam- Enthu, Engane, Enthinu?'* describing what, why and how of responsible fisheries also has been released.
- A state-wide painting competition on the theme 'Responsible fisheries' was conducted for the students of fisheries technical schools, vocational higher secondary schools and fisheries colleges of Kerala.
- An animation film titled '***Kunjumeenum kothukuvalayum***", (*Tiny fish and Mosquito net*) was developed and released. This film was broadcast at periodic intervals by the Doordharshan.

Hon'ble Minister for Fisheries, Govt. of Kerala releasing the Malayalam version of FAO Code of Conduct for Responsible Fisheries

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Institution-Village-Linkage-Programme for technology assessment and refinement in the coastal agro ecosystem of Ernakulam in Kerala**
SCIENTISTS	**R.Sathiadhas**, Sheela Immanuel, L.Krishnan, A.Laxminarayana and D.Noble
CENTRES	Cochin

- The project site is the village of Elamkunnapuzha in Vypeen Island. The second Site Committee meeting approved the following 15 techno-interventions for implementation in the second phase, which have been implemented.
- Farms for these diverse sets of techno-interventions were selected and farmers were given training on scientific farming practices in concerned areas. Procurement and supply of critical inputs like fish seeds, vegetable seeds, slips of paragrass and banana suckers and hybrid variety of rabbits and ducks from Kerala Agricultural University, Mannuthy were completed.
- A book entitled '*Institution-Village-Linkage-Programme: Coastal Agro Ecosystem and interventions*' highlighting the activities undertaken in the first phase was released.

Livestock intervention in progress at Elamkunnapuzha village

INTERVENTIONS

Fishery based	Livestock based	Agriculture based
(1) Polyculture of crabs and *Mugil cephalus*	(1) Broiler rabbit farming	(1) Farming of amaranthus(*Kannara Local*) as an intercrop with Banana (*Nendran*)
(2) Farming of *Penaeus indicus* with polyculture of finfish	(2) Duck farming in homesteads	(2) Rice cultivation using biofertilizers
(3) Crab fattening	(3) Fodder cultivation on unutilised marshy lands	(3) Farming of improved variety of ridgegourd
(4) Monoculture of *M.cephalus*		(4) Salad-cucumber
(5) Pearl spot seed production		(5) Vegetable cowpea
(6) Application of new antifouling paints for fishing boats.		(6) Integrated farming of improved variety of vegetable on the embankments along with paddy

FUNDING AGENCY	**NATP/MM**
PROJECT TITLE	**Integrated National Agricultural Resources Information System- INARIS**
SCIENTISTS	**N.Gopalakrishna Pillai** and T.V.Sathianandan
CENTRES	Cochin (Co-operating Centre)

- The entity-relationship diagrams and data dictionary for the databases on fishery technologies, fishery statistics and research projects have been completed.
- Database on fishery technologies developed by CMFRI (mariculture technologies) and CIFT (harvest and post harvest technologies) has been created in MS Access
- Sixteen digit species codes were generated for 46 fish groups following the standard coding pattern provided by IASRI in the Code Book I.
- Database creation on marine fish landings (state-wise and species-wise) during 1995 to 1998 is in progress

FUNDING AGENCY	**NATP/ATIC**
PROJECT TITLE	**Establishment of Agricultural Technology Information Centre - ATIC**
SCIENTISTS	**R.Sathiadhas** and V.P.Vipinkumar.
CENTRES	Cochin

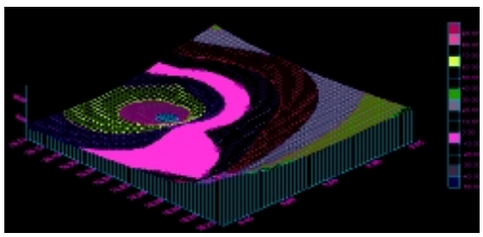
- The Agricultural Technology Information Centre (ATIC) was established to implement a single window delivery system for all the technological inputs, products and services. All sales/services/products were channeled through the single window delivery system under ATIC of the Institute.
- The ATIC building was commissioned, inaugurated and made operational.
- A publication entitled '*Agricultural Technology Information Centre: Activities and Achievements*' and three brochures on ATIC in English, Malayalam and Hindi languages were released.
- The ATIC web site www.aticcmfri.org was launched.
- A total of 1012 farmers/ fishermen/ entrepreneurs visited and interacted with the ATIC during the period under report.
- Sale of products/services had benefited 594 farmers.
- Diagnostic services and laboratory tests of samples brought by farmers generated an annual revenue of Rs 68,429/-

Hon'ble Secretary, DARE and DG, ICAR, Dr. Mangala Rai visiting the audio-visual lab in ATIC

FUNDING AGENCY	**NATP/PSR**
PROJECT TITLE	**National resource management - coral reef ecosystem**
SCIENTISTS	**A.C.C. Victor**
CENTRES	Tuticorin

- Analysis of silica, carbon, phosphorus and nitrogen in suspended matter around coral island at Tuticorin indicates more sedimentation from fly ash dyke. The enhancement of silica sedimentation may have caused the degradation of corals in addition to illicit extraction.

- Bed load sediment evaluation was carried out using the internal waves and standing wave principles. The nature of sediments motion is illustrated in the GIS format to visualize the 2D and 3D nature for conservation measures. The base of the reef contains sediment that mixture of $CaCO_3$ debris (derived from the breakdown of reef material) and silt from fly ash in Van Tivu and other terrigenous sediment eroded from the coast has been inferred in the field. The relations to coral health are poorly understood and are now focused in our investigations.
- The coral Sr/Ca ratio indicates the temperature variation for coral islands. The residual ä ^{18}O signal is used to define the sea surface temperature and to evaluate the growth of coral adjacent to the fossil corals.



GIS image of sediment transport pattern of Vantivu island

Coral rejuvenation pattern

- Studies on coral settlement were made using various materials. Among the various species of corals *Acropora* sp. were found to settle more on the tiles kept at Harbour basin. Monthly coral (*Acropora humilis*) settlement on the tiles were enumerated and measured. The number of colonies varied from 2 –25 per tile with an average of 16 corals/ tile. The rate of settlement of coral was estimated to 330/ sq.m. The diameter of the settled coral ranged from 3.7 to 11.1 mm and the average growth (in diameter) was 7.8 to 10.8 mm per month. After initial circular basement development, the vertical growth of polyp was observed on 4th month and the height was 2mm.

FUNDING AGENCY	**NATP/ISD**
PROJECT TITLE	**Library Information System**
CENTRES	Cochin

- During the year library facilities and information system were upgraded utilising the funds allotted under the project. Eight foreign journals were subscribed and seven CD-ROM databases were procured. In addition to this, old Siboga Expedition Reports were digitized into eight CD-ROMs. The networking facilities were upgraded through procurement of a LAN server, three new computers, a CD writer and one scanner.

Technology Assessed & Transferred

Location specific techno-interventions with the active participation of farmers were successfully implemented in a coastal village, Elamkunnapuzha in Ernakulam district, under the Institute–Village-Linkage-Programme (IVLP). The mariculture technologies transferred were:

- Monoculture of mud crabs
- Polyculture of finfish in tide-fed ponds
- Integrated farming of fish and poultry
- Monoculture of *Penaeus monodon* under modified extensive method of farming
- Cage culture of crabs in tide-fed ponds

The performance of the technologies transferred was assessed through several performance indicators such as biometric observation, economic indicators, farmer's reaction and by matrix ranking. The traditional methods of farming were modified by applications of scientific farming method so as to increase productivity and better return for the farmer. The benefit-cost ratio for different technologies was higher compared to the farmer's practice in most of the interventions.

Harvest of polycultured finfish

Integrated farming of fish and poultry

i. Monoculture of crabs

The recommended culture practice is the monoculture of uniform sized juvenile crabs, *Scylla tranquebarica* in tide fed ponds. Crabs weighing 150-200 g stocked at a rate of 4800 nos/ha and fed at 8-10% of the bodyweight attained commercially valuable size with an increase in yield of 48.8% compared to traditional practice. The benefit-cost ratio is worked out to be 2.1:1 as against 1.36:1 in farmer's practice.

ii. Polyculture of fin-fish in tide-fed ponds

The milkfish *Chanos chanos* and *Mugil cephalus* stocked in a farmer's pond at the rate of 20,000 nos/ha attained a mean weight of 200 g and 400 g, respectively in a culture period of 11 months. In the traditional practice, harvesting is done through out the year and the returns were better when fishes are caught at the end of 11 month culture period with a higher B-C ratio of 1.64:1 compared to 0.96:1 obtained under farmer's practice.

iii. Integrated farming of fish and poultry

Integrated farming of fish and poultry improved the productivity and net returns. The poultry dropping increases pond productivity and the operational expenses reduced by 8-12% by adopting this practice. The matrix ranking of the preference of farmers indicates that there is significant cost-effectiveness in adopting the integrated approach.

iv. Monoculture of *P. monodon* under modified extensive method of farming

The results of the treatment varied between ponds. The percent survival varied between 15-60% due to mortality in one pond consequent upon sudden drop in salinity and pH in a shallow pond. Seeds (PL_{20}) stocked at 50000 nos/ha were harvested after 3 months with a higher B-C ratio of 1.50:1 compared to 1.12:1 in farmer's practice.

v. Cage culture of crabs in tide-fed ponds

Culture of crabs in iron cages fixed in a tidal pond was not very successful due to poor water quality and enormous stress to the crabs consequent upon frequent handling. Though the growth rate was reasonable, low survival resulted in poor net economic returns.

Mussel farming

Mussel farming activities were further extended in Kerala state with backing of the Aquaculture Development Agency in Kerala (ADAK), which initiated a new programme on mussel farming with scientific support from CMFRI. The CMFRI identified the sites suitable for mussel farming and imparted training to 340 fishers including 180 women in the coastal villages at Atholi, Chaliyar, Kannur, Beypore, Elathur, Padanna, Pattuvam, Payyanur and Purangara. From these villages, the ADAK identified villagers and formed 15 groups and provided free material for construction of farm such as bamboo poles, nylon rope and other necessary items for setting up mussel farms. The production of farmed mussels in the state increased from 950 tonnes in 2001 to 1250 tonnes in 2002 and the entire produce was from the small-scale farm units.

Mussel farming demonstration in Atholi village

The mussel farming technology was extended to farmers in the state of Maharashtra through the co-operating centre KKV, Ratnagiri. More than 3 Women SHGs were formed for implementing the programme. Economic analysis of the demonstration farm indicated that with an investment of Rs. 25,000, annual profit ranging from Rs. 11,000 – 19,000 could be obtained from a unit area of 200m^2.

Oyster farming

The number of edible oyster farms in Kayamkulam estuary increased substantially with the establishment of nearly 35 farms owned by Women Self Help Groups. The SHGs obtained financial help from the BFFDA and received help for marketing of the produce from MATSYAFED. The production of farmed oysters increased from 200 tonnes in 2001 to 350 tonnes in 2002.

Marine pearl culture

With the technical expertise from CMFRI, community owned pearl culture farms were set up by M.S. Swaminathan Research Foundation in the Mundalmunai village near Mandapam, Tamil Nadu. This programme was initiated as an alternative income generation opportunity for the poor fishers in the Gulf of Mannar region.

A village level society, "Mundalmunai Pearl Culture Society" was formed. Twenty members from 10 families (one adult male and female member from each family) of this society were trained in pearl culture at the pearl farm and pearl culture unit of the Institute at Mandapam Regional Center. Two farms (15 x 10 m) were constructed and 40,000 implanted pearl oysters were supplied by CMFRI for stocking in the farms. The villagers who were trained in farm maintenance and management are monitoring the pearl farms.

Farmers engaged in mending of cages on the pearl oyster rack off Mandapam

Seaweed farming

Experimental field cultivation of *Kappaphycus alvarezii*, *Gracilaria corticata* and *G.foliifera* was carried out in the intertidal area of Elathur (Calicut) by vegetative propagation method using longline coir ropes as a demonstration programme.

EDUCATION & TRAINING

Post Graduate Programme in Mariculture

The achievements of the PGPM

- The Peer Review Team constituted by the Director General, ICAR with Dr. K.V. Devaraj, Former Vice-Chancellor, University of Agricultural Sciences as Chairman; Dr. M. Babu Rao, Retd. Associate Dean, ANGRAU; Dr. Sunderraj, Dean, Fisheries College as Members and Dr. N.L. Maurya, ADG, ICAR as Member Secretary visited CMFRI, Cochin on 12-09-2002 in connection with the assessment for Accreditation of M.F.Sc. & Ph.D. Programmes in Mariculture.
- The Director, CMFRI convened a meeting of the Heads of Divisions, Faculty Members and M.F.Sc. and Ph.D. students of PGPM on 16-07-2002 to review the activities of Postgraduate Programme in Mariculture. In his address, Director commended the achievements in post-graduate education at CMFRI since its inception in 1980.

Ph.D. Programme

- **A total of 17 regular students and Senior Research Fellows** in sponsored projects of the Institute were awarded Ph. D Degrees during the period as detailed below:
- Ph.D. degrees were awarded to 11 students in Mariculture by the CIFE, 3 students in Marine Sciences by the CUSAT, 2 students by the Manonmaniam Sundaranar University and one by the University of Madras.

Degrees awarded by the Central Institute of Fisheries Education (Deemed University)

- Shri. C. N. Haneefa Koya for his thesis entitled "Studies on ecology, chemical constituents and culture of marine macroalgae of Minicoy Islands, Lakshadweep (Major Advisor Dr. C.P. Gopinathan, Principal Scientist, FEMD).
- Shri. Ashuthosh D. Deo for his thesis entitled "Ichthyocrionotoxicity of marine catfishes of Mumbai coast. (Major Advisor Dr. M. Devaraj, former Director, CMFRI).
- Shri. S. Renjith for his thesis entitled "Impact of feed and feed ingredients on the environment and microflora of farmed shrimp. (Major Advisor Dr. K. Gopakumar, Former Deputy Director General, (Fy), ICAR, New Delhi).
- Kum. Soniya Sukumaran for her thesis entitled "Studies on sporulation in some commercially important marine algae" of Mandapam coast. (Major Advisor Dr. N. Kaliaperumal, Principal Scientist, FEMD).
- Shri. R. Manoj Nair for his thesis entitled "Studies on induced maturation, spawning and larval settlement in Green Mussel *Perna viridis* (Linnaeus 1758) (Major Advisor Dr. K.K. Appukkuttan, Principal Scientist & Head, MFD).
- Shri. T.M. Najmudeen for his thesis entitled "Reproductive Biology and seed production of the tropical abalone *Haliotes varia* Linnaeus (Gastropoda)" (Major Advisor Dr. A.C. C. Victor, Principal Scientist).

- Ms. Vineetha Aravind for her thesis entitled "An evaluation of the intertidal oligochaete *Pontodrilus bermudensis* as dietary supplement for stimulation of reproduction in *Penaeus semisulcatus* de Haan" under the guidance of Dr. G. Maheswarudu, Senior Scientist.
- Mr. Anil Kumar P.K. for his thesis entitled "Biochemical studies and energetics of the spiny lobster *Panulirus homarus* (Linnaeus 1758)"under the guidance of Dr. E.Vivekanandan, Principal Scientist.
- Mr. Sunil Kumar P. for his thesis entitled "Boring sponge infestation on the mussel *Perna indica* Kuriakose and Nair 1976 from the South West Coast of India" under the guidance of Dr. P.A. Thomas, Principal Scientist (Rtd).
- Mr. Ansy Mathew for his thesis entitled "Nursery rearing of pearl oyster *Pinctada fucata* (Gould, 1850)" under the guidance of Dr. G. Syda Rao, Principal Scientist.
- Ms. Pramila, S. for her thesis entitled " Bacterial diseases and their management in chosen marine ornamental fishes" under the guidance of Dr. A. P. Lipton, Principal Scientist.

Degrees awarded by the Cochin University of Science and Technology

- Ms.Josileen Jose, Scientist (SS), Crustacean Fisheries Division, CMFRI was awarded Ph.D in Marine Sciences for her thesis entitled 'On the Fishery, Biology and Hatchery Technology of the Portunid crab *Portunus pelagicus.*' under the guidance of Dr. N.G. Menon, Principal Scientist.
- Mr. Abdul Samad for his thesis entitled "Population characteristics of prawns in natural and selective stocking systems" under the guidance of Dr. N.G. Menon, Principal Scientist.

Degrees awarded by the Manomanium Sundaranar University

- Shri. A.N. Rajan, SRF, (ICAR Ad-hoc project) was awarded Ph.D. degree in Applied biology for his thesis entitled "Studies on ulcerative disease in *Etroplus maculatus* caused by *Vibrio* species and its management using bacteria and marine natural products" under the guidance of Dr. A.P. Lipton, Principal Scientist.
- Shri. J. Selvin, SRF (ICAR Ad-hoc project) was awarded Ph.D. degree in Environmental Biotechnology by Manonmanium Sundaranar University for his thesis entitled "Shrimp disease management using bioactive secondary metabolites from marine organisms". Under the guidance of Dr. A.P. Lipton, Principal Scientist.

Degrees awarded by the University of Madras

- Shri. R. Soundararajan, Principal Scientist, CARI, Port Blair (on study leave) for his thesis entitled "Studies on Marine Bivalves – some ecological and biological aspects of C*rassostrea rivularis* (Gould) and *Saccostrea cucullata* (Born) (Family: *Ostreiidae*)"under the guidance of Dr. E.Vivekanandan, Principal Scientist.
- **Five more Ph.D students** of Mariculture Programme have submitted their thesis to CIFE and **one student** of Marine Sciences to the Cochin University of Scicece and Technology for adjudication and the results were awaited.
- **Eighteen Ph.D. students** under the PGPM under the CIFE stream

14 Ph.D. students of the CUSAT stream are progressing with their research/course work.

M.F.Sc. Mariculture Programme

- **Ten students** have successfully completed the M.F.Sc. degree in Mariculture and were awarded Degree by CIFE (Deemed University) during November 2002.
- **Fifteen M.F.Sc. students** are currently progressing well with their Course/Research work.

Preparation of Lecture outlines and Practical Manual

- Lecture outlines were prepared for 10 M.F.Sc. courses in Mariculture.
- Practical Manuals were prepared for 10 M.F.Sc. courses in Mariculture.

Revised Draft Syllabus for Ph.D. Mariculture

- The Draft Syllabus for Ph.D. Mariculture has been prepared.

Krishi Vigyan Kendra

KVKs' are innovative grass root level Agricultural Institutions. The basic philosophy behind KVK is vocational training in Fisheries, Agriculture, Animal Science and Home Science to be imparted for practicing farmers, rural youth, rural women and extension workers of the state belonging to the development departments. Rapid, continuous and accelerated adoption of technology is possible only when the farming community is educated, enlightened and trained in the rudiments of science and technology.

a. Practicing farmers (On campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC	
						M	F
Fisheries	Coastal Bio resource management	1	18	55	19	3	6
Agriculture	Ornamental plant nursery management	1	-	8	8	-	-
	Nutrition management in coconut farm	1	8	12	20	-	-
TOTAL (a)		3	26	57	83	3	6

b. Practicing farmers (Off campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC	
						M	F
Fisheries	Shrimp farming	15	285	29	314	56	3
	Fresh water ornamental fish culture	1	7	4	11	1	1
Agriculture	Vegetable cultivation	2	30	6	36	-	-
	Coconut cultivation	5	9	91	100	1	2
	Jasmine cultivation	2	3	37	40	-	2
Animal Science	Disease management in cattle	1	5	2	7	-	-
TOTAL (b)		26	339	169	508	58	8

c. Rural Youth (On campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC	
						M	F
Fisheries	Fresh water ornamental fish culture	1	-	19	19	-	1
Home Science	Shrimp pickle preparation	1	-	19	19	-	1
	Pine apple jam preparation	1	-	16	16	-	1
	Cleaning powder preparation	4	-	78	78	-	3
	Tomato sauce preparation	2	-	39	39	-	-
	Fish cutlet preparation	2	-	40	40	-	-
	Fish wafer preparation	1	-	20	20	-	1
	Health and Hygiene	1	-	20	20	-	1
	Wine making	2	-	38	38	-	-
	Shrimp wafer preparation	1	-	16	16	-	1
TOTAL (c)		16	-	305	305	-	8

d. Rural Youth (Off campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC	
						M	F
Fisheries	Shrimp farming	6	78	42	120	25	4
	Fresh water ornamental fish culture	1	11	9	20	2	-
	Aqua farming	1	4	38	42	3	24
Agriculture	Vegetable cultivation	2	1	41	42	-	-
	Mushroom cultivation	4	13	67	80	1	3
	Jasmine cultivation	15	33	283	316	1	23
	Vanilla cultivation	1	10	12	22	-	1
	Medicinal plant cultivation	1	-	20	20	-	-
Home Science	Shrimp pickle preparation	4	4	87	91	-	9
	Fish pickle preparation	5	-	112	112	-	32
	Fish cutlet preparation	3	4	66	70	-	6
	Pine apple jam preparation	4	4	80	84	-	23
	Tomato sauce preparation	2	-	40	40	-	5
	Orange squash preparation	4	-	80	80	-	19
	Grape squash preparation	1	-	20	20	-	-
	Mixed fruit jam preparation	3	-	70	70	-	30
	Wine making preparation	3	-	54	54	-	35
	Cleaning powder preparation	13	11	268	279	-	58
	Environmental hygiene	3	-	58	58	-	6
	Health and hygiene	1	-	20	20	-	1
	Food and nutrition	1	-	20	20	-	-
Animal Science	Goat farming	1	-	20	20	-	-
TOTAL (d)		79	173	1507	1680	32	279

e. Extension workers

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC M	SC F
Home Science	Shrimp wafers	2	6	24	30	1	2
TOTAL (e)		2	6	24	30	1	2
GRAND TOTAL (a+b+c+d+e)		**126**	**544**	**2062**	**2606**	**94**	**303**

Conducting Seminars /Women's meet/farmers meet etc.

Sl.No.	Date	Nature of activity	Place
1.	17-8-2002	Farmers day programme	Krishi Bhavan , Eloor
2.	16-10-2002	World food day with the theme "Water: Resource for food security	KVK, CMFRI, Narakkal
3.	25 to 27-11-2002	Seminar on "Empowerment of women"	Gramma panchayat, Eloor
4.	21-12-2002	Women's meet on "Empowerment of rural women"	Surya Kudumba shree unit, Kadapuram, Narakkal
5.	23-12-2003	Kisan Divas	KVK, CMFRI, Narakkal
6.	1-1-2003	Women's meet on "Empowerment of rural women"	Gramma panchayat, Elamkunnapuzha
7.	12-2-2003	Seminar on "Pokkali paddy cultivation"	Government H.S.S. Elamkunnapuzha
8.	10-3-2003	Women's meet on "Empowerment of rural women"	Model Kudumbashree unit, Kadapuram, Narakkal

Conducting camps, campaign and demonstration

Sl.No.	Date	Nature of activity	Place
1.	4-6-2002	Immunization camp for cattle	Village north of KVK campus, Narakkal
2.	26 & 28 - 6 - 2002	Vaccination campaign for Raniket disease of poultry	Village north of KVK campus, Narakkal
3.	27-7-2002	De worming campaign for poultry	Village north of KVK campus, Narakkal
4.	1 &2 - 3-2003	Demonstration on de-salination	KVK Campus, Narakkal

Shri T.M. Jacob and Dr. M.A. Kuttappan, Hon'ble Ministers, Govt. of Kerala visiting the desalination unit at KVK campus

Empowerment of rural women

Self help groups were identified for the empowerment of rural women. Training programmes were arranged for selected women groups The self help group "*Shree Lakshmi*" at Kuzhipilly in Vypeen Block for which training was given in the preparation of cleaning powder has started a small scale unit and started marketing the cleaning powder under the name "*Shree Lakshmi products*". The inaugural sale of the product was on 27-1-2003.

Trainers' Training Centre

During the year, 12 training courses were organized availing the expertise at CMFRI. The courses were conducted at Cochin, Calicut, and Badagara. Rs. 1,03,000 (Rupees one lakh three thousand only) was collected towards the course fee during the year. The participants were officials and entrepreneurs. The details of the training programmes conducted are given below.

Sl. No.	Title of the course	Month	No. of Days	No. of Participants
1.	Crab culture	April 02	6	14
2.	Mussel culture	April	2	20
3.	Ornamental fish culture	June	6	18
4.	Ornamental fish culture	July	6	10
5.	Ornamental fish culture	September	6	15
6.	Fish processing	September	6	20
7.	Fish diseases and their management	September	8	5
8.	Mariculture	September	6	19
9.	Ornamental fish culture	October	6	14
10.	Ornamental fish culture	December	6	10
11.	Ornamental fish culture	February 03	6	15
12.	Ornamental fish culture	March	3	22
	Total number of courses conduced		**12**	
	Total number of participants		**182**	

TTC training programme on 'Fish Disease and their Management' for MPEDA officials during 23rd September to 1st October 2002

Awards & Recognitions

Dr. V.S.R. Murty receiving the Rafi Ahmed Kidwai Award from the Hon'ble Agriculture Minister and President of ICAR Society Shri Rajnath Singh

Dr. V. Kripa receiving the Best Scientific Paper in Hindi Award from the Hon'ble Union Minister Shri Arun Jaitly

Ms. Smitha Gopal

Ms. C.N. Bhavani

Mr. Joice Abraham

Ms. Sandhya Sukumaran

The **Rafi Ahmed Kidwai Award** for Outstanding Agriculture Research for the biennium 2001-2002 has been conferred on *Dr. V. Sriramachandra Murty*, Principal Scientist and Head, Demersal Fisheries Division for his pioneering and original research for nearly four decades in fisheries biology, population dynamics, stock assessment and sustainability of several groups of marine fishes. Dr. Murty's contributions are pioneering and are of immense value in resource management, which will help policy planners to devise and implement sustainable fisheries management policies relevant to the Indian situation. His work contributed significantly to marine fisheries development and management of exploited demersal finfish stocks besides becoming a reference material for other marine fisheries researchers. The award was presented to Dr. Murty at a function held at New Delhi on 16-07-03 by the Honorable Union Minister for Agriculture, Shri. Rajnath Singh.

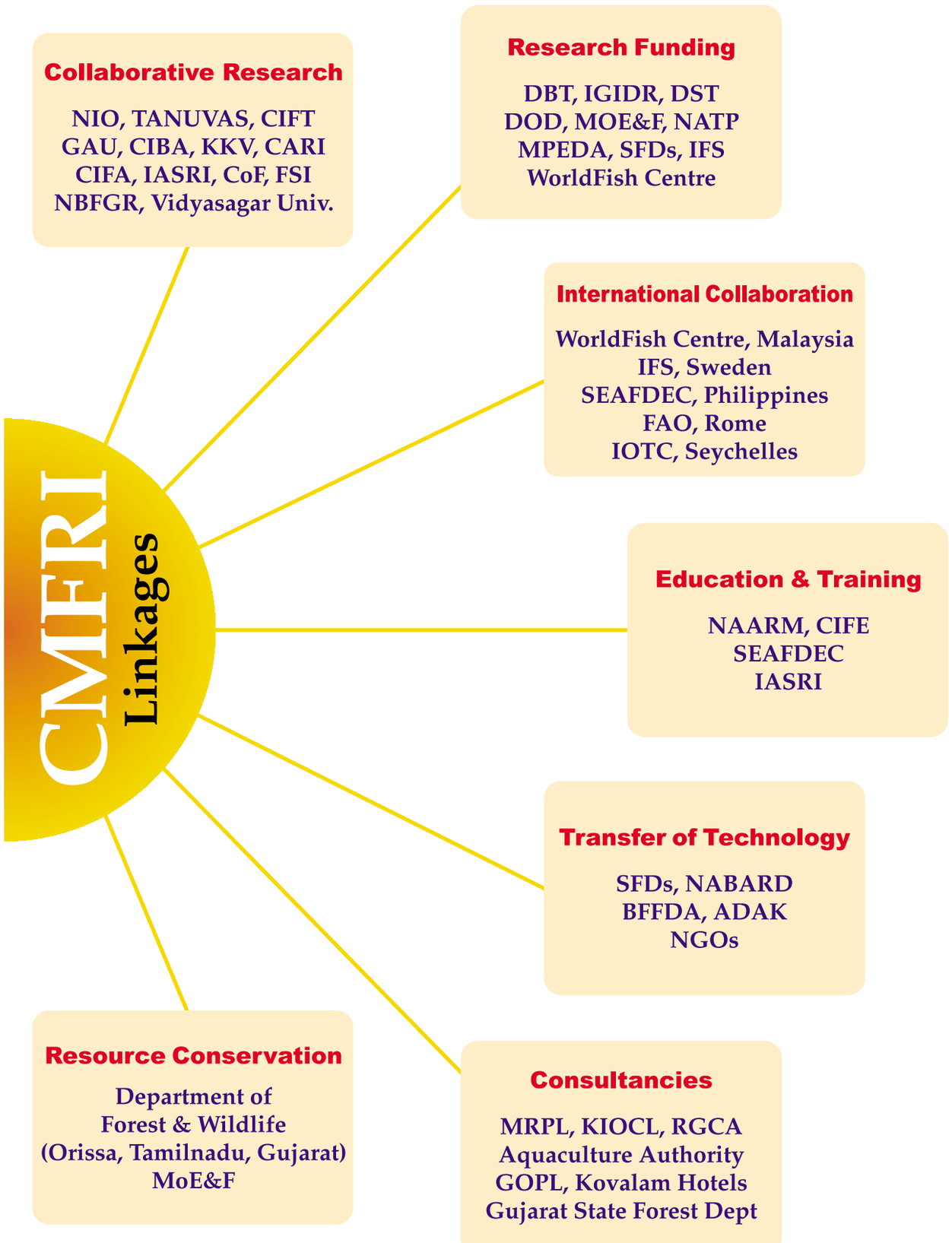
Dr. V. Kripa, Senior Scientist, Molluscan Fisheries Division was conferred an award by the Kendriya Sachivalay Hindi Parishad, New Delhi. Dr. Kripa's paper was adjudged the **Best Scientific Paper in Hindi** under the non-Hindi speaking category. The award was presented by the Honorable Union Minister for Law, Shri Arun Jaitly at New Delhi on 27th June 2002.

Ms. Sandhya Sukumaran, Ph.D scholar in Mariculture secured the **First Rank in ARS Examination** (2001-02) in the discipline Fish and Fisheries Science conducted by ASRB, New Delhi.

Ms. Smitha Gopal, M.F.Sc student (1999-01 batch) was awarded the **Hiralal Choudhary Gold Medal** by the CIFE for securing first rank in M.F.Sc Mariculture.

Ms. C.N. Bhavani, M.F.Sc student (2000-02 batch) was awarded the **Gold Medal** by the CIFE for securing first rank in M.F.Sc Mariculture.

Shri Joice Abraham and *Ms. Sandhya Sukumaran* Ph.D students of PGPM of CMFRI won the **First Prize of the Dr. S. Jones Memorial Quiz on Marine Life** conducted by the Marine Biological Association of India at CMFRI, Cochin on 28-02-2002.


CMFRI
Linkages
Collaborative Research
NIO, TANUVAS, CIFT
GAU, CIBA, KKV, CARI
CIFA, IASRI, CoF, FSI
NBFGR, Vidyasagar Univ.
Research Funding
DBT, IGIDR, DST
DOD, MOE&F, NATP
MPEDA, SFDs, IFS
WorldFish Centre
International Collaboration
WorldFish Centre, Malaysia
IFS, Sweden
SEAFDEC, Philippines
FAO, Rome
IOTC, Seychelles
Education & Training
NAARM, CIFE
SEAFDEC
IASRI
Transfer of Technology
SFDs, NABARD
BFFDA, ADAK
NGOs
Consultancies
MRPL, KIOCL, RGCA
Aquaculture Authority
GOPL, Kovalam Hotels
Gujarat State Forest Dept
Resource Conservation
Department of
Forest & Wildlife
(Orissa, Tamilnadu, Gujarat)
MoE&F

Publications

- **Indian Journal of Fisheries**
- **Marine Fisheries Information Service Technical and Extension Series**
- **CMFRI Newsletter**
- **Matsyagandha** - CMFRI special publication
- **Book of Abstracts** - National Conference on Aquaculture Nutrition
- **Book of Abstracts** - First Indian Pearl Congress and Exposition
- **Bibliography of the Gulf of Mannar** - CMFRI special publication
- **Code of Conduct for Responsible Fisheries** - in Malayalam
- **Little Fishes and Tiny Nets** - an animated film on CD
- **Agricultural Technology Information Centre** - Activities and Achievements
- **Institution Village Linkage Programme** - Coastal Agro Ecosystem and Interventions

Peer Reviewed Journals

CHAKRABORTHY, S.K. 2002. Growth, mortality and stock assessment of *Nemipterus mesoprion* (Bleeker) from Mumbai waters. *Indian J. Fish*., 49 (4): 389-395.

DHARMARAJ, S AND C.P. SUJA. 2002. Development of technology in in-vitro pearl production in India. *Bull. Malacological Soc. London* 39: 9-10.

GRACE MATHEW, N.K. SANIL, N. SREEDHARAN, K.S. LEELA BHAI, L.R. KAMBADKAR AND N. PALANISWAMY, 2002. Experiments on Broodstock development and spawning of *Epinephelus tauvina. Indian J. Fish.* 49 (2): 135-139.

JAYAPRAKASH, A.A. 2002. Long term trends in rainfall, sea level and solar periodicity: A case study for forecast of Malabar sole and oil sardine fishery. *J. mar. biol. Ass. India*, 44 (1&2): 163 –175.

KAGLEY, A.N., R.G. SNIDER, P.K. KRISHNAKUMAR AND E. CASILLAS. 2003. Assessment of seasonal variability of cytochemical responses to contaminant exposure in the blue mussel *Mytilus edulis* (Complex). *Arch. Environ. Contam. Toxicol***.** 44: 43–52.

KALADHARAN, P., R.GIREESH AND K.S.SMITHA, 2002. Cost effective medium for the laboratory culture of live feed micro algae. *Seaweed Res. Utiln.,* 24(1): 33-40.

KALIAPERUMAL, N., J. R. RAMALINGAM, S. KALIMUTHU AND R. EZHILVALAVAN, 2002. Seasonal changes in growth, biochemical constituents and phycocolloid of some marine algae of Mandapam coast. *Seaweed Res.Utiln.*,24(1): 73-77.

KIZHAKUDAN, J.K. 2002. Fishery of the blue swimming crab, *Portunus pelagicus* (Linnaeus) in Gujarat. *J. mar. biol. Assn. India*, 44 (1 &2): 97-106.

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Approved Ongoing Projects

In-house Projects

SL. NO.	Project Code No.	Title of the Project
FISHERY RESOURCES ASSESSMENT DIVISION		
1.	FRA/ASSESS/01	Assessment of exploited marine fishery resources
2.	FRA/ASSESS/02	Stock assessment techniques for exploited marine fish and shellfish resources
3.	FRA/MOD/01	Predictive modelling in marine fisheries
4.	FRA/MOD/02	Determination of optimum sample size to estimate the catch and effort for use in marine fisheries
PELAGIC FISHERIES DIVISION		
5.	PEL/CAP/1	Development of management strategies for sustainable fishery of Sardines (*Sardinella* spp.)
6.	PEL/CAP/2	Development of management strategies for judicious harvesting of anchovies
7.	PEL/CAP/3	Development of strategies for rational exploitation of seerfishes
8.	PEL/CAP/4	Development of strategies for sustainable exploitation of tuna and billfish resources of Indian EEZ
9.	PEL/CAP/5	Development of management strategies and options for sustainable harvest of mackerels
10.	PEL/CAP/6	Development of management strategies and options for sustainable fishery of Bombay duck
11.	PEL/CAP/7	Monitoring of fishery and resource characteristics of exploited ribbonfish stocks and their management along the Indian coast
12.	PEL/CAP/8	Management of carangid resources of Indian EEZ
13.	PEL/BIOD/01	Taxonomy of marine pelagic finfishes
DEMERSAL FISHERIES DIVISION		
14.	DEM/CAP/01	Fishery and biological characteristics of the exploited stocks of elasmobranchs
15.	DEM/CAP/02	Fishery and biological characteristics of exploited resources of groupers, snappers, breams and catfishes
16.	DEM/CAP/03	Characteristics of exploited stocks of threadfin breams and silverbellies
17.	DEM/CAP/04	Fishery and biological characteristics of exploited stocks of croakers
18.	DEM/CAP/05	Biology and stock assessment of lizard fishes, bulls eye, pomfrets and threadfin resources
19.	DEM/CAP/06	Biology and fishery of flatfishes, flatheads, goatfishes and whitefish
20.	DEM/BIOD/01	Taxonomy of demersal fishes of India
21.	DEM/CUL/01	Marine finfish culture
CRUSTACEAN FISHERIES DIVISION		
22.	CRU/CAP/01	Investigations on the fishery and biological characteristics of exploited penaeid shrimp stocks
23.	CRU/CAP/02	Stock assessment and management of non-penaeid shrimp resources of India
24.	CRU/CAP/03	Investigations on the resource characteristics and development of management strategies for lobsters and crabs
25.	CRU/BIOD/01	Taxonomy of important crustaceans
26.	CRU/CUL/01	Broodstock development, selective breeding and restocking of marine shrimps
27.	CRU/CU//02	Breeding and seed production of lobster and crabs
MOLLUSCAN FISHERIES DIVISION		
28.	MOL/CAP/01	Fishery and biological characteristics of exploited cephalopod resources
29.	MOL/CAP/02	Assessment of bivalve and gastropod resources
30.	MOL/CUL/01	Technological feasibility studies and upgradation of molluscan mariculture
31.	MOL/CUL/02	Selective breeding of pearl oyster *Pinctada fucata* (Gould)
32.	MOL/CUL/03	Technological upgradation of molluscan seed production
33.	MOL/CUL/04	Marine pearl production through tissue culture and disease investigations on farmed bivalves
34.	MOL/BIOD/01	Taxonomy of marine molluscs

FISHERY ENVIRONMENT MANAGEMENT DIVISION

35.	FEM/01	Monitoring the environmental characteristics of the inshore waters in relation to fisheries
36.	FEM/02	Monitoring the state of health of the sea
37.	FEM/03	Resource assessment of seaweed and their culture
38.	FEM/04	Development of strategies for sea turtle and sea cucumber conservation
39.	FEM/05	Mariculture of live feed organisms
40.	FEM/BIOD/01	Taxonomy of marine zooplankton

PHYSIOLOGY, NUTRITION AND PATHOLOGY DIVISION

41.	PNP/NUT/01	Development of cost- effective and eco-friendly feeds for cultivable marine crustaceans and finfish by biotechnological interventions
42.	PNP/PAT/01	Disease monitoring and management in mariculture
43.	PNP/BIOT/01	Development of molecular and immuno- diagnostic kits for marine finfish and shellfish pathogens
44.	PNP/BIOT/02	Cryo-preservation of marine fish spermatozoa
45.	PNP/GEN/01	Population genetic studies in threadfin breams and sardines
46.	PNP/PHY/01	Development of cost effective low-stress methods for live transport of fish and crustaceans

SOCIO-ECONOMIC EVALUATION AND TECHNOLOGY TANSFER DIVISION

47.	SEE/PMS/01	Price behaviour and marketing system of marine fisheries in India
48.	SEE/ECO/01	Economics of marine fishing operations
49.	SEE/ITK/01	Indigenous knowledge systems and community based resource management in marine fisheries
50.	SEE/TOT/01	Evaluation of transfer of technology programmes in marine fisheries sector

Sponsored Projects (National)

SL. NO.	Project Code No.	Title of the Project
1.	ERP/REV/01	Production of agar and sodium alginate from the sea weeds of Gulf of Mannar and Palk Bay
2.	ERP/REV/02	Commercial production of cultured pearls adopting onshore culture technology
3.	ERP/DST/01	Studies on the immuno-response during molt cycle in the spiny lobster
4.	ERP/APC/11	Application of trophic modeling for management of marine fisheries of Karnataka
5.	ERP/APC/12	Studies on incidence of toxic principle and parasites on seafood
6.	ERP/APC/13	Intensive culture of brine shrimp
7.	ERP/APC/14	Evaluation of genetic heterogeneity in marine ornamental fishes using molecular genetic markers
8.	ERP/APC/15	Investigations on reproductive dynamics of penaeid prawns in Mumbai
9.	ERP/APC/16	Increasing fish production through artificial fish habitats
10.	ERP/APC/17	Studies on the immune response in shrimp (*Penaeus indicus*)
11.	ERP/APC/18	Development of technology for sea farming of commercially important whelks *Babylonia spp*
12.	ERP/DOD/05	Investigations on the toxic algal blooms in the EEZ of India
13.	ERP/DOD/06	Studies on deep scattering layer in the Indian EEZ
14.	ERP/DOD/07	Development of acoustic techniques for fish and DSL biomass estimation
15.	ERP/DOD/08	Investigations on the effect of bottom trawling on the benthic fauna off Mangalore coast
16.	ERP/DBT/07	Studies on biotechnological aspects of disease management in aquaculture using immunostimulants
17.	ERP/DBT/08	Transfer of technology of seaweed culture for rural developmnet
18.	ERP/KFD/02	Development of artificial reefs off Moodadi and Thikkodi
19.	ERP/KFD/03	Development of artificial reefs along the Kerala coast (Kannur)
20.	ERP/KFD/04	Survey, assessment and popularization of marine ornamental fishes along the north Malabar coast
21.	ERP/MEF/04	Studies on the biology, captive spawning and searanching of the sea horse
22.	ERP/MPD/04	Participatory Management and conservation of lobster resources along the south west coast of India
23.	ERP/IGD/01	Economic analysis of inshore fishery resource utilization of coastal Kerala

Sponsored Projects (International)

SL. NO.	Project Code No.	Title of the Project
1.	ERP/WFC/02	Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poor households in Asia
2.	ERP/IFS/02	Effect of probiotic feeding in the rearing and production of marine shrimp larvae
3.	ERP/IFS/03	Environment impact assessment of suspended culture of the green mussel *Perna viridis* and the edible oyster *Crassostrea madrasensis* in a tropical estuarine system

NATP Schemes

SL. NO.	Project Code No.	Title of the Project
PSR Mode		
1.	2090000002	Nutrition and pathology in mariculture
2.	2090000003	Shrimp and fish broodstock development and breeding under captive conditions
3.	2090000004	Breeding and culture of pearl oysters and production of pearls
4.	2090000008	Mussel Mariculture
5.	2090000009	Impact of dams on river run-off into sea and changes in nutrient and productivity profile of coastal waters
6.	2090000013	Mangrove ecosystem : Biodiversity and its influence on the natural recruitment of selectede commercially important finfish and shellfish species in fisheries
7.	2090000014	Studies of fisher women in coastal ecosystems of Andhra Pradesh, Karnataka, Tamil Nadu and Kerala
8.	2090000015	Augumentation of marine fish production in Lakshadweep
9.	2090000016	National resources management-coral reef ecosystem
CGP Mode		
10.	2090000007	Aquaculture, breeding and hatchery production of marine ornamental fishes with special reference to clownfishes and damselfishes
11.	2090000011	Designing and validation of communication strategies for sustainable/responsible fisheries - a co-learning approach
12.	2090000013	Broodstock development, breeding, hatchery production and restocking of mud crabs
13.	2090000017	Development of a national referral laboratory for marine fish & shellfish micobial diseases
ATIC		
14.	2090000005	National Agricultural Technology Information Centre
IVLP		
15.	2090000010	Technology assessment and refinement in coastal agro-ecosystems
MM		
16.	2090000017	National Integrated Resources Management System
ISD		
17.	2090000006	Library Information System

Consultancies & Patents

Consultancies during the year

S.No	Name of Client	Name of the consultancy project	Duration	Amount.
1	M/s.MRPL, Mangalore	Marine pollution monitoring in the Arabian sea off Chitrapur on weekly basis during non-monsoon season.	May 2002-Apr 2003	Rs. 18,04,000
2	M/s.KIOCL, Mangalore	Chemical parameters of the effluent and hydrobiological conditions in the effluent receiving water off Thannirbavi. (Phase-6)	Sep 2002-Aug 2003	Rs. 4,25,000
3	M/s GPOL, Mangalore	Monitoring studies on the hydrobiological conditions in the Arabian Sea off Thanirbavi , near the marine outfall of Thanirbavi Power Plant Facility M/sGPOL, Mangalore	Oct 2002-May 2003	Rs. 3,00,000
4	Gujarat State Department of Forest & Environment	Rapid Impact Assessment Study in Marine National Park in Gulf of Kutch, Gujarat.	Dec 2002-May 2003.	Rs. 14,45,460
5	M/s MRPL Mangalore	Environmental monitoring in the Arabian sea off Chitrapur and effluent analysis. (Phase-7)	Nov 2002-Oct 2003	Rs. 6,64,000
		Total Amount		**Rs. 46, 38,460**

Patents (provisional) obtained during the year

S.No	Name of Scientist	Name of Patent	Research Centre	Date of Provisional Patent grant
1	Dr. G. Syda Rao Principal Scientist	Onshore marine pearl culture	Visakhapatnam	19-02-2002
2	Ms. Grace Mathew Principal Scientist	Broodstock development of groupers in indoor FRP tanks in recirculating seawater system under controlled conditions	Cochin	07-03-2003

Important Meetings

RAC

The Eighth meeting of the Research Advisory Committee (RAC) of the CMFRI was held on 4.2.2003 at the Institute headquarters, Cochin under the chairmanship of Dr. T.J. Pandian, Former National Professor. After considering the proposals made by the Director, the RAC recommended the following.

- Creation of a division of Mariculture with a major focus on ongoing programmes and in addition, selected ornamental fishes and black lip oyster.
- Creation of division of Marine Biodiversity and regrouping of the programmes of the PNP Division by creating the two new divisions namely Physiology, Nutrition and Pathology and Genetics and Marine Biotechnology.
- The RAC also recommended establishment of a Research Centre in Orissa on a priority basis to cover the Northeastern maritime States of Orissa and West Bengal to increase the coverage of fish landing data collection and to address region-specific issues related to the approved projects of the CMFRI.
- Impressed by the performance of the CMFRI, several funding agencies like ICAR, DOD, DBT, MoE&F have chosen to invest on the expertise of the CMFRI; this is amply evidenced by the grant of more than Rs.9 crores by these agencies. At present, each scientist is responsible for at least one in-house project and a sponsored project. Hence it becomes all the more important to go for recruitment to fill vacant positions of scientists for the CMFRI.
- The RAC recommended the restoration of the two positions of Joint Directors, one for Research and another for Administration by re-designating two of the Principal Scientists positions to assist the Director in the overall management of the Institute.
- The contingency available for scientists towards the implementation of research programmes should be substantially increased in view of the cost escalation of the various consumables and maintenance of specialized equipment. It is recommended that the contingency per scientist per annum is increased from Rs.40,000 to Rs.1,00,000.
- In view of the constant escalation of railway and airfare the TA available for scientists is totally inadequate. The RAC recommends that the TA for visits abroad may be budgeted separately from that within the country. The TA funds for Research managers including Director/Heads of Divisions should be budgeted separately from general TA for other scientists and field staff.
- Travel grant for scientists within the country must be substantially increased, as the CMFRI has 3 Regional Centres, 9 Research Centres and 28 field Stations.
- The RAC strongly recommended provision of E-mail facility in all the field Centres, with network connectivity between the Institute, Regional Centres, Research Centres and Field Centres.
- In the Annual Reports, the list of publication may be grouped under three heads: (i) Research publications (ii) Popular articles and (iii) Abstracts of the presentations in Seminar/Symposia.

IMC

The Institute Management Committee (IMC) met once during the year 2002-2003, on 4-10-2002. The Committee observed that not filling up of the vacancies in the Scientific Category since 1999 is affecting the research work badly. The Committee felt that till the new recruitment is made, Council should give permission to recruit research scholars on contract basis as done in the cases of funded projects, or else the Director of the Institute should be delegated with powers to engage retired Scientists on short term basis as is done in SAUs.

The Committee observed that the utilization of funds should be speeded up to avoid rush of expenditure during the last months of the financial year. The Committee also approved the proposal for replacement of the existing lifts in the CMFRI Lab-cum-Office building by meeting the expenditure within the overall estimated construction of 5th and 6th floor. The Committee also ratified the X Five Year Plan proposals of the Institute.

SRC

The ninth reconstituted Staff Research Council (SRC) of CMFRI was held at Cochin on 27th and 28th June 2002. 71 Scientists who are Principal Investigators of ongoing in-house and sponsored research projects from the Head Quarters, Regional and Research Centres of CMFRI presented the progress of the projects. The meeting is significant in that the progress report is for the final year of the IXth plan and from 2002 onwards the Institute will be implementing the Xth plan projects. The Chairman Prof (Dr.) Mohan Joseph Modayil in his welcome address pointed out that the Institute will have to function with lesser man power as there is no recruitment to fill up the vacancies. He emphasized the need for patenting of the technologies and to provide major thrust on publications. The proposal for establishing a Centre of Excellence in Tropical Mariculture at Regional Centre of CMFRI, Mandapam Camp is expected to be approved in the EFC. Dr. A.D. Diwan, ADG (M.Fy) appraised the need for commercialization of mariculture technologies developed by the Institute. The progress under each project was critically evaluated.

Participation of scientists in conferences, meetings, workshops, symposia and training in India and abroad

Prof (Dr.) Mohan Joseph Modayil, Director, participated in the following meetings

1. Fisheries Divisional Committee meeting for Zero Base Budgeting at ICAR Headquarters under the Chairmanship of DDG (Fy) on 11th April 2002.

2. Meeting with the Lakshadweep Administrator, Kavarati regarding establishment of an ornamental fish hatchery and culture facilities at Minicoy Island along with Head, DFD of CMFRI, Cochin on 4th July 2002.

3. EFC finalization meeting with SMD, ICAR, New Delhi from 4th to 6th September 2002.

4. Seminar/Meeting held at IARI, New Delhi on 26th September and presented a concept note on Global Warming and Challenges in Marine Fisheries.

5. Chaired the 57th Management Committee of CMFRI, held at Cochin on 4th October 2002.

6. First meeting of the Expert Committee to study the impacts of tourism on the backwater ecosystems in the State of Kerala and for submitting appropriate recommendations, on 7th October at Trivandrum.

7. Second Indian Fisheries Science Congress at Bhopal during 23rd - 25th October 2002.

8. West Coast Bio-diversity meeting organized by the Ministry of Environment & Forest on 26th & 27th October at Goa and on 25th November 2002 at CMFRI, Cochin.

9. Meeting on KVKs/TTCs of CMFRI, CIFA and CIFRI with the Directors and representatives of the concerned Institutes under the Chairmanship of DDG(Fy) on 29th November, 2002 at New Delhi.

10. Project Planning Committee Meeting under the Chairmanship of Dr. Swaminathan at Dr. Swaminathan Research Foundation, Chennai on 12th December 2002.

11. Eighth Coastal Zone Management Authority Meeting of Govt. of Kerala at Science, Technology & Environment Department, Trivandrum on 15th January 2003.

12. Research Advisory Committee of CMFRI held on 4th February 2003 at CMFRI, Cochin.

13. Meeting held at CMFRI, Cochin, with the Principal Advisor (Agriculture), Planning Commission, Govt. of India, along with the Financial Advisor, ICAR, DDG (Fy), ICAR and all ICAR Directors of Fisheries Research Institutes, for discussion on X Plan EFC Documents on 13th February 2003.

14. Seminar organized by CIFT on “Fishing and fish processing Industry of Gujarat - present status and future needs” on 7th March 2003 at CIFT, Veraval.

Scientists of the institute participated in the following conferences, meetings, workshops, symposia and training

First Meeting of Reconstituted Consultative Group of FSI at Mumbai on 18.4.2002 – *Dr. V.S.R. Murthy*

Meeting with Secretary, DAHD & DDG (Fisheries), ICAR at New Delhi 18-19 September, 2002 to discuss issues on marine fisheries research and data needs – *Dr. V.S.R. Murthy & Dr. M. Srinath.*

Capacity Building Training Workshop on Sea Turtle Conservation and Management for the frontline staff of Wildlife, fisheries and research organization of west coast of India and Lakshadweep at Cochin during 19-21 June 2002 – *Drs. M. Rajagopalan, VS.R. Murthy, M. Srinath, E.V. Radhakrishnan, J.P. George, P. Kaladharan, P.K. Krishnakumar, Reeta Jayasankar, S. Ashaletha, V.P. Vipinkumar, K. Vijayakumaran*

First Meeting of the Sagar Sampada Cell Scientific and Technical Advisory Committee during 3-5 June 2002 at Cochin - *Dr. V.S.R. Murthy*

Meeting of the ADB sponsored ICAR-ICLARM collaborative project at CICFRI, Barrackpore during 10-12 July 2002 and at CMFRI, Cochin during 28-29 January 2003 – *Dr. N.G.K. Pillai.*

Sixth Indian Fisheries Forum at CIFE, Mumbai during 17-20 December 2002 – *Drs. N.G.K. Pillai, R. Sathiadas, S.G. Raje, J.K. Kizhakudan, Josileen Jose, G.S.D. Selvaraj, P. Kaladharan, V.V. Singh, Reeta Jayasankar, P. Jayasankar, K.S. Sobhana, M.K. Anil*

Joint meeting of Kerala Biodiversity Committee and Steering Committee of State Biodiversity Strategy and Action Plan at Thycaud, Thiruvananthapuram during 16 January 2003 – *Dr. N.G.K. Pillai.*

National Official Language Seminar on Identification of new researchable issues in Marine Fisheries at CMFRI, Cochin during 30-31 January 2003 – *Drs. N.G.K. Pillai, K.K. Appukuttan, M. Rajagopalan, R.Paul Raj, E.V. Radhakrishnan, L. Krishnan, P.C. Thomas, P. Jayasankar, K.S. Sobhana, Imelda Joseph, Shoji Joseph, N. Aswathy*

Research Advisory Committee of CMFRI at CMFRI, Cochin during 4th February 2003 – *Drs. N.G. K. Pillai, R. Paul Raj, E.V. Radhakrishnan, M. Srinath, L. Krishnan, M. Rajagopalan, R. Sathiadas.*

Meeting at CMFRI, Cochin, with the Principal Advisor (Agriculture), Planning Commission, Govt. of India, along with the Financial Advisor, ICAR, DDG (Fy), ICAR and all ICAR Directors of Fisheries Research Institutes, for discussion on X Plan EFC Documents during 13th February 2003 - *Drs. N.G. K. Pillai, M. Srinath*

NATP/SAP meeting at CIBA, Chennai on 12th August, 2002 – *Drs. K.K. Appukuttan, R. Paul Raj*

State Level Committee meeting on Action Plan for Mussel culture at Calicut on 17th October, 2002 - *Dr. K.K. Appukuttan*

NATP Review meeting at Chennai on 27th December, 2002 - *Dr. K.K. Appukuttan*

Committee meeting of State Committee for Action Plan for mussel farming organized by the State Fisheries Department at Kanjangad, Kasargode on 9th January 2003 - *Drs. K.K. Appukuttan, P.K. Asokan, P. Laxmilatha*

First Indian Pearl Congress and Exposition, 5-8 February 2003 at Cochin – *35 scientists*

NATP Review Meeting at CTCRI, Thiruvananthapuram on 17-18 March 2003 – *Drs. K.K. Appukuttan, R. Paul Raj, T.S. Velayudhan, J.P. George, P.K. Krishnakumar*

Seminar on the New Avenues in marine Pearl Culture on the occasion of Haritha Sangaman organized by Jeevan TV at Hotel Taj Residency, Kochi on 22nd March, 2003 - *Drs. K.K. Appukuttan, K.S. Mohamed*

NATP (CGP) workshop at HAU, Hissar (Haryana) 1-2 March 2002 – *Drs. E.V. Radhakrishnan, G.Gopakumar, C. Ramachandran*

Symposium on Seafood Safety: Status and Strategies, organized by Society of Fisheries Technologies (India) & CIFT, Cochin, during 28-30 May 2002 – *Drs. E.V. Radhakrishnan, V. Kripa, R. Sathiadas*

Meeting to discuss implementation of the Project "Participatory Management and Conservation of Lobster Resources along the South west coast of India" 27.5.2002 and 26.03.2003 – MPEDA Cochin and inaugural function at Khadiyapatinam on 22-11-02 - *Dr. E.V. Radhakrishnan*

Meeting of Experts on Development of Sustainable shrimp farming in India organized by Aquaculture Authority, Chennai, 26-28 August 2002 - *Dr. E.V. Radhakrishnan*

Workshop on Impacts, Adaptation and Vulnerability of Indian Agriculture to Global Climatic Change at Hyderabad during 19-20 December 2002 – *Drs. M. Rajagopalan & P.K. Krishnakumar*

ICAR National Network Meeting on Aquatic Environment Management and presented the research Activities of FEM Division of CMFRI at New Delhi during February 2003 – *Dr. M. Rajagopalan*

Workshop on 'Structural aspects of Hindi'. Organized by CMFRI, Kochi, during 16th September 2002 – *Drs. R. Paul Raj, P. Jayasankar, K.S. Shobhana, Imelda Joseph, Shoji Joseph*

Winter School on ' Recent Advances in Diagnosis and Management of Diseases in Mariculture' from 7th to 27th November 2002, organized by the Education Division, ICAR held at CMFRI, Kochi – *Drs. K.C. George, R.Paul Raj, P.C. Thomas, N.K. Sanil, K.S. Shobhana, P. Jayasankar, K.N. Salila, K.S. Mohamed, P.K. Asokan. K.K. Philipose, Miriam Paul, P.S. Asha, Preetha Panikkar*

30th Academic Council Meeting of the Central Institute of Fisheries Education, (Deemed University), Mumbai during 13th November 200 – *Dr. R. Paul Raj*

Meeting on Formation of Networks on Fish Nutrition convened by Deputy Director General (Fisheries), at ICAR, New Delhi on 21st January 2003 - *Dr. R. Paul Raj*

National Conference on Aquaculture Nutrition, sponsored by NATP, CMFRI, Kochi during March 12-14, 2003 – *20 scientists*

56th Annual Conference of Indian Society of Agricultural Statistics at University of Agricultural Sciences, Dharwar 18-20 December, 2002 – *Dr. M. Srinath*

National Scientific Seminar in Hindi at CIFT, Cochin on 16-17 August, 2002 - *Dr. M. Srinath*

Workshop on "Kerala Fisheries – The Deepening Crisis" conducted at SIFFS, at Trivandrum on 28-29 March 2003 - *Dr. M. Srinath*

Workshop on "Fishing ban, fish famine and livelihood issues" conducted at SDM Law College, Mangalore on 15 – 16 March, 2003 - *Dr. M. Srinath, Dr. C. Muthiah*

Annual review workshop of IVLP at Trivandrum during 21-22 June 2002 – *Dr. R. Sathiadas, Ms. Sheela Immanuel*

Final review workshop of the project Economic analysis of environmental resource at Hyderabad during 10-12 September 2002 - *Dr. R. Sathiadas*

Annual review workshop of IVLP at Gandhigram Rural Institute, Dindigul during 7-9 October 2002 - *Dr. R. Sathiadas, Ms. Sheela Immanuel*

Network meeting on social sciences at KAB, New Delhi during 10th December 2002 - *Dr. R. Sathiadas*

Annual review workshop of ATIC at Bikaner during 18-19 January 2003 - *Dr. R. Sathiadas*

Workshop organized by the Institute of Coastal Management, Kakinada on 30 & 31-10-2002 – *Dr. S. Sivakami*

Workshop on " Development of Fisheries in Association with CAPART (Council for Action Plan on Advanced Rural Technology) held by Andhra Pradesh State Fisheries Department at the State Institute of Fisheries Technology" Kakinada on 20-2-2002 - *Dr. S. Sivakami*.

Task Force on Biotechnology based programmes for SC/ST population during 30-31 July and 18-20 December 2002 at New Delhi – *Dr. L. Krishnan*

Training programme on HRD –leadership skills at Tuticorin R.C. of C.M.F.R.I., Tuticorin – *Mr. S.G. Raje, Ms. P.S. Asha, Ms. Bindu Sulochanan*

Advanced software training covering RDBMS concepts, Java2, Networking, Oracle Essentials, D2K, GIS and Special Data Management Concept – organized by IASRI, New Delhi at National Institute of Information Technology, New Delhi from May 27 to June 25, 2002 – *Dr. T.V. Sathianandan*

HRD training on 'FEEL Research Manager" at College for Leadership and Human Resource Development, Mangalore, Karnataka from 9-15 December, 2002 – *25 scientists*

Workshop on small area estimation techniques in agriculture at Indian Agricultural Statistics Research Institute, New Delhi from 13-23 May, 2002 – *Ms. K.G. Mini*

Four meetings convened by the Commissioner of fisheries (Govt. of Maharashtra) in connection with management of marine fishery resources of the state – *Dr. V.D. Deshmukh*

Training on "Fish Stock Assessment" conducted by the FRAD, CMFRI, Cochin from 11th November to 10th December 2002 *Drs. J.K. Kizhakudan, Shoji Joseph, M. Sivadas, S.J. Kizhakudan*

Seminar on "Fishing and fish processing industry in Gujarat – Present Status and Future Needs" conducted by CIFT and SOFTI, at Veraval on 7th March 2003 – *Dr. J.K. Kizhakudan*

Workshop on Mangrove Ecosystem bio-diversity studies and presented a paper and Visited Sundabans Mangrove ecosystem at Midnapur during 8-10th June 2002 – *Drs. J.P. George, P. Kaladharan*

The National Seminar on Marine Biodiversity as a source of food and medicine at Tuticorin during 26-28th September 2002 – *Dr. N. Kaliaperumal*

National Symposium on "Algae and Environment" at Trivandrum during 13th - 15th Feb 2003 – *Drs. N. Kaliaperumal, P, Kaladharan, Reeta Jayasankar*

State level seminar on "Impact of environmental pollution on aquatic animals in coastal Karnataka at Mangalore on 12 June 2002 – *Dr. P.K. Krishnakumar*

Southern India Conference on "HRD for Neutralizing Violence" at Mangalore on 1- 3 November 2002 - *Dr. P.K. Krishnakumar*

National workshop on Carrageenan and Carrageenophytes at Chennai on 23-25th November 2002 – *Drs. P. Kaladharan, Reeta Jayasankar*

ICAR National Network Meeting on Seaweed Research at New Delhi during Feb. 2003 - *Dr. P. Kaladharan*

Workshop on fisheries forecasting at Mumbai on 22.04.02 – *Dr. V.V. Singh*

Second Indian Fisheries Science Congress at Bhopal on 23rd to 25th Oct. 2002 - *Dr. V.V. Singh*

National Seminar in Hindi on Extension of Indian Aquaculture at CIFE, Mumbai on 15th-16th Jan. 2003 - *Dr. V.V. Singh*

National Action Plan for Biodiversity at Peechi, Thrissur, Kerala on 23-24th September 2002 – *Dr. Reeta Jayasankar*

Winter school on Advances in Harvest Technology for 30 days at Cochin on 20-11-2002 to 19-12-2002 – *Drs. Gulshad Mohamed, K.P. Said Koya, Bindu Sulochanan, Sheela Immanuel, E.M. Abdussamad, P.P. Manojkumar, B. Ignatius*

Training at National Academy of Agriculture Research Management (NAARM), Hyderabad from 3rd January to 2nd May, 2002 – *Ms. Bindu Sulochanan*.

Meeting on Formation of Networks on Fish Genetics and Biotechnology convened by Deputy Director General (Fisheries), at ICAR, New Delhi on 3rd December 2002 – *Dr. P.C. Thomas*

Training Programme on "Management of Research" organized by the Ministry of Environment and Forests, Govt. of India at the Administrative Staff College of India, Hyderabad from 8th to 12th July 2002 – *Dr. A.P. Lipton*

Expert Consultation on Rapid Diagnosis of Shrimp Viral Diseases" held at CIBA organized by NACA (Network of Aquaculture Centers of Asia-Pacific/CSIRO, Australia, AICAQ, Australia, MPEDA and ICAR from 12-06-2002 to 14-06-2002 – *Dr. K.C. George*

Meeting on Formation of Networks on Fish Health Management convened by Deputy Director General (Fisheries), at ICAR, New Delhi on 28th January 2003 - *Dr. K.C. George*

National Workshop on "Shrimp Disease Control and Coastal Management" sponsored by MPEDA, NACA and Ministry of Agriculture at Chennai during 5th to 6th March 2003 - *Dr. K.C. George*

FISHNET (National Network in Fisheries and Aquaculture) organized by Fisheries Division of ICAR, New Delhi, 4th February 2003 – *Dr. P. Jayasankar*

National Symposium on 'Genetics and Gene Banking of Fish and Shellfish' organized by CIFE, Mumbai, 29th – 30th March 2003 - *Dr. P. Jayasankar*

Interactive seminar on 'Sterilization through ionizing process (Irradiation)' organized by the Kerala Industrial Infrastructure Development Corporation (KINFRA) and Industries Department, Govt. of Kerala at Hotel Avenue Centre, Cochin on 20th September 2002 – *Dr. K.S. Sobhana*

First Meeting of the High Level Expert Committee on Aquaculture Drug Regulations at Cochin on 17th January, 2002 – *Dr. K.S. Mohamed*

Second Meeting of the High Level Expert Committee on Aquaculture Drug Regulations organized by Aquaculture Authority of India at Chennai on 30th October, 2002 - *Dr. K.S. Mohamed*

Workshop on 'DFID research programme on system based approach to controlling blow fly infestation in traditionally processed fish in Andhra Pradesh' at Visakhapatnam on 4th March 2002 – *Drs. R. Narayanakumar, K. Vijayakumaran*

Winter school on Participatory technology-concept & methodology development at Kasargod on 4-26 September 2002 – *Ms. Sheela Immanuel*

Review workshop of NATP PSR projects at CRIDA, Hyderabad on 15-16 December 2002 - *Drs. K.K. Appukuttan, R. Paul Raj, T.S. Velayudhan, P.K. Krishnakumar, A.C.C. Victor*

Refresher course on Education at Trivandrum on 26 December 2002 - 12 January 2003 – *Dr. S. Ashaletha*

75th Foundation course for Agricultural Research Management at Hyderabad on 1August to 28 November 2002 – *Ms. N. Aswathy*

Workshop on "Studies on Fisherwomen in coastal-system of Andhra Pradesh, Tamil Nadu, Kerala and Karnataka" during 17th and 18th October 2002 at College of Home Science (ANGRAU) Hyderabad – *Dr. H.M. Kasim*

Meeting on Community participation in research – a conceptual framework for research partnerships conducted by Integrated Coastal Management during 30th -31st October, 2002 at Kakinada - *Dr. H.M. Kasim*

Brainstorming Workshop on Biodiversity conducted by Dept. of Environment, Chennai on 5-12-2002 - *Dr. H.M. Kasim*

Workshop on "Artificial Reef and Fish Pickling unit" organized by M.S.Swaminathan Research Foundation as the part of their Project scheme "Promoting alternative livelihoods for the poor in the Gulf of Mannar Region" held at Vellapatti village on 2.2.2003 – *Dr. A.C.C. Victor*

Training workshop conducted by the Wild Life Warden, Gulf of Mannar Marine National Park to scientifically equip their staff members on different marine culture activities at Ramanathapuram on 14.3.2003 - *Dr. A.C.C. Victor*

Brainstorming session of NATP projects at NCAP, New Delhi on 12th August 2002 – *Dr. G. Gopakumar*

Training programme on 'Research Data Analysis and interpretation' organized by Malabar Coastal Institute for Training Research and Action (MCITRA) held on 27th March 2003 at SRC, Malaparamba, Calicut – *Dr. P.N.R. Nair*

District Planning Board Meeting on 08-10-2002, 14-12-2002 and 28-03-03 at Civil Station Calicut – *Mr. K.K. Philipose*

Seminar on Ramsar sites of Kerala conducted at CWRDM, Kozhikode on 26.2.03 – *Dr. P.K. Asokan*

Workshop on 'People planning in fisheries' organized by MCITRA, Calicut on 30-10-2002 – *Mr. P.P. Manojkumar*

Training programmes on Taxonomy, Genetics and Gene Banking of coastal and marine Bio-resources and Bio diversity at CIFE, Bombay from 18-06-2002 to 08-07-2002 - *Mr. P.P. Manojkumar*

Conference on Strategies for Drought Mitigation, 14-15 February 2003, Visakhapatnam, Indian Meteorological Society, Visakhapatnam Chapter - *Mr. K. Vijayakumaran*

Meeting on "Popularization of V-form otter boards" organized by CIFT at Visakhapatnam on 13th April 2002 – *Drs. G. Syda Rao, G. Mahesawaradu, A.K.V. Nasser, K. Vijayakumaran, U. Rajkumar*

Institute-Industry Meet organized by CIFT on 14th April 2002 at Visakhapatnam - *Drs. G. Syda Rao, G. Mahesawaradu, A.K.V. Nasser, K. Vijayakumaran, U. Rajkumar*

Fishermen meet organized by Forum of Fisheries Professionals of India, Visakhapatnam at Visakhapatnam on 24th May 2002 - *Drs. G. Syda Rao, A.K.V. Nasser, U. Rajkumar*

Annual Review work of NATP project "Impact of Dams on River Runoff into sea and changes in the nutrient and productivity profiles of coastal waters" during 14th-15th May 2002 at Mangalore – *Mr. K. Vijayakumaran*

Final Workshop on Globalization and Seafood Legislation: the impact on poverty in India**,** 23-24, January 2003, Visakhapatnam organized by Natural Resource Institute, UK and South Indian Federation of Fisheries Societies, Trivandrum and ICM, Kakinada - *Mr. K. Vijayakumaran*

Eighth Consultative meeting of the FSI base at Porbandar on 4th May 2002 – *Dr. K.V.S. Nair*

Seminar on marine fisheries of Gujarat at Veraval on 28th Aug. 2002 - *Drs. K.V.S. Nair, J.K. Kizhakudan*

International Seminar on Aquaculture and the Ornamental Fisheries at Cochin during 30-31 December 2002 - *Drs. N.G.K. Pillai, M. Rajagopalan, G. Gopakumar*

Expert Committee meeting to fix standards for Aquaculture inputs at MPEDA, Cochin on 28th February 2003 - *Dr. R. Paul Raj*

Training programme on "Methodology for impact analysis of KVK programme activities" at IIHR, Bangalore on April 12-13, 2002 - *Dr. P.K. Martin Thompson*

Short course Water and waste water Management in aquaculture systems at Tuticorin on 8-17 July 2002 –*Dr. P. Muthiah, Ms. P.S. Asha, Ms. Bindu Sulochanan*

Deputations Abroad

Dr. L. Krishnan was deputed to the Islamic Republic of Iran to make a feasibility study on the breeding of mullets for Shilat the Iranian Fisheries Department from 04.12.01 to 18.02.02.

Dr. N. Gopalakrishna Pillai, Head, PFD was deputed to Penang, Malaysia to participate in the Second Regional Workshop on Aquaculture Technologies and Fishery practices in Asia of ICAR-ICLARM Project "Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poor household in Asia" under the ADB-RETA 5945 Project during 17th to 27th March 2003.

Workshops Seminars Summer Institutes Farmer's Day Organised

National workshop on field data collection

A 3-day (4-6-02 to 6-6-02) workshop was held for the field staff engaged in resources data collection of FRAD posted at different regional centers, research centers and field centers of the Institute at the Headquarters. Field staff was divided into three separate groups and three simultaneous sessions were conducted. These groups discussed in detail, the fishing activities in each zone, introduction of new craft/gear, and formation of new landings centers in their zone. Changes in landings centers, methods of improving data collection and recording and other related issues. A separate session was particularly arranged for updating their knowledge in field level identification of marine species. Decisions were made on all vital information on data collection, processing and dissemination of processed results.

A one-month training programme on **Fish population Dynamics and Stock assessment** was organized by FRAD for seven scientists of the Institute from 11 November 2002. The participants were exposed to topics in stock assessment and fishery management techniques including surplus production and yield per recruit models, modal progression and virtual population analysis, MSY, ECOPATH modeling etc. and encouraged to analyse their data using different software packages.

The CMFRI organized the **First Indian Pearl Congress and Exposition** (FIPCE) at the International Hotel, Cochin during 5 – 8 February 2003. The Congress was inaugurated no 5th by Dr. S. Z. Qasim, Former Member Planning Commission, and Government of India. Dr. K. V. Peter, Vice Chancellor of Kerala Agricultural University presided over the function. The scientific sessions on marine and freshwater pearl culture were held from 6 -7th in which about 50 scientific papers on different aspects of freshwater and marine pearl culture like physiology and biotechnology applications, seed production and hatchery techniques, pearl culture technology and nucleus and image production were presented by over 125 researchers. Leading pearl jewellers from different parts of the nation displayed the rare wonders of nature for the public during the pearl exposition running from 6th to 8th. Mabe pearls were available in the stalls of Geeri Pai, CIFA and Swati Pearls. The famed Mikura pearls from Japan set in white and yellow gold was offered in the Alukkas International stall. Exquisite pearl jewellery in combination with diamonds, corals and rubies were available in the stalls of Moti Mahal and Sai Pearls.

CMFRI, Cochin organized the GOI-UNDP **Capacity Building Training Workshop on Sea Turtle Conservation and Management** for the frontline staff of wildlife, fisheries and research organizations on 19–21 June 2002. In the 8 scientific sessions aspects on identification and biology, nesting beaches, fishery interface issues, incidental catches and TED were discussed and recommendations drafted.

The CMFRI jointly organized with Vidyasagar University a **Workshop on Mangrove Ecosystem Biodiversity** at Midnapore on 8-10 June 2002.

CMFRI organized the **National Official Language Seminar on Identification of New Research Issues on Marine Fisheries** at Cochin on 30-31 January 2003. Fishery scientists from ICAR fisheries institutes presented papers and a 12-point recommendation was drafted for action.

The CMFRI celebrated the **Kisan Divas** on 23rd December 2002 at all its

Dr. S.Z. Qasim delivering the inaugural address at FIPCE

View of an exhibitors stall at FIPCE


Dr. K.V. Peter, Vice Chancellor, KAU, Dr. N.R. Menon, Director, IMCOZ and Prof. (Dr.) M.J. Modayil, Director, CMFRI at the inauguration of Capacity Building Training Workshop on Sea Turtle Conservation and Management

Award winning farmers during *Kisan Divas* celebrations organized at KVK, Narakkal on 23rd December, 2002

Prof. (Dr.) A.D. Mukhopadhya, Vice Chancellor, Vidyasagar University, W. Bengal releasing the Manual on Research Methodology during NATP workshop

School children examining the exhibits during the open house in connection with the Institute foundation day

Foundation day celebrations

research centres. At Cochin 10 progressive fish farmers were honoured with the Best Farmer Awards.

CMFRI conducted a training programme on **Self Help Group Mobilization** in Ernakulam district during 21-25 November 2002 and on **Empowerment of Women** at Kannur during 27-31 March 2003.

Under the NATP, CMFRI organized the **National Conference on Aquaculture Nutrition** during 12-14 March 2003 at Cochin. The conference, which was attended by 60 national delegates, was inaugurated by Dr. S.D. Tripathi, Former Director, CIFE, Mumbai. More than 30 papers on larval nutrition, biotechnological interventions, grow-out nutrition and feed management were presented. A panel discussion on prospects and constraints of aquafeed industry was held on the concluding day.

A **Winter School on Recent Advances in Diagnosis and Management of Diseases in Mariculture** was conducted by CMFRI from 7th to 27th November 2002 at Cochin. The winter school, which was attended by faculty and scientists of various fisheries institutions, covered topics on histo-pathology; DNA based diagnostic methods and parasitiology.

A Hindi **Workshop on Structural Aspects of Hindi** was organized by CMFRI at Cochin 16th September 2002.

National Science Day on 28th February 2003

National Science Day was celebrated on 28th February 2003 with Exhibition of posters and a Quiz Programme depicting the focal theme "50 years of DNA – the blueprint of life" and a series of seminars related to molecular biology were organized on topics such as DNA vaccines and gene therapy; genetically modified organisms – implications for agricultural sustainability and biodiversity; and Fish Genomics – present status and prospects.

Institute Foundation Day

The 56th Foundation day of the Institute was celebrated on 3 rd February 2003 at Head quarters under the auspices of the Recreation club, CMFRI. As a part of the celebration, the Institute was open to the public in the forenoon. The research and development activities of the Institute were explained to more than 800 students who visited the Institute. The public meeting in the evening was presided by the Director, Prof. (Dr.) M.J.Modayil. The chief guest of the function was Dr. S. D. Tripathi former Director, CIFE and member of RAC. The guest-of-honour, Dr. K. Gopakumar, former DDG (Fy), ICAR released *Tharangam*, CMFRI Souvenir. Dr. D. Kapoor, Director, NBFGR and Dr. K. Devadasan, Director, CIFT offered felicitations on the occasion. Variety entertainment programmes of the staff, their children and the PGPM students were presented before the audience, which included the retired staff of the Institute and their family members.

Conservation of lobster resources

The implementation of MPEDA funded project 'Participatory Management and Conservation of lobster resources along the southwest coast of India was inaugurated at Khadiyapatnam village, Kanyakumari district, Tamilnadu on 26-11-2002 by Dr. K. Devadasan, Director, CIFT in the presence of Dr. M.J. Modayil, Director, CMFRI, Cochin. The CIFT designed lobster traps and a lobster conservation sticker were released in the function. Several dignitaries and fishermen attended the meeting.

Distinguished Visitors

Cochin

Shri Ajit Singh, Hon'ble Union Minister for Agriculture and President, ICAR Society
Shri. Hukumdeo Narayan Yadav, Hon'ble Minister of State for Agriculture, GOI
Dr. Mangala Rai, Director General, ICAR, New Delhi
Dr. Panjab Singh, Former Director General, ICAR, New Delhi
Mr. M. Ramesh Kumar, IAS, Secretary, Agriculture, Animal Husbandry, Dairy Development & Fisheries Department, GOI
Mr. M. Radhakrishnan, Hon'ble Minister for Fisheries, Govt. of Tamilnadu
Smt. Binoo Sen, Secretary, Government of India, Ministry of Agriculture, Dept. of Animal Husbandry & Dairying, GOI
Dr. K.V. Peter, Vice Chancellor, KAU, Mannuthy, Thrissur
Dr. S. Ayyappan, DDG Fisheries, ICAR, New Delhi
Shri N. Radhakrishnan, Minister of Fisheries, Govt. of Tamilnadu
Prof. K.V. Thomas, Minister of Fisheries, Govt. of Kerala
Shri Jose Cyriac, Chairman, MPEDA, Cochin
Dr. S.Z. Qasim, Former Secretary, Govt. of India
Dr. S.D. Tripathi, Former Director, CIFE, Mumbai
Dr. M. Sakthivel, Aquaculture Foundation of India, Chennai
Ms. Tinku Biswal, IAS, Managing Director, Matsyafed, Thiruvananthapuram

Veraval

Dr. (Mrs.) Suman S. Pava, Dept. of Zoology, Institute of Sciences Mumbai
Shri Ramesh M. Madhvi, Machhimar Boat Association, Veraval
Shri Vasharam Jva Solanki, President Kolisamaj Bhidia, Veraval
Shri Saifuddin Anis, Deputy Director & Shri K.R. Rameshbabu, Asst. Director, MPEDA, Valsad
Shri H.B. Dave, Deputy Director of Fisheries, Veraval
Shri M.I. Patel, Dy. Director of Fisheries, Gandhinagar
Dr. Devadasan, Director, CIFT, Kochi

Calicut

Shri.Thottathil Raveendran, Mayor of Calicut Corporation
Shri. A. Sujanapal, MLA of Calicut and, Smt. Padmavathi, Former Mayor
Dr. E.J. James, Director, CWRDM.
Dr. E.J. Parthasarathy, Director IISR, Calicut
Smt. K. Anitha, Joint Director of Fisheries, North Zone
Shri. J.A. Joseph, Regional Executive, Kerala State Fisheries Welfare Board
Shri. James Joseph, Deputy Director, MPEDA, Kochi
Shri. K. Jagadees, Joint Director, MPEDA, Kochi
Shri. Puthukudy Hameed, President, Thikkodi Grama Panchayat
Shri. J.K. Nayar, Asst. Director, EIA, Calicut
Shri. Baby John, Director, MCITRA

Krishi Vigyan Kendra, Narakkal

Dr M.A. Kuttappan, Minister for Backward classes and Youth Development, Government of Kerala
Shri T.M. Jacob, Minister for Irrigation, Government of Kerala
Shri Gyanesh Kumar, I.A.S., District Collector, Ernakulam
Shri Mohammed Kutty Master, District Panchayat President, Ernakulam
Shri Munambam Santhosh, Block Panchayat President, Vypeen Block

Dr. Mangala Rai, Director General, ICAR, New Delhi inaugurating the ATIC building of CMFRI by lighting the traditional lamp

Vizhinjam

Shri. Vasanth V. Salian, Hon. Minister for Fisheries & Ports, Govt. of Karnataka, Bangalore.

Shri. Hukumdeo Narayan Yadav, Hon. Minister of Agriculture, Govt. of India, New Delhi.

Dr. M.V. Rao, Special DG, ICAR (Retd.), NATP- SAP Chairman, Hyderabad.

Dr. K.V. Peter, Vice Chancellor, Kerala Agriculture University, Trichur

Minicoy

Dr. S. Arul Raj, Head (Social Science), CPCRI, Kasargod

Shri I.G. Ibrahim Manikfan, Chairman, Minicoy (Dweep) Island Panchayat

Tuticorin

Shri Hukumdeo Narayan Yadav, Honourable Minister of State for Agriculture, Government of India

Major R. Subramanyam & 16 Officers of the 42nd Course of the National Defense College, New Delhi

Dr. Robert B. Grubh, Director, Institute for Restoration of Natural Environment, Christopher Nagar, Nagercoil

Mandapam

Shri.M.P.Mohan, Member of Parliament, (Madurai Constituency)

Shri.N.Nanmaran, Member of Legislative Assembly (Madurai Constituency)

Shri.Hukumdeo Narayan Yadav, Honourable Minister for State for Agriculture, Government of India, New Delhi

Chennai

Dr. M. Sakthivel, President Aquaculture Foundation of India

Dr. S. Ayappan, DDG (Fisheries), ICAR, New Delhi

Dr. K. Kannan, Reader in Zoology, Vivekananda College, Chennai

Kakinada

Dr. Chris Mees and Ms. Catherine O'Neil, Marine Resources Assessment Group, United Kingdom

Dr.T. Rajyalakshmi, President, Society for the Promotion of Integrated Coastal Areas Management (SPICAM), Kakinada

Shri. Ramatheerthan, Assistant Director of Fisheries, SIFT, Kakinada

Visakhapatnam

Dr. K.S. Tilak, Professor, Dept. of Zoology, Nagarjuna University

Shri V. Suresh, Joint Director of Fisheries (Inland), Hyderabad

Dr. K. Phani Prakash, State Institute of Fisheries Training (SIFT)

Dr. Mostafa A.R. Hossain, Associate Professor, Bangladesh Agricultural University, Mymensing, Bangladesh

Mangalore

Dr. V.N. Sanjeevan, Principal Scientific Officer, Department of Ocean Development, CMLRE, Kochi.

Shri K.K. Achankunju, Assistant Director, MPEDA, Kochi.

Shri S.H. Gaonkar, Senior Manager, Process Control Department, Kudremukh Iron Ore and Chemicals Limited (KIOCL), Mangalore.

Prof.R.Damodaran, Dean, Faculty of Marine Sciencies, CUSAT, Kochi.

Personnel
(Managerial Position only)

1	**Director**	**Dr. Mohan Joseph Modayil**
2	**Heads of Divisions**	
	Fishery Resources Assessment Division	Dr.M. Srinath
	Pelagic Fisheries Division	Dr.N. Gopalakrishna Pillai
	Demersal Fisheries Division	Dr.V. Sriramachandra Murty – upto 31st January 2003 Dr.(Mrs) S. Sivakami
	Crustacean Fisheries Division	Dr.E.V. Radhakrishnan
	Molluscan Fisheries Division	Dr.K.K. Appukuttan
	Fishery Environment Management Division	Dr.M. Rajagopalan
	Phisiology, Nutrition and Pathology Division	Dr.R. Paul Raj
	Socio-Economic Evaluation & Technology Transfer Division	Dr.R. Sathiadhas
3	**Sr. Administrative Officer**	Shri Charles Ekka
4	**Sr. Finance & Accounts Officer**	Shri A.V. Joseph
5	**Administrative Officer**	Shri P.S. Sudersanan
6.	**Scientists-in-Charge of Regional/Research Centres**	
	Mandapam Camp	Dr.N. Kaliaperumal, PS
	Chennai	Dr.H. Mohamed Kasim, PS
	Tuticorin	Dr.A.C.C. Victor, PS
	Kakinada	Dr.(Mrs) S. Sivakami, PS
	Karwar	Dr.V.S. Kakati, PS
	Mangalore	Dr.C. Muthiah, PS
	Veraval	Dr.K.V. Somasekharan Nair, PS
	Vizhinjam	Dr.A.P. Lipton, PS
	Mumbai	Dr.V.D. Deshmukh, PS
	Minicoy	Shri.K.P Said Koya, Scientist
	Visakhapatnam	Dr.G. Syda Rao, PS
	Calicut	Dr.P.N. Radhakrishnan Nair, PS
	Krishi Vigyan Kendra	Dr.P.K. Martin Thompson, Technical Officer
	Trainers' Training Centre	Dr.A. Laxminarayana, Chief Training Officer
	Fisheries Harbour Laboratory, Cochin	Mrs. Grace Mathew, PS

Special Infrastructure Development

- New analytical equipment, Gas Chromatograph with Mass Spectrometer (Shimadzu GCMS- QP 5000) procured under the NATP project on "Impact of Dams" has been installed at Mangalore Research Centre. Above equipment will be used for analyzing oil residues, PAHs, pesticides, PCB etc. and for identifying and finger printing various organic pollutants in seawater and marine organisms.
- A Marine Research Aquarium was established at Calicut. The aquarium which is open to the public is maintaining nearly 100 species of marine fishes and invertebrates. Broodstock of some high value varieties are also maintained for breeding and hatchery production. The facilities will be utilized further for conducting research and training on marine ornamental fish breeding and aquarium development and management.

GC-MS facility at Mangalore

- A state-of–the–art marine hatchery facility was established at Regional Centre, Visakhapatnam for conducting hatchery experiments with pearl oysters, cephalopods, shrimps and crabs.
- The National Referral Laboratory for Marine Fish and Shellfish Microbial Diseases equipped with modern instrumentation was established at headquarters.
- ATIC building with facilities for single window delivery system of technology and technical services to fisherfolk was commissioned during the year. This facility has modern video and three-dimensional displays for the benefit of fishers.
- A computer facility for the exclusive use of PGPM students has been created.
- Hostel amenities have been created at the CMFRI residential complex for postgraduate women students.
- Green tiger shrimp hatchery facilities at Mandapam were renovated and made state-of-the-art.
- Kovalam Field Laboratory near Chennai was made functional with the commissioning of the seawater intake facilties
- A Twin-screw extruder for production of a variety of pellet feeds including floating pellets and a Mycotoxin analyzer completes a newly developed feed biotechnology facility.

Marine aquarium facility at Calicut

Implementation of Official Language

Programmes were implemented during the year with a vision to use Hindi for all official purposes and the main activities are featured below.

- Achieved 100% working knowledge in Hindi typewriting and stenography at Headquarters. During the year 2 more Centres of the Institute viz. Karwar and Calicut have been notified under Rule 10(4) of Official Languages Rules for acquiring 80% working knowledge in Hindi. Use of Leap Office software, bilingual letterheads and standard drafts have been ensured in 58 computers of the Institute.

- A web page *(www.cmfri.com/hindi)* with an outline about the Institute and the Hindi implementation activities in the Official Language Hindi was launched on 21-9-2002 by Shri A.P. Saxena, Chief General Manager, BSNL. A special incentive scheme with cash prizes was planned and introduced during the year for the functional development of Hindi and it proved very effective.

- Hindi Week was observed at CMFRI Headquarters and research centres from 16-21 September 2002 with multi dimensional programmes. The significant contributors to Hindi were recognized and prizes, cash awards and trophies were distributed during the valedictory function on 21-9-2002.

- Hindi publications play a significant role in the functional development of Hindi at CMFRI. The *MFIS* quarterly aimed for the dissemination of technical news and the *CMFRI Samachar* aimed as a house journal was released in bilingual form. The Hindi publication *Matsyagandha* for the dissemination of fisheries news in the national stream of agricultural information in the Official Language Hindi was a turning point in the functional development of Official Language Hindi at the Institute.

- Hindi correspondence was increased from 34 to 39% and significant improvement was made in file notings from 4 to 20%. Two Sections were specified to undertake 100% work in Hindi.

- The Kochi Town Official Language Implementation Committee awarded trophies to CMFRI for excellent Hindi implementation activities and proclaimed *Matsyagandha 2000* as the best Hindi publication in the area.

Shri A.P. Saxena, Chief General Manager, BSNL launching the CMFRI's Hindi web page

कार्यकारी सारांश

वर्ष के दौरान केंद्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान ने अपने अधिदेश का कार्यान्वयन, ५० गृहांदर परियोजनाओं २६ बाह्य निधिबद्ध परियोजनाओं और १७ राष्ट्रीय कृषि प्रौद्योगिकी परियोजनाओं (एन ए टी पी) के ज़रिए ,किया. इसके सिवा औद्योगिक संगठनों केलिए ५ परामर्श परियोजनायें भी संस्थान के वैज्ञानिकों द्वारा लिया गया. वर्ष के दौरान के अनुसंधान परिणामों और उपलब्धियों के प्रमुख भाग नीचे दिए गए हैं.

वर्ष २००२ की अनुमानित समुद्री मछली पकड २.६४ मिलियन टन होते हुए भी पकड में १३.५S वृद्वि के साथ ३.१४ लाख टन मछली पकडी गई. इसका कारण सुरा, तारली, बम्बिल, फीतामीन, करंजिड, सुरमई, ट्यूना, पेनिअइड झींगा और शीर्षपाद मछलियों में हुई वर्द्धित पकड है. पर्च मछलियों और पेनिअइड झींगों की पकड में घटती की प्रवणता दिखाई पडी. कुल मछली उत्पादन में यंत्रीकृत सेक्टर का योगदान ६७.९S , मोटोरीकृत का २५S और कारीगरी सेक्टर का ७.१S था. प्रत्येक समुद्रीय मेखलाओं से हुए उत्पादन उत्तर पश्चिम तट-९.०८ लाख टन, दक्षिण पश्चिम तट - ८.६ लाख टन, पश्चिम पूर्व तट - ६.११ लाख टन और उत्तर पूर्व तट - २.२७ लाख टन हैं. केरल में ट्राल के ज़रिए पकडी जानेवाली तलमज्जी (डमर्सल) मछलियों के अनुकूल पकड समय और उपलब्धि समझने केलिए षेफ़र मोडल का प्रयोग करते हुए अध्ययन चलाया गया. इन अध्ययनों ने व्यक्त किया कि जून- जूलाई के दौरान मत्स्यन में रोक लगाना इसकी बढती और ट्राल के ज़रिए उपलब्धि केलिए अच्छा है. केरल के मोटोरीकृत यान मत्स्यन पर किए अध्ययनों ने व्यक्त किया कि इसकी वजह से कुल मछली पकड में ५६,००० टन के बराबर की बढती हुई है.

तारलियों की व्यापक और सतत उपलब्धि वर्ष के दौरान की विशेषता थी. पकड का अधिक भाग तरुण और अल्प वयस्क की तारलियाँ थी. तरुण तारलियों में मन्द बढ़ाव भी दिखाया पडा जो कि संपदाओं की अधिक सघनता के कारण खाद्य की कमी से हुई हो. तारलियों के अधिकतम वहनीय पकड (एम एस वाई) स्तर के अनुसार के विदोहन वर्ष के दौरान हुआ था. ऐंचोवी मछलियों की उच्च संपदा सघनता माँग्लूर तट में और कम संपदा सधनता केरल तट में देखी गई. दोनों तटों से विदोहन अधिकतम वहनीय पकड स्तर में किया गया. स्टोलिफोरस इंडिकस और कोईलिया डसुमरी की अधिक विदोहन साध्यताएं अध्ययनों के ज़रिए सूचित की गई.

राजा सुरमई स्कोम्बिरोमीरस कमर्सन की विदोन दर ०.५१ और ०.७८ के बीच देखा; दक्षिण-पश्चिम तट में इसका मत्स्यन दबाव अधिक है और उत्तर-पूर्व तट में पकड अनुकूलतम है. केरल और लक्षद्वीप में प्रचालन किये जानेवाले ड्रिफ्ट गिल नेटों से १९९८ से लेकर पकड में बढती दिखाई पडती है. बाँगडों की विदोहन दर में विषिंजम, कालीकट, और माँग्लूर माल्प में कमी दिखाई पडी तो कोचीन, टूटिकोरिन, चेन्नै और काकिनाडा में अनुकूल विदोहन दर देखी गयी. फीता मीनों का अंडजनन मौसम नवंबर से जून तक चलते हुए देखा. इनके अच्छे संभरण समय जनवरी में और दूसरा, जुलाई-अगस्त में देख गया. पिछले वर्ष की तुलना में बम्बिलों की पकड में ४२S बढती हुई. १७ करंजिड जातियों पर किए गए अध्ययनों ने व्यक्त किया कि इन में से ५ करंजिड जातियों का अतिविदोहन हो रहा है और ये भी नियंत्रित क्षेत्रों से. मछली कुटुम्बों जैसे क्लूपिडे, चीरोसेन्ट्रिडे, करंजिडे और स्कोमब्रोइडे की संपदाओं की वर्गीकरण स्थिति का पुनराकलन किया गया. राष्ट्रीय कृषि प्रौद्योगिकी परियोजना के संयोजित राष्ट्रीय कृषि संपदा सूचना प्रणाली (क्षत्रङ्कक्ष्च्) कार्यक्रम के अधीन मानक कोडिंग पार्टन के अनुसार ४६ मछली वर्गों केलिए १६ डिजिट स्पीशीज़ कोडस् का विकास किया गया. भारत में उपलब्ध समुद्री मत्स्यन रीतियों, समुद्री संवर्धन और संग्रहणोत्तर प्रौद्योगिकियों का प्रलेखन किया गया.

वर्ष २००१ की तुलना में उपास्थिमीन मछलियों की पकड में ३.१S बढ़ती हुई; मुख्य भाग तमिलनाडु से मिली थी. शंकुशों (हिमान्तूरा ब्लीकेरी, हि.अलकाई और जिम्नूरा पोइसिलूरा) के लिंग अनुपात पर किये अध्ययनों ने व्यक्त किया कि जीवसंख्या में नर जाति की प्रचुरता है. पर्च मात्स्यिकी ग्रूपर, स्नापर और पिगफेस ब्रीम्स से बनी हुई है. एपेनिफेलस डायकान्थस ट्राल से और ई.टविना हूक आन्ड लाइन के ज़रिए मूलतः पकडी जाती है. नेमिप्टीरस मीसोप्रिओन और

नेमिन्टीरस जापोनिकस का प्रजनन मौसम पश्चिम तट में अक्तूबर - नवंबर और पूर्व तट में नवंबर देखा था. सियनिड मात्स्यिकी में २४ जातियों की क्रोकर मछलियाँ दिखाई पडीं. वेरावल में मिलनेवाली जे. ग्लाकस मछलियों की प्रजनन अवधि जनवरी-अप्रैल और अक्तूबर-दिसंबर थी. वेरावल में तुम्बिल मछलियों की उच्चतम पकड मिली थी. स्कोम्ब्रोइड जातियों में पश्चिम तट से यदि साऊरिदा तुम्बिल और एस. अन्डोस्क्वामिस प्राप्त हुई तो पूर्व तट से इनके अलावा एस. माइक्रोपेक्टोरलिस और एस. लोंगिमानस प्राप्त हुईं. चपटी मछलियों की पकड में साइनोग्लोसस माइक्रोस्टोमस की प्रचुरता थी; प्रमुख जाति सी. माक्रोलेपिडोटास थी. सियनिडे, साइनोग्लोसिडे और सोलिडे कुटुम्बों की मछलियों के वर्गीकरण का पुनराकलन उनके आकृतिमान और गणनीय लक्षणों के अनुसार किया गया.

गहरे वितलन तल (डी एस एल) पर किया गया बहु संस्थानीय कार्यक्रम में पाया गया कि जन्तुप्लवकों की तुलना में अन्य तरणक घटक कम है. नितलस्थ ट्रॉलन के प्रभाव पर किये गये अध्ययन ने व्यक्त किया कि ट्रालन के बाद नितलस्थ प्राणिजातों के जैववैविद्यता सूचकांक (षानन-वीनर और सिंपसन डैवर्सिटी) में, कमी होती है.

पेनिआइड झींगा मात्स्यिकी में उत्तर पश्चिम तट में सोलिनोसीरा कासिकोरनिस और कर्नाटक तट में एस.चोप्रै प्रमुख संपदा के रूप में उपलब्ध हुई थी. कोल्लम तटों से इस वर्ष गहरा सागरीय चिंगट की बढती पकड मिली जो कि इस संपदा के पुनरुत्थान का सूचक है. मुंबई में मेटापेनिअस अफिनिस के स्टॉक-रिक्रूटमेंट संबंध पर किया गया अध्ययन रिकर कर्व का अनुसरण करते हुए सूचित किया कि १९३ टन जीवमात्रा के प्रजनन से उच्च संभरण साध्य है. मुबंई व नवाबंदर में नॉन-पेनिअइड झींगा मात्स्यिकी पर किये गये अध्ययन ने सूचित किया कि नेमाटोपालिमोन टेनिपस की विदोहन दर इन स्थानों में क्रमशः ०.७२ और ०.६९ है. मुंबई में महाचिंगट पानुलिरस पोलिफागस की विदोहन दर संकटात्मक पहचाना गया. महाचिंगटों के मत्स्यन और निर्यात पर विनियमक उपाय कार्यान्वित करने का कार्य समुद्री विकास प्राधिकरण द्वारा निधिबद्ध एक परियोजना के ज़रिए लिया गया. कर्कट मात्स्यिकी में खाद्य कर्कट चारिब्डस लूसिफेरा का महत्वपूर्ण योगदान देखा गया. चिंगटों की ५० जातियों , कर्कटों की ३९ जातियों , महाचिंगटों की ९ जातियों और रंध्रपादों की ४ जातियों की वर्गीकरणात्मक विशिष्टता सुनिश्चित की गई.

कोचीन में इंडियन स्क्विड लोलिगो डुवासेल्ली संपदा की विदोहन दर में भारी घटती हुई जबकि अक्टोपस मेम्ब्रेनेइसियस की विदोहन दर में विचारणीय वृद्धि हुई. एल. डुवासेल्ली और सेपिआ फराओनिस, की पकड में किसी प्रकार का दबाव नहीं था. द्विकपाटी और जठरपादों की अखिल भारतीय पकड ६०,३०७ टन थी जिस में ९७१ द्विकपाटियों का योगदान था. पकडी गई द्विकपाटियों में प्रमुख संपदा रही सीपी विल्लेरिटा सिप्रिनोइडा और हरित शंबु परना विरडीस.

तटीय पानी के पर्यावरणिक अभिलक्षणों का मोनिटरन पूरे वर्ष में किया गया. पश्चिम तट से उत्तर तट तक जन्तुप्लवक जैवमात्रा का परास १.१-३३.० मि ली १०० ɱ-३ से ०.२-४०.० मि ली १०० ɱ-३ देखा गया. पानी और समुद्री जीवियों में भारी धातुओं के अंश पर चलाए विश्लेषणों ने व्यक्त किया कि तटीय पानी व जीवों में इनका अंश अधिक नहीं है फिर भी पूर्व तट में जिंक का अंश कुछ ज्यादा है. २००२ के दौरान उड़ीसा तट में ओलिव रिडले कच्छप के समूह नीडन में भारी कमी दिखायी पडी. समुद्री ककडियों होलोथूरिया स्काब्रा के परिरक्षण कौशल के अधीन स्फुटनशाला में उत्पादित किए १०,००० से ऊपर ककडियों का समुद्र रैंचन टूटिकॉरिन के वान द्वीप समूह में किया. कोपिपोड और डेकापोड कुटुम्बों के जन्तुप्लवकों के वर्गीकरण स्टाटस का पुर्ननिरीक्षण किया गया.

भारत के पश्चिम तटों में होनेवाला खतरनाक समुद्रीपादप फुल्लन की निगरानी की गई. ऐसा फुल्लन होर्नोल्लिया मरीना नामक पादप से कालीकट के तटीय पानी में सितंबर के दौरान हुआ था जिसकी वजह से मछलियाँ बडे तादाद में मर गई; यह समूह मृत्यु सूपर आक्सैड राडिकल की उपस्थिति से हुई है. केरल, पश्चिम बंगाल और आंडमान निकोबर द्वीप समूह के मैंग्रोव (गरान) परिस्थितिक तंत्र के सच्चे मैंग्रोव पादपों की २४ जातियों ३१ सहपादप जतियों और १० सम गुणवाले (मीसोफैटिक) चढनेवाली पादप जातियों का पहचान और अभिलेख किया गया.

समुद्री पख मछलियों के संवर्धन कार्यक्रम में टैंकों में पालित ग्रूपर मछलियों के अंडाशावकों में हार्मोनल जोड-तोड से उनका प्रेरित परिपक्वन परीक्षण किया गया. ग्रूपरों में मीथैल टेस्टोस्टीरोण के प्रयोग से ४० दिनों में लिंग विपर्यय साध्य हो गया पर इन्हों ने प्रकार्यात्मक परिपक्वता नहीं दिखाई. अलंकार डामसेल मछली क्रिसोप्टीरा यूनिमाकुलाटा के अंडशावक विकास, प्रजनन और डिंभक पालन में सफलता पाई गई. मंडपम में समुद्री घोडा हिप्पोकाम्पस कुडा की तीसरी पीढी का जनन, पालन टैंकों में संभव हो पाया. अलंकारी मछलियों और कवच मछलियों के पालन और प्रजनन पर परीक्षण करने का अवसर आम जनता को देते हुए कालीकट में ऐसा एक समुद्री जल जीवशाला खोला गया.

पुलि झींगा पी. मोनोडॉन के क़१ पीढी का सफलतापूर्ण पालतूकरण तालाब और टैंक में पालित करते हुए किया गया. विशाखपट्टणम क्षेत्रीय केंद्र में मुक्ता शुक्तियों , शीर्षपादों, चिंगटों और कर्कटों पर स्फुटनशाला परीक्षण त्वरित करने को एक शास्त्रीय समुद्री स्फुटनशाला स्थापित की गई. चिंगट पानुलिरिस होमारस का हैचरी में ही परिपक्वन और प्रजनन कराए जाने की प्रौद्योगिकी का विकास और मानकीकरण किया गया. पंक कर्कटें सिल्ला सेराटा और सिल्ला ट्रान्कुबारिका का हैचरी उत्पादन संस्थान में सफलतापूर्ण ढंग से वैज्ञानिकों द्वारा किया गया.

तकनॉलजी के तबादले पर अधिक ध्यान दिए जाने के फलस्वरूप तटीय क्षेत्रों में हरित शंबु और खाद्य शुक्तियों के पालन कार्य बढ गए. पालन के ज़रिए हरित शंबुओं का १२५० टन और खाद्य शुक्तियों का ३५० टन उत्पादन सफल हो पाया. इस क्षेत्र में अभूतपूर्व योगदान दिए शंबु कृषक श्री गुल मोहम्मद को भारत सरकार के कृषि मंत्रालय ने कर्षक शिरोमणि पुरस्कार देते हुए सम्मानित किया. विविध रंगों के मुक्ता शुक्ति पालन परीक्षण में काले रंग के बैंडवाले स्पाटों (शिशु शुक्ति) में अधिक बढती दिखाई पडी और हरित और शोण बैंडवाले शुक्तियों में यथाक्रम कम बढती भी. टूटिकोरिन में स्थापित कवचमछली हैचरी में वर्ष के दौरान ९८५०० मुक्ताशुक्ति, पिंक्टाडा फ्यूकाटा और १,७४,४०० सीपी, पाफिया मलबारिका के स्पाटों का उत्पादन किया.

शंबु बीजों के जीवमात्रा पर अंडमान व निकोबार द्वीपसमूह, केरल, कर्नाटक, महाराष्ट्र, गोआ, गुजरात, तमिलनाडु , पोंडिचेरी और आंध्रप्रदेश के ७०२ हेक्टयर क्षेत्र में चलाए गए अध्ययनों ने व्यक्त किया कि इन क्षेत्रों में १६,१३० टन जीवमात्रा उपलब्ध है. वेल्क बाबिलोणिया स्पिरेटा का स्फुटन और डिंभक पालन कोचीन में सफल हो पाया. रस्सियों में लटकाते हुए किये जानेवाला शंबु पालन से पर्यावरण में होनेवाला प्रभाव पर किए अध्ययन ने व्यक्त किया कि अवसाद में, पालन की वजह से ऑरगनिक कार्बन की कमी हुई है. राष्ट्रीय कृषि प्रौद्योगिकी परियोजना कार्यक्रम के अधीन कोल्लम में मोती पालन केलिए किए गए प्रयास में ६.८ मि मी व्यास के बडे-बडे समुद्री मोती प्राप्त हुए. इसके सिवा मेषे मेती के उत्पादन किए जाने की प्रौद्योगिकी भी वर्ष के दौरान विकसित की गई. समुद्री मोतियों के रंग में हर-फेर करने को खाद्य में ट्रेस मेटल जोडते हुए खिलाना प्रोत्साहजनक देखा गया. मोती परिक्रमण निधि परियोजना के अधीन एम.एस स्वामिनाथन फाऊन्डोशन को रोपण किए ४०,८०० शुक्तियों का आबंटन किया ताकि इस तकनोलजी का प्रयोग व पालन सारे तलों पर पहूँचा जाए.

लंबी कयर रस्सियों में समुद्री शैवाल कप्पाफाइकस अलवरेज़ी के पालन पर किए परीक्षणार्थ पालन में ४८ दिवसों में इसकी ५ गुनी बढती रेकोर्ड की गई. सोडियम बाइकार्बोनेट की विभिन्न सान्द्रताओं में प्रयोगशाला में पालित किए सूक्ष्म शैवाल क्लोरेल्ला और नॉनोक्लोरोप्सिस की बढती और प्रोटीन मात्रा में सुधार दिखाया पडा. अगारोद्भिद ग्रासिलेरिया इडुलिस के कायिक प्रवर्धन रीति पर विकसित की गयी प्रौद्योगिकी का प्रचार पाक और मान्नार की खाडी के मछुआरों के बीच किया गया. मंडपम के अगर उत्पादन संयंत्र में ८७० कि ग्रा अगर का उत्पादन किया जिससे १.६७ लाख रुपये का आय कमाया.

चिंगटों में विषाणु (वैरस) से होनेवाला रोग वाइट स्पॉट सिड्रॉम की जाँच करने का एक ड्यूफ्लेक्स पी सी आर किट का विकास वर्ष के दौरान की उल्लेखनीय उपलब्धि है. नेस्टड पी सी आर किट की तुलना में यह तेज और निर्भरयोग्य है. पंक कर्कट और सजावटी मछलियों को खिलाने केलिए गुटिका रूपी खाद्य का विकास किया गया. सूत्र पख मछलियाँ माने थ्रेडफिन ब्रीमों के जोड आकृतिमान पर किए वैविद्यपूर्ण विश्लेषणों ने व्यक्त किया कि कोचीन और विशाखपट्टणम में पकडनेवाले इस वर्ग की एन. जापोनिकस जाति के आकार में अंतर है जबकि दूसरी जाति एन. मीसोप्रिओन के बाह्यलक्षणों में समरूपता है. समुद्री मछली और कवचमछली रोगाणु संबंधी नैशनल रेफेरल लबोरटरी कार्यक्रम में रोगबाधित जीवियों से विब्रियो बाक्टीरिया के ३७ आइसोलेटों, एयरोमोनास जाति के २६ आइसोलेटों और स्यूडामोनास जाति के ८ आइसोलेटों का विलगन किया .

मोनोडॉन झींगों में संयुक्त प्रतिरक्षा उत्तेजनों (कंबैन्ड इम्यूनोस्टिमुलेशन) से होनेवाली रोगप्रतिरोध शक्ति जो एक निर्दिष्ट रोग केलिए नहीं है, का मूल्यांकन किया गया. विब्रियो रोगाणु से होनेवाले रोग के प्रतिरोध करने में समुद्री शैवाल अल्वा के सिर्फ एक डोस का प्रयोग अत्यंत आशावह देखा गया कि अतिजीविता दर ८०१ तक बढ गयी. मोनोडॅन झींगो में रासायनिक दाबकारक जैसे तांबे से रक्ताणु की संख्या और रक्तसंलय प्रोटीन कम

होते है. समुद्री चिंगट डिंभक की मृत्युता कम करने में मनुष्य में दिखाये पडनेवाला प्रोबयोटिक यीस्ट सक्कारोमैसेस बुलारडी सक्षम देखा गया. झींगे में होनेवाले रोगों के रोकथाम केलिए प्रोबयोटिक्स का प्रयोग आशावह देखा गया ; पी एल-२० तक बढे डिभकों को प्रोबयोटिक्स से खिलाने और प्रोबयोन्टस से संपुटीकृत आर्टिमिया से खिलाने की रीति का विकास भी यहाँ किया गया.

भारत के सारे समुद्रवर्ती राज्यों में वर्ष के दौरान अवतरित हुई समुद्री पख मछली और कवचमछली जातियों का वार्षिक औसत थोक और खुदरा दाम का आकलन किया. यंत्रीकृत सेक्टर में ट्रालन की एकल दिवसीय परिचालन दर ०.४९ और बहुदिवसीय परिचालन दर ०.६८ थी. गिल नेट परिचालन की एकल दिवसीय परिचालन दर ०.६० और बहुदिवसीय दर ०.५५ थी. ३० वर्षों में अतिमत्स्य से हुए आर्थिक नष्ट शिंगटियों में १६०.६ करोड रुपए , उपास्थिमीनों में ४५८.५ करोड रुपये और गोटफिशों में ३.९ करोड रुपए आकलित किए. संस्थान ग्राम संपर्क कार्यक्रम की दूसरी दशा के कार्यान्वयन केलिए १५ प्रौद्योगिकियाँ अनुमोदित की गई. भारतीय कृषि अनुसंधान परिषद के महानिदेशक डॉ मंगलराय द्वारा कृषि प्रौद्योगिकी सूचना केंद्र के कमीशनिंग के बाद संस्थान की सारी उत्पाद और प्रौद्योगिकियों का वितरण इसके ज़रिए किया जा रहा है. दायित्वपूर्ण मत्स्यन पर एफ ए ओ के कोड आन्ड कोन्डक्ट का मलयालम तर्जुमा का प्रकाशन एफ ए ओ, रोम के सहयोग से किया गया.

संस्थान के कार्मिकों द्वारा बहुचर्चित जर्नलों में २८ अनुसंधान लेख, ३४ तकनीकी लेख और संगोष्ठी / सिंपोसिया में ६७ प्रलेख प्रस्तुत किए गए. अपतटीय मोती पालन और ग्रूपर मछली प्रजनन प्रौद्यागिकी केलिए संस्थान ने दो अस्थायी पेटेंट प्राप्त किया. वर्ष के दौरान संस्थान ने ४६.४ लाख रुपयों की औद्योगिक परामर्श परियोजनाएं कार्यान्वित कीं. वर्ष के दौरान ५ गृहांदर परियोजनाएं जैसे समुद्रकृषि करने योग्य क्षेत्रों का जी आइ एस मापिंग, चिंगटों का जैव पालन, मात्स्यिकी प्रबंधन के लिए सिमुलेशन गेम्स का रूपायन , द्विकपाटी पालन प्रौद्योगिकी और कर्कट फाट्टनिंग प्रौद्योगिकी का स्थानांतरण कार्यान्वित किए. इसके सिवा भारत सरकार के महासागरीय विकास विभाग ने आन्डमान निकोबार द्वीपसमूहों में काला मोती पालन, समुद्री स्तनियों में सीनोबयोटिक्स और प्रेडिक्टिव मॉडलिंग नामक ३ परियोजनाएं मंजूर की. भारतीय कृषि अनुसंधान परिषद के ए.पी. सेस फन्ड ने भी भौमीय तापन का प्रभाव और समुद्री संवर्धित उत्पादों का जोखिम निर्धारण पर दो परियोजनाएं अनुमोदित की. संस्थान के वैज्ञानिकों ने कई गौरवशाली पुरस्कार प्राप्त किए जिन में राफी अहमद किद्वाई अवार्ड उल्लेखनीय है.

शिक्षा कार्यक्रमों के अधिन वर्ष के दौरान १७ छात्रों को पी एच.डी और १० छात्रों को एक.एफ.एस.सी की उपाधि प्रदान की गई. २ एम एस सी छात्रों ने स्वर्ण पदक जीत लिए. संस्थान के के वी के ने १२६ प्रशिक्षण कार्यक्रम और टी टी सी ने १२ पाठ्यक्रम आयोजित किए. संस्थान के कार्मिकों के व्यक्तित्व और प्रबंधकीय दक्षता के विकास केलिए मानव संपदा विकास कार्यक्रम के अधीन प्रशिक्षण दिये गए.

Acronyms Used

ADAK	Association for Development of Aquaculture in Kerala
ATIC	Agricultural Technology Information Centre
BFFDA	Brackishwater Fish Farmers Development Agency
CARI	Central Agricultural Research Institute
CGP	Competitive Grants Programme
CIBA	Central Institute of Brackishwater Aquaculture
CIFA	Central Institute of Freshwater Aquaculture
CIFE	Central Institute of Fisheries Education
CIFT	Central Institute of Fisheries Technology
CMFRI	Central Marine Fisheries Research Institute
CoF	College of Fisheries, Mangalore
DBT	Department of Bio-Technology
DOD	Department of Ocean Development
DST	Department of Science & Technology
E	Exploitation Rate
FAO	Food and Agricultural Organisation
FSI	Fishery Survey of India
GAU	Gujarat Agricultural University
GOPL	GMR PSEG Operations Private Limited, Mangalore
IASRI	Indian Agricultural Statistics Research Institute
ICAR	Indian Council of Agricultural Research
IFS	International Foundation of Science
IGIDR	Indira Gandhi Institute of Development Research
IOTC	Indian Ocean Tuna Commission
ISD	Information System Development
IVLP	Institution Village Linkage Programme
KIOCL	Kudremukh Iron Ore Company Limited
KKV	Konkan Krishi Vidhyapeeth
MM	Mission Mode
MOE&F / MEF	Ministry of Environment & Forest
MPEDA	Marine Products Export Development Authority
MRPL	Mangalore Refineries and Petrochemicals Limited
MSY	Maximum Sustainable Yield
NAARM	National Academy of Agricultural Research Management
NABARD	National Bank for Agricultural and Rural Development
NATP	National Agricultural Technology Project
NBFGR	National Bureau of Fish Genetic Resources
NGOs	Non-Governmental Organisations
NIO	National Institute of Oceanography
PSR	Production Systems Research
RC	Research Centre
RGCA	Rajiv Gandhi Centre for Aquaculture
SEAFDEC	South East Asian Fisheries Development Centre
SFDs	State Fisheries Departments
TANUVAS	Tamil Nadu Veterinary and Animal Science University
WFC	World Fish Centre
Z	Mortality Rate