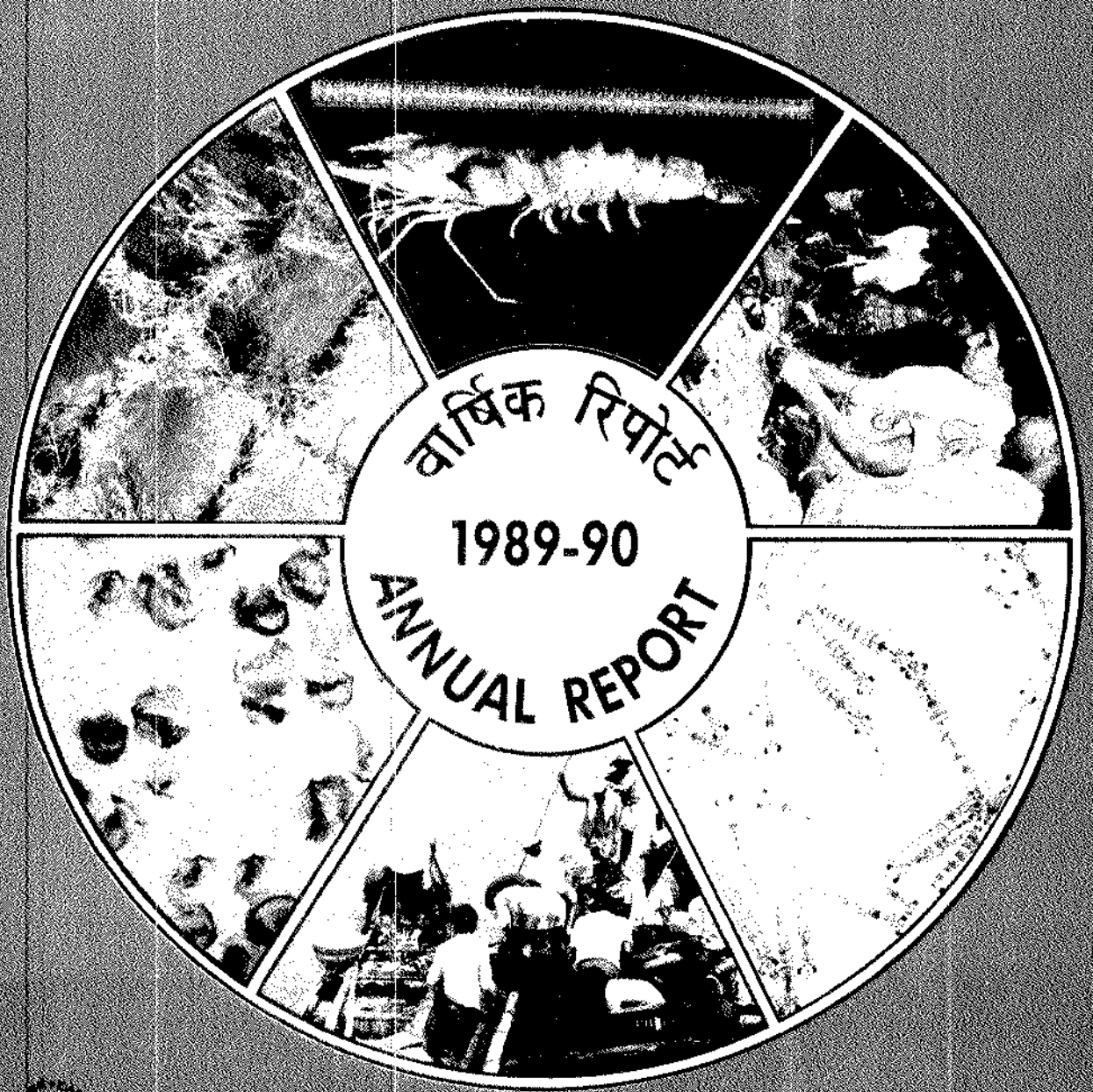
केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान, कोचीन

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN



भारतीय कृषि अनुसंधान परिषद्

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN

Annual Report 1989-90

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Issued by

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CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
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Cover Photo (Clockwise)

1 The largest ever recorded sized (360 mm) Jumbo tiger prawn (*Penaeus monodon*) landed at Bombay.
2 Extension activity—Local women engaged in fish pickle preparation.
3 Post larvae of *Penaeus semisulcatus* released into the Pillaimadom lagoon at Mandapam under the sea ranching programme.
4 Artisanal fishermen landing their catches at Fort Cochin Beach.
5 Pearl oyster (*Pinctada fucata*) seeds produced at Tuticorin hatchery
6 Experimental culture of the seaweed *Gelidiella acerosa* on coir rope nets at Minicoy.

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ANNUAL REPORT 1989 - '90

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Annual Report 1989-90

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

INTRODUCTION

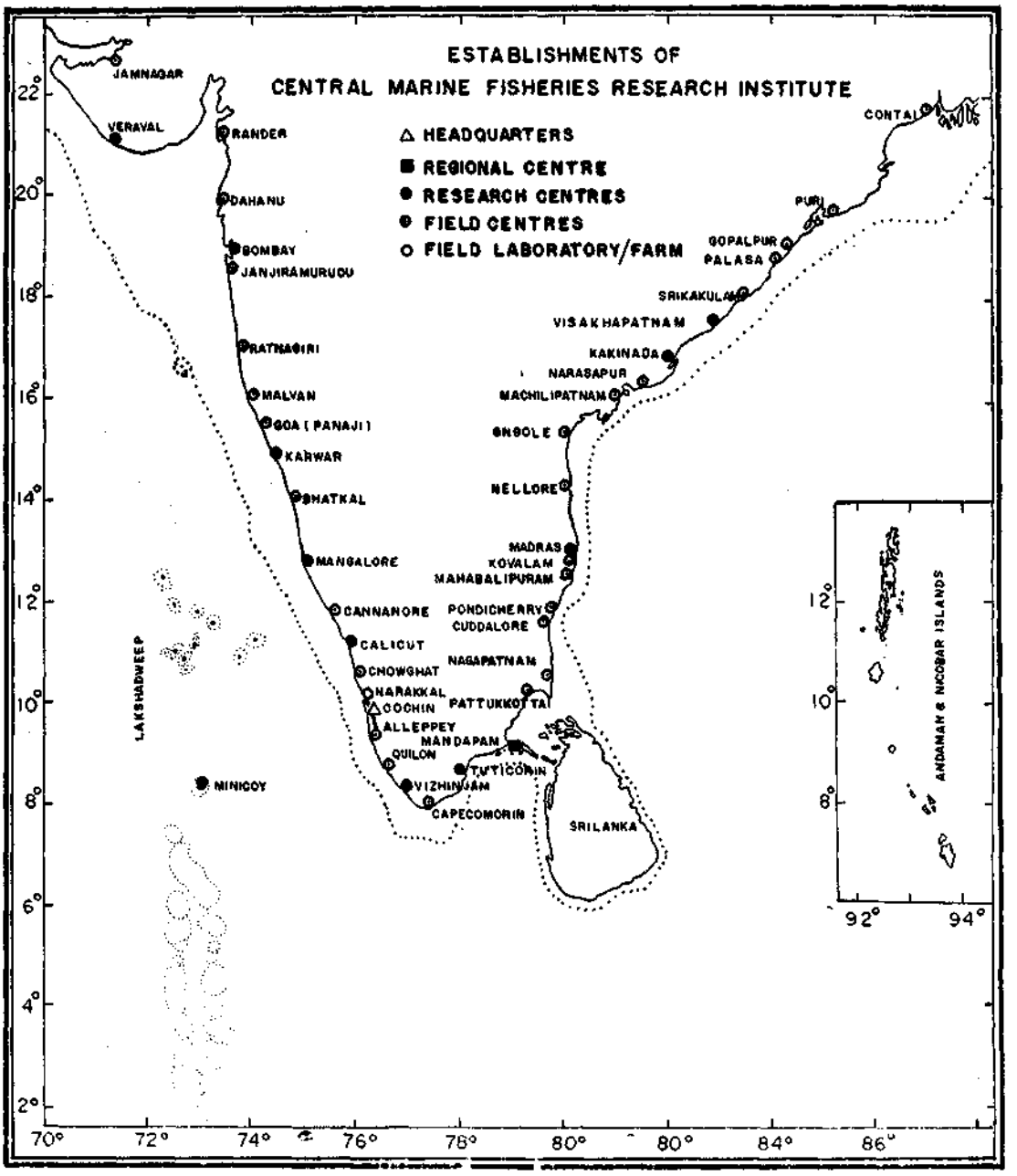
Brief History, Mandate and Organisational set up

The Central Marine Fisheries Research Institute was established in 1947 by the Ministry of Agriculture and Irrigation and subsequently brought under the Indian Council of Agricultural Research in 1967. The Institute headquarters is located at Cochin and its Regional Centre at Mandapam Camp. The 11 Research Centres and 28 Field Centres are situated along the east and west coasts.

The Institute has been actively conducting research both in the capture and the culture fisheries and has contributed significantly to the overall development of marine fisheries in the country. The Institute has the mandate to conduct Research for assessing and monitoring the exploited fisheries resources leading to rational exploitation, conservation and management; to assess the under exploited marine fisheries resources of the Exclusive Economic Zone; to understand the fluctuations in abundance of marine fisheries resources in relation to changes in the environment by conducting vessel based programmes; to develop suitable mariculture technologies for finfish and shellfish production; to conduct transfer of technology; short term and long term training and post-graduate programmes.

The Institute implements its research programmes through the following eight major divisions: Fishery Resources Assessment Division; Pelagic Fisheries Division; Demersal Fisheries Division; Molluscan Fisheries Division; Crustacean Fisheries Division; Fishery Environment Management Division; Physiology, Nutrition and Pathology Division and Fishery Economics and Extension Division.

The post-graduate programme in mariculture affiliated to the Cochin University of Science & Technology conducts M.Sc. and Ph.D. programmes in Mariculture. The Library and Documentation Section provides reference facilities to the staff and students of the Institute and to visitors both within and outside the country. It is also responsible for bringing out the Institutes' publications. The Krishi Vigyan Kendra and Trainer's Training Centre at Narakkal are involved with extension programmes and imparting training in capture and culture fisheries.


ESTABLISHMENTS OF
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
△ HEADQUARTERS
■ REGIONAL CENTRE
● RESEARCH CENTRES
● FIELD CENTRES
○ FIELD LABORATORY/FARM
JAMNAGAR
VERAVAL
RANDER
DAHANU
BOMBAY
JANJIRAMURUDU
RATNAGIRI
MALVAN
GOA (PANAJI)
KARWAR
BHATKAL
MANGALORE
CANNANORE
CALICUT
CHOWGHAT
NARAKKAL
COCHIN
ALLEPPEY
QUILON
VIZHINJAM
CAPECOMORIN
NINICOY
LAKSHADWEEP
CONTAI
PURI
GOPALPUR
PALASA
SRIKAKULAM
VISAKHAPATNAM
KAKINADA
NARASAPUR
MACHILIPATNAM
ONGOLE
NELLORE
MADRAS
KOVALAM
MAHABALIPURAM
PONDICHERRY
CUDDALORE
NAGAPATNAM
PATTUKKOTTAI
MANDAPAM
TUTICORIN
SRILANKA
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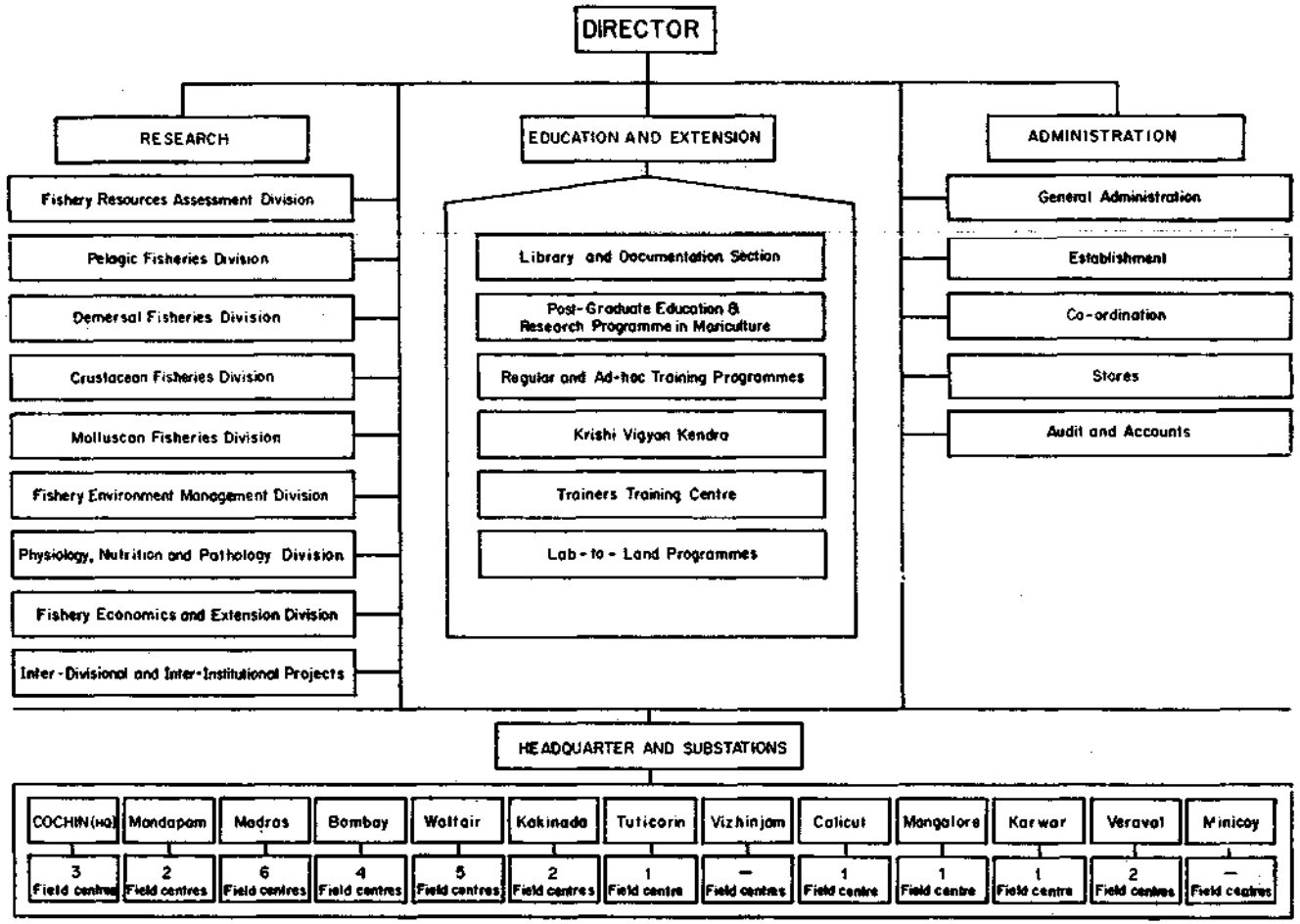
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE (ICAR)
ORGANISATIONAL CHART



IMPORTANT FINDINGS DURING THE YEAR

The research projects of the Institute were reoriented during the year and integrated projects involving monitoring of fishing activities, environmental parameters, economics and extension were taken up. This was done with a view to assess the stock of major groups and suggest measures for better management of the resources exploited from the Exclusive Economic Zone.

Marine Fish Production :

The annual marine fish production in India for the year 1989 has been provisionally estimated at 2.2 million t, a steep increase of 451,000 t (25%) as compared to 1.8 million t of 1988. The increase has been mainly along the west coast, where an increase of 32% was recorded. Along the east coast, an increase of 7.7% was noticed. Mackerel, oil sardine, Bombay duck and coastal tunas registered higher catches and contributed significantly to the total landings.

Pelagic Resources :

The pelagic group of fishes contributed 1,371,787 t to the total catch. The catch this year increased by 443,000 t. Mackerel accounted for 21.3% of the catch with a landing of 291,000 t. followed by oil sardine which accounted for 20.4% (279,000 t). These were mainly caught by the purse seines and the ring seines. At Lakshadweep, 99% of the tuna catch was brought by the pole and line. The catch rates improved by 10% at Minicoy but at Agatti both the catch and catch rate decreased. The decline has been attributed to certain social developments and non-availability of tuna-bait in required quantities.

Demersal Resources:

The demersal group of fishes comprised 882,837 t and registered a marginal increase of 0.6% over that of 1988. The small mechanised trawlers landed 763,000 t with a CPUE of 433 kg. Landing of prawns, perches, croakers and cephalopods increased. The large trawlers mainly landed penaeid prawns and *Nemipterus* spp. Deep sea lobsters were caught off the south-west coast of Alleppey, Quilon, Wadge Bank and Gulf of Mannar.

Molluscan Resources :

The cephalopod landings, consisting of cuttlefishes and squids increased to 56,000 t this year from 39,000 t of 1988. They were landed along the west coast mostly by the small mechanised trawlers. A new bed of *Meretrix casta* was observed at the barmouth of Mulki estuary, Mangalore. The stock here was estimated at 50 t. The marine clam *Sunetta scripta* sustained a good fishery along the Murukumpadam-Munambam area. Tagged chanks (2 nos) were recovered from the Tuticorin Harbour Basin after 9 months of release. An increase of 2.5 mm in length and 5 g in weight was noticed.

Crustacean Resources :

Crustacean resources in general showed an increase in landings this year. However, the ban imposed on the operation of small mechanised trawlers in Kerala during the monsoon months, adversely affected the landings of the penaeid prawn, *Parapenaeopsis stylifera* at the Centre. *Penaeus monodon* having a total length of 363 mm and weighing 440 g was recorded at Bombay. This is reported to be the largest record size for this species.

Environmental studies :

Live seed material of *Gracilaria edulis* was successfully transported from Mandapam to Minicoy and culture of this seaweed was initiated for the first time in the lagoon waters. Culture was successful both in the coirnet frame method and the longline method. Survey of the coral reef habitat in and around Port Blair in the National Marine Park, S. Andamans was carried out. The reefs were infestated with *Acanthaster planci.* However, they did not pose a threat to the reefs. The survey revealed the occurrence of the live-bait, *Spratelloides delicatulus* in good quantity around the reefs.

Physiology, Nutrition, Pathology and Genetics :

Dimethyl sulfoxide (10%) in combination with Alsever's solution and buffers b and c was found to be the most suitable chemical for preserving *Liza parsia* sperms at low temperature. Histochemically, the pituitary of mature *Liza parsia* contained higher glycoprotein material than maturing fishes. *L. macrolepis* maintained under different salinity ranges for 60 days retained normal protein and ash contents but their lipid content increased with increase in salinity.

A survey conducted to assess the status of commercial fish and prawn feed industry in the country indicated that 12 companies had the facility for commercial scale feed production. One company had the technology to manufacture medicated feeds. The Institute offered free advisory service to prawn farmers and feed manufacturers on the type and quality of raw materials to be used in prawn feeds and need for balancing nutrient levels in the feed.

Lead nitrate had haemolytic effect on the R.B.C. of *L. parsia* and *Tilapia mossambica.* It resulted in degenerative changes of the kidney and hepatic cells and gliosis in brain. D.D.T. treated fishes showed demylination in brain, severe necrosis and desquamation of gill epithelial cells and vacuolations in the liver.

The diploid chromosome number in *Villorita cyprinoides* and *Lates calcarifer* was 38 and 48 respectively. Sister chromatid exchanges were successfully demonstrated in *Terapon* sp. and *L. parsia* for the first time. The electrophoretic pattern of lactate dehydrogenase and isocitric dehydrogenase enzymes of mackerel were similar in 70

specimens from Cochin and 10 specimens from Madras.

Fishery Economics :

The average revenue from gill net operation at Cochin Fisheries Harbour was Rs. 950/- per day. The operating cost was worked out at Rs. 550/- per day and the net profit after deducting all costs came to Rs. 150/- per day. The average annual revenue per purse seine unit operating along Karnataka coast was Rs. 7 lakhs. The cost including depreciation and interest on investment was Rs. 6.3 lakhs, thus leaving a net profit of Rs. 70,000/- per year. At Cochin Fisheries Harbour, the average annual revenue per purse seine unit was Rs. 5 lakhs. The total cost was Rs. 4 lakhs with a net profit of Rs. 1 lakh.

Mariculture:

Penaeus semisulcatus rematured in captivity for the first time by unilateral eyestalk ablation and also without eyestalk ablation. About 470,556 post larvae (PL 10 - 15) of P. *semisulcatus* were released into the Pillaimadom lagoon at Mandapam under the sea ranching programme. A prawn hatchery was established by the CMFRI scientists at Mopla Bay, Cannanore for the MATSYAFED using the technology developed by the Institute. Unilaterally ablated *Panulirus homarus* females, developed ovigerous setae and carried berry irrespective of mating. The time lapse between moults for *P. homarus* reduced to 32 days when they were injected with fat body extracts.

Seeds of *Meretrix casta,* produced at Madras laboratory for the first time, were ranched into the Muthukad lagoon. The fifth generation of *Pinctada fucata* was successfully raised in the hatchery at Tuticorin. Hatchery produced seeds of *P. fucata* and *Crassostrea madrasensis* were sent to the Fisheries Department, Gujarat.

Artificial reefs (ARs) were constructed at Tuticorin and Minicoy island. The Institute also provided technical guidance to the Brotherhood Society of Valiathura to construct another AR. Fishes were found to inhabit the AR at Tuticorin by the 3rd month. Cuttlefishes in spawning condition congregated in large numbers around the AR at Vizhinjam.

Vessel Based Programmes :

FORV *Sagar Sampada* made 12 research cruises mainly along the south-east and Andaman sea. She logged 190 days at sea and covered a total track of 41,268 nautical miles. Along the south-east coast, good concentrations (1,130-5,390 kg/h) of scads, *Pomadasys*, mackerel, *Lethrinus* and cephalopods occurred within 10° 00' - 10° 30'N at a depth range of 45 - 85 m. In the Andaman sea high catch of 935 - 1,350 kg/h mainly consisting of scads, red snappers, *Lethrinus* and sharks was obtained from 6° 00' - 6° 30'N and 94° 00'E at a depth range of 52 - 96 m.

The *Cadalmins* stationed at the 7 research centres monitored the environmental parameters in the inshore waters.

Education, Training and Transfer of Technology :

Under the post-graduate programme in Mariculture, two junior research fellows from the 7th batch and one from the 8th batch passed with distinction. Three senior research fellows were awarded Ph.D. degrees by the Cochin University of Science and Technology. Five scientists of CMFRI received specialised training in various organisations in India and abroad.

The KVK conducted 90 courses and trained 1,013 women and 342 men. The Trainers' Training Centre organised training courses in hatchery production of marine prawns, prawn farming, post harvest technology and SCUBA diving.

P. S. B. R. JAMES
(Director)

GENERAL INFORMATION

Conference, Workshop, Summer Institute

The National Workshop on *Bechede-mer* was organised during 23-25 February 1989 at Mandapam.

The National Workshop on Taxonomy of economically important marine algae of India was held at the Regional Centre of CMFRI, Mandapam Camp from 2-4 March 1989. It was organised by the Seaweed Research and Utilisation Association of India in collaboration with the CMFRI and the CSMCRI.

The National Conference on Tunas was organised at Cochin during 21-22 April 1989.

The First Workshop on the Scientific Results of FORV *Sagar Sampada* was jointly organised by CMFRI and CIFT from 5-7 June 1989 at Cochin.

Summer Institute in Recent Advances on the study of Fish Eggs and Larvae sponsored by ICAR and organised by CMFRI, Cochin was conducted at Mandapam Camp from 14 June to 3 July 1989.

Advisory/Consultancy Services

Dr. K. Alagaraja, Principal Scientist served as an expert in the following :

High Power Expert Committee on Marine Fishery Resources Management in Kerala.

Task Force on Fisheries for formulation of VIII Plan in Kerala.

Expert Committee to study the impact of Introduction of fishing inputs in the traditional sector on the available fishery resources of Kerala.

The Evaluation Committee for the studies relevant to the Development of the State, undertaken by the Kerala Statistical Institute.

Dr. C. S. Gopinadha Pillai, Principal Scientist served as a member of the National Committee on Marine Parks under Ministry of Forest and Environment, New Delhi.

Exhibitions

The Institute actively participated in the following exhibitions :

Jawaharlal Nehru Centenary All India Agricultural, Industrial, Technological and Arts exhibition at Tiruvalla, 1 February - 16 March.

All India Science and Technology Demonstration Campaign at Ottapalam, 1-14 September.

Indian Science Congress Exhibition (ISCEX) at Cochin, 4-15 February.

Deputations

Shri D. B. S. Sehara, Scientist (SG) to Bangkok for In-service Training for Senior Economist under FAO/UNDP programme, 11 March - 31 December '89.

CONFERENCE

The National Conference on Tunas was organised at Cochin from 21-22 April. The Conference considered all scientific technical and development aspects of tuna fisheries and provided a common platform for the scientists, planners, administrators, development agencies and financing institutions.

Dr. P.V. Dehadrai, Deputy Director General (Fisheries), ICAR delivering the Presidential address.

Hon'ble Union Minister of State for Agricultural Research and Education, Shri Harikrishna Sastri (extreme right) inaugurated the Conference.

Seated from left to right are Dr. P.S.B.R. James, Director, CMFRI;

Shri K.A. Chandra Secretary, Dept. of Food Processing Industries;

Shri C. Cherian, President Seafood Exporter's Association of India;

Dr. S. Jones, former Director, CMFRI

and Prof. K.V. Thomas, Member of Parliament, Ernakulam.

Dr. P.S.B.R. James, Director, CMFRI addressing the delegates.

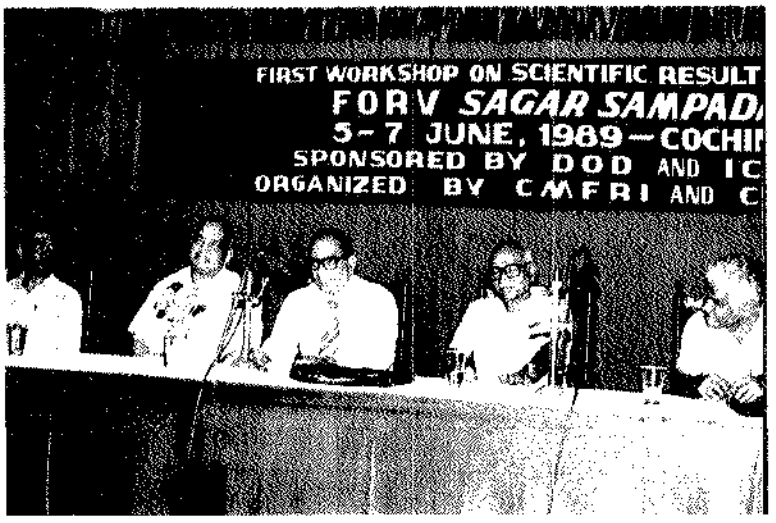
Seated on his left is Shri. R. Sathiarajan, Director, IFP, Cochin and towards right are S/Shri C. Chidambaram, Retd. Director MPEDA and Director, Matsyasagar Consultancy Service Madras and

M.R. Nair, Director, CIFT, Cochin

WORKSHOP

The first workshop on scientific results of FORV Sagar Sampada was held at Cochin from 5-7 June 1989.

Shri. M.R. Nair, Director, CIFT, Cochin welcoming the distinguished gathering. Dr S.Z. Quasim, Vice-Chancellor, Jamia Millia Islamia University, New Delhi and Former Secretary, DOD (second from right) inaugurated the workshop. Seated from left to right are Dr. P.S.B.R. James, Director, CMFRI ; Dr. K. Alagarswami, Director, CIBA, Madras; Dr. Jenson, Member Danish Delegation on FORV *Sagar Sampada* and Dr. S.N. Dwivedi, Additional Secretary, DOD.



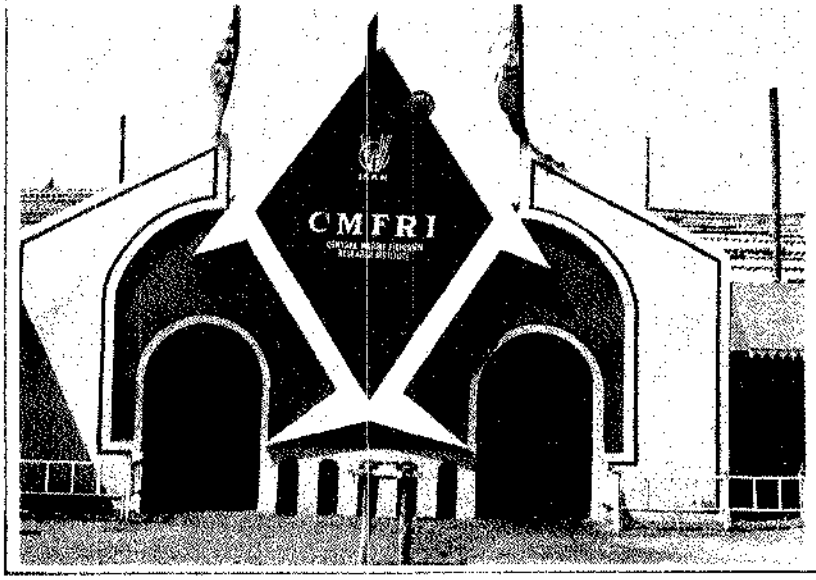
Dr. P.S.B.R. James, Director, CMFRI, chairing the plenary session of the workshop. Seated on the dias are the Chairmen of the different sessions, from left to right are Dr. P.V.R. Nair, Retired Principal Scientist, CMFRI; DR. S.N. Dwivedi, Additional Secretary, DOD; Dr. C.V. Kurian, Emeritus Scientist and Dr.C.T. Samuel, Head, Department of Industrial Fisheries, Cochin University of Science and Technology.

WORKSHOP

The national workshop on Beche-de-mer was organised at Mandapam Camp from 23-25 February

Shri M.R. Nair, Director, CIFT, Cochin (second from left) inaugurated the Workshop. Dr. P.S.B.R. James, Director, CMFRI (second from right) presided. Dr. P.V. Rao, Officer in-charge, Regional Centre of CMFRI, Mandapam Camp (extreme left) welcomed the gathering and Shri. K. Sachithanathan former processing expert of FAO (extreme right) delivered the keynote address. Scientists, Administrators, Policy makers, entrepreneurs and fishermen attended the workshop

EXHIBITION

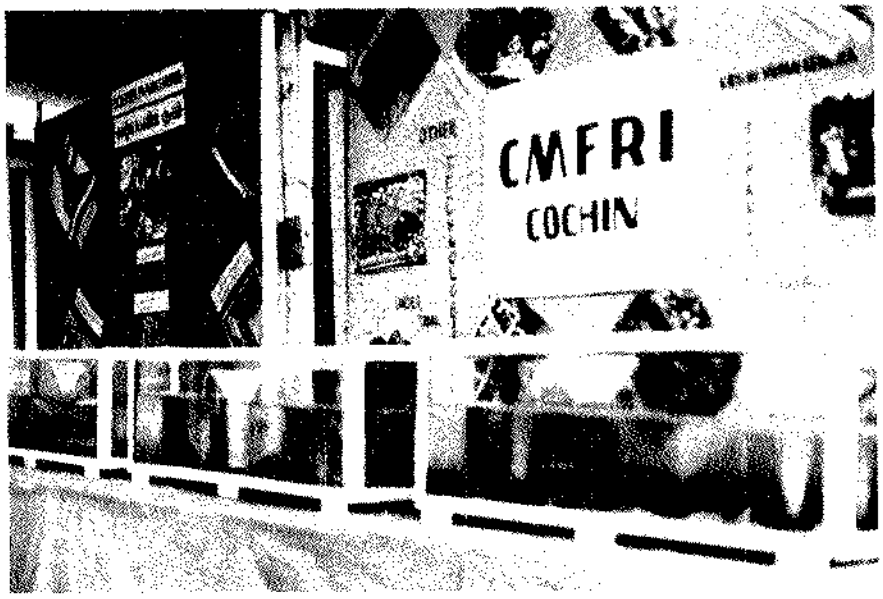


CMFRI actively participated in several exhibitions during the year.

Front view of the CMFRI stall at the Indian Science Congress Exhibition (ISCEX-90) held at Marine Drive Ground, Ernakulam.

EXHIBITIONS

Visitors curiously watching various exhibits in the CMFRI Stall at the Indian Science Congress Exhibition (ISCEX-90) at Ernakulam.



An Inside View of the CMFRI stall
at the All India Science and Technology Exhibition, Ottapalam.

Ms. Reeta Jayasankar, Scientist to Sugarcane Breeding Institute, Coimbatore for training in tissue culture techniques.

Shri S. R. Narayanan, Superintendent to CIBA, Madras.

Dr. P. V. Sreenivasan, Scientist (SG) and **Dr. P. Kaladharan**, Scientist to China for training in *Laminaria* Polyculture with molluscs organised by NACA/FAO/UNDP, 18 July - 28 August.

Shri M. E. Rajapandian, Scientist (SG) to attend a Workshop on Sanitation and marketing of Molluscs in France organised by NACA / FAO / UNDP and also to present a paper on the 'Present status of shellfish sanitation and marketing of molluscs in India', 16-28 November.

Dr. S. C. Mukherjee, Principal Scientist to attend Regional Follow-up Seminar on Veterinary Pathology at Hano, Vietnam, 28 November to 7 December.

Dr. P. S. B. R. James, Director to PDR Yemen as member of Indian delegation to identify areas of co-operation in fisheries from 8-14 January '90.

Dr. P. S. B. R. James, Director, to Rome, Italy to attend second meeting of the Advisory Committees on the study of International Fisheries Research, 26-28 March '90.

Lectures/Talks :

Dr. K. A. Narasimham, Principal Scientist attended the meeting at Tuticorin Port Trust, Tuticorin in connection with promotion of Exports of Fish and Frozen Marine Products and gave a talk on the potential for the export of fishery products from Tuticorin area.

Dr. C. S. Gopinadha Pillai, Principal Scientist gave a special talk on coral reef management at the National Conference on Coastal Zone Management at Cochin.

Dr. K. Alagaraja, Principal Scientist gave the following invited lectures :

On 'Fish Stock Assessment Models' to the Carribean Scientists at NIO, Goa, 20 October '89.

On 'Fishery Resource Assessment' in the Fisheries Research Cell of the programme for Community Organisation Centre, 27 October '89.

On 'Resources in deep sea and offshore areas of Kerala' in the Seminar on 'Medium size fishing vessels for deep sea and offshore fishing in Kerala'.

The following scientists delivered lectures at the refresher course to EIA Officers of F & A section, Export Inspection Agency, Bombay :

Shri K. S. Sundaram, Scientist (SG) on 'Identification of Fishes'.

Dr. (Ms.) P. V. Kagwade, Principal Scientist on 'Finfish Fishery resources of India'; 'Crustacean fishery resources' and 'Molluscan fishery resources'.

Dr. V. D. Deshmukh, Scientist (SG) on 'Identification of prawns'.

Radio talks were delivered by :

Shri M. Feroz Khan, Scientist on Marine Pollution 'Samudra Jala Malineekaranam'.

Dr. M. M. Thomas, Principal Scientist on 'Prawn seed collection — a new employment'.

Shri P. Radhakrishnan, T-5 on 'Employment opportunities for women in scientific prawn farming'.

Shri A. K. Unnithan, T-7 on 'Naran Farming — different aspects to be considered'.

Training :

A two month training programme in SCUBA Diving was conducted by the Tuticorin Research Centre of CMFRI in February. Seven trainees from various Institutes participated.

One week training course on edible oyster culture and ten days training on hatchery producton of edible oyster was conducted at Tuticorin Research Centre during April and May respectively.

Engagements :

Dr. P. S. B. R. James, Director, CMFRI attended the following :

Management development programme for Senior Executives of ICAR at NAARM, 30 January - 10 February '89.

Seafoods trade fair of MPEDA at Madras, 11 February '89.

Beche-de-mer Workshop at Mandapam Camp, 23-24 February.

Meeting of FAO Mission for Sea Farming at Delhi, 10 March '89.

Audit para meeting at ICAR Headquarters. 13 March '89.

ICAR Co-ordination Committee to finalise the cruise programme of FORV *Sagar Sampada* at Delhi, 16 March '89.

In-house Review High Level Expert Group meeting convened by ICAR at Krishi Bhavan, 29 March '89.

ICAR Scientific panel meeting for fisheries at Delhi, 11 April.

11th meeting of the Steering Committee for Island Development Authority at Delhi, 12 April '89.

Workshop on *Artemia* organised by BOBP at Madras, 4-5 May '89.

Meeting of the advisory Committee to the World Bank on the study of International Fisheries Research at Washington DC, USA, 15-17 May '89.

Meeting convened by the Hon'ble Minister of State with all Directors at IARI, Delhi, 26-27 May '89.

Seminar organised by the World Bank Mission on International Fisheries Need at Madras, 12-13 July '89.

Meeting of Planning Commission group for fisheries for VIII Plan at Delhi, 25 July '89.

Third meeting of the National Co-ordinators of the Seafarming Development Project at Qingado, China, 22-29 August '89.

Management Commitee meeting of the Central School at Mandapam Camp, 11 September '89.

Meeting to identify the research strategy for CARI, Port Blair during VIII Plan and to decide about collaborative projects between CARI and mainland based ICAR Institutes at Port Blair, 3 September '89.

Meeting of the Workshop on Brackishwater finfish breeding and seed production organised by CIBA at Madras, 6 December.

Regional Workshop on aquaculture at Visakhapatnam, 12 December '89.

Seminar on Ocean Science and Technology organised by the Indian National Science Academy at Trivandrum, 2 January '90.

Discussion on acquisition of new research vessel for DOD to undertake survey research for living resources at CIFE, Bombay, 13 March '90.

Second advisory committee meeting of the World Bank for the study of International Fisheries Research at Rome, 26-28 March '90.

Shri S. Mahadevan, Principal Scientist; **Dr. D. B. James, Dr. C. P. Gopinathan, Shri M. E. Rajapandian**, Scientists and **Shri D. Gandhi**, Technical Assistant, participated in the National Workshop on *Beche-de-mer* held at Mandapam Camp, 22-24 February '89.

Dr. M. M. Thomas, Principal Scientist and Officer-in-Charge of KVK, Narakkal attended the monthly T & V Workshop of the Agricultural Extension Programme of the Kerala Agricultural University.

Shri M. H. Dhulkhed, Dr. K. A. Narasimham, Principal Scientists; **Dr. H. M. Kasim and Shri Pon Siraimeetan**, Scientists (SG) attended the first workshop on the scientific results of FORV *Sagar Sampada* at Cochin, 5-7 June '89.

Dr. V. S. Kakati, Scientist (SG) attended BFDA (Karnataka Govt. Fisheries Dept.) M. C. meeting.

Dr. D. B. James, Shri M. E. Rajapandian and **Shri R. Marichamy**, Scientists (SG) attended the State Level Seminar on Prawn Farming in Tamil Nadu held at Fisheries College, Tuticorin, 13 May '89.

Dr. G. Luther, **Dr. T. Appa Rao**, Principal Scientists, **Shri S. Reuben, Dr. G. S. Rao, Shri Y. Appanna Sastry**, Scientists (SG) and **Shri G. Radhakrishnan** Scientist attended the Workshop on Marine Wood Biodeterioration at Visakhapatnam, 19 June '89.

Dr. T. Appa Rao, Principal Scientist, **Shri S. Reuben, Dr. G.S. Rao, Shri Y. Appanna Sastry, Shri G. Radhakrishnan** and **K. Vijayakumaran**, Scientists participated in the one day Regional Workshop on Aquaculture at Visakhapatnam.

Dr. G. Luther, Principal Scientist participated in the Workshop organised by the Australian Centre of International Agricultural Research at Horiara, Solomon Islands during 12-13 December '89 and presented a paper on the "Biology of White bait anchovy from Indian water".

Dr. K. A. Narasimham, Principal Scientist participated in the Workshop on Coastal Zone Management of Tamil Nadu held at Madras from 12-14 October and presented a paper on oyster and clam culture potential and problems.

Dr. C. S. Gopinadha Pillai, Principal Scientist participated in the Workshop on Coastal Zone Management at Madras, 12-14 October and presented a status paper on coral reefs of Tamil Nadu and their management.

Dr. K. A. Narasimham, Dr. Peer Mohamed, Principal Scientists, **Dr. H. M. Kasim** and **Shri R. Marichamy,** Scientists (SG) attended the Farmers meeting held at Fisheries College, Tuticorin.

Dr. (Ms.) V. Chandrika, Scientist (SG) participated in the 'First National Workshop on use of Radio Isotopes in Biology' at BARC, Bombay, 16-17 October '89.

Dr. V. S. Kakati, Scientist (SG) attended Managing Committee Meeting & Technical meeting of Brackishwater Fish Farmer Development Agencies of Government of Karnataka at Karwar. He also attended Aquarium Management Committee at Jilla Parishad Office, Karwar.

Shri G. G. Annigeri, Principal Scientist; **Dr. V. S. Kakati,** Scientist (SG), **Dr. P. K. Krishnakumar** and **Shri P. K. Asokan,** Scientists attended the Workshop on Shrimp farming at Jilla Parishad Meeting Hall, Karwar, 9 March.

Dr. C. Suseelan and **Shri K. Narayana Kurup,** Scientists attended the fisrt Meeting of Members of the Advisory Committee and Core Team constituted to study the impact of ban on monsoon trawling along Kerala coast held at CIFT, Cochin, 6 March.

Visitors :

Cochin :

Shri P. V. Jayakrishnan, Chief Secretary, Government of Goa.

Dr. R. P. S. Tyagi, Member (AS), ASRB.

Dr. B. B. Mallik, Joint Director (R), IVRI, Izatnagar (UP).

Dr. Karl Banse, Professor, School of Oceanography, University of Washington.

Dr. N. K. Bhattacharya, Director, Central Institute for Research on Goats, Makhdoom, UP.

Dr. F. Francis Christy, Deputy Team Leader, SIFR, U.S.A.

Ms. F. Casbon (Economist & Mission Leader), Dr. C. Bowley (Fisheries Technologist), Dr. A. Menz (Pelagic Fisheries Biologist) and Dr. A. Good (Social Anthropologist) members of the Offshore Pelagic Fisheries Mission, U.K.

Mandapam :

Dr. M. Lakshmanan, Vice Chancellor, Madurai Kamaraj University.

Prof. A. G. Satyanesan, Emeritus Scientist, CSIR, Cochin.

Shri Ashok Kumar, Additional District and Sessions Judge, Ramnad at Madurai.

Dr. N. Murthi Anishetty, Agricultural Officer, FAO, Rome.

Dr. P. Haridas, Scientist, NIO, Cochin.

Mr. John Reynolds, Assistant Director, Design and Construction, U. S. National Park Services, USA.

Mr. Guthia Nielson, Chief Interpretator, Glacier National Park, U.S.A.

Mr. Carl Nielson, Manager, John Pennekamp, Coral Reef State Park, Key Largo, Florida, U.S.A.

Mr. Peter Me Ginnity, Great Barrier Reef Marine Park Authority, Australia.

Mr. John Clark, University of Miami.

Dr. Abdul Rahman, AVVM Shri Pushpam College, Poondi.

Mr. S. Sankaramurthy, Conservator of Forests, Trichy.

Mr. P. Majumdar, Joint Director, Ministry of Environment and Forests, Government of India, New Delhi.

Forty delegates of the Indo-US Seminar on Marine Parks.

Mr. S. Machendra Nathan, Director of Fisheries, Department of Fisheries, Madras.

Air Marshal C. K. S. Raja, Chairman, National Air Port Authority, New Delhi.

Veraval :

Dr. H. K. Patel, Professor of Extension, Gujarat Agricultural University, Anand.

Dr. P. A. Pomidas, Scientist S-3, CIFT, Cochin.

Ms. Ujjivala Gadre and Mr. S. K. Pandey, Sr. Demonstrator (S), CIFE, Bombay.

Prof. R. S. Biradar and Shri A. Dwivedi, Scientists along with 24 students, CIFE, Bombay.

Karwar :

Prof. Baby Sebastian, St. Berchman's College, Kerala.

Prof. S. S. Kittad, Shri Warana College, Kolhapur, Maharashtra.

Prof. Y. A. Bhosale, L. B. S. College, Satara, Maharashtra.

Prof. V. J. Kulkarni, Rajaram College, Kolhapur.

Dr. M. Shahid Siddique, Reader in Zoology and Co-ordinator, N.R.D.M.S. project of DST, Aligarh.

Prof. A. B. Dandekar, Lecturer in Zoology, Modern College, Pune.

Prof. S. L. Patil, Head, Department of Zoology, R. L. Science Institute, Belgaum.

Vizhinjam :

Prof. D. Venkata Rao, Department of Pharmacology, Andhra University.

Prof. K. G. Radhakrishnan with staff and 14 students, N. S. S. College, Pandalam.

Dr. K. R. Singh, Jawaharlal Nehru University, New Delhi.

Tuticorin:

Dr. Kenneth Frost, General Manager, J & B Coats, Glascow, London.

Shri M. Devaraj, IAS, District Collector, Madurai District.

Shri B. C. Mallik, Assistant Director (IMI), SISI, Government of India, Cuttack, Orissa.

G. Prabhavathy, Assistant Director of Fisheries, State Fisheries Training Institute, Madras.

Dr. Arul Ramanathan, Director, Department of Fisheries, Tamil Nadu.

Captain P. R. Franklin, Indian Navy, Naval Headquarters, New Delhi.

Shri S. N. Rangaprasad, Assistant Director (Chem.), Br. SISI, Tuticorin.

Kakinada :

Shri M. Mangapathi Pallam Raju, Member of Parliament.

Shri Jayaprakash Narayana, District Collector (Magistrate), E. G. District, Kakinada.

Visakhapatnam :

Dr. K. M. Cherian, Principal Scientist, Hindustan Lever Research Centre, Bombay.

Dr. K. Alagarswami, Director, CIBA, Madras.

Dr. K. Radhakrishna, ADG, ICAR, New Delhi.

Dr. K. R. Singh, Jawaharlal Nehru University, New Delhi.

Dr. V. G. Jhingran, Former Director, CIFRI.

Shri Debananda Pati, Shri Praneya Kumar Jena and Shri M. K. Ashok, Asst. Professors, College of Fisheries, Orissa with students.

Minicoy :

Shri Sukumal Sen, MP, West Bengal.

Shri Beerbhadra Pratap Singh, MP, Madhya Pradesh.

Dr. Y. Sivaji, MP, Andhra Pradesh.

Shri B. L. Panwar, MP, Rajasthan.

Shri I. Yadav, MP, Karnataka.

Shri M. Rajamkan, MP, Tamil Nadu.

ACTUAL EXPENDITURE FOR THE YEAR 1989-90 UNDER NON-PLAN & PLAN

(Rs. in Lakhs)

		Non-Plan	Plan
1.	Establishment Charges	347.63	30.72
2.	T. A.	10.21	6.21
3.	Leave Salary, Pension and Provident Fund	0.41	...
4.	Other Charges	83.28	12.37
5.	Seminar and Conference	0.23	...
6.	Grant-in-aid	1.02	...
7.	Lands & Buildings	...	6.75
8.	Fellowship/Scholarships	...	12.95
	TOTAL	442.78	69.00

PROGRESS OF RESEARCH

FISHERY RESOURCES ASSESSMENT DIVISION

Marine fish production in India during 1989

Marine fish production in India during 1989 has been provisionally estimated at 2.2 million t against 1.8 million t of 1988, thus registering an increase of 451,000 t (25%). West coast registered an increase of 32% and the east coast 7.7%. Pelagic group of fishes showed a steep increase by 443,000 t (47.8%) and the demersal group by 6,000 t (0.6%) over that of 1988. Among the commercially important fishes that contributed to the increase, mackerel stands foremost with an increase of 187,000 t followed by oil sardine which increased by 148,000 t. Bombay duck and coastal tunas also contributed to the increase.

Region-wise production of marine fish

A substantial increase of 25,000 t (43.1%) is discernible in the north-east region over that of 1988. This increase has been mainly due to Hilsa shad which showed an increase of 12,000 t over just 1,000 t of 1988. Croakers sustained a reduction by about 9,000 t from 19,000 t of 1988. However, pomfrets recorded an increase of about 5,000 t.

The south-east region registered a marginal increase of 2.9% with a landing of 445,000 t over 432,000 t of 1988. An increase of 18,000 t was noticed in the landings of oil sardine. Among other commercially important varieties, tunnies registered an increase of 19,000 t from 5,000 t of 1988. A remarkable feature was the reduction in the landings of *Stolephorus* spp. to 15,000 t from 35,000 t of 1988. Silver bellies also reduced to 39,000 t from 51,000 t of 1988. No appreciable difference was discernible in the landings of penaeid prawns, ribbonfishes, perches and croakers.

Table 1

Regionwise production of marine fish during 1989 (in tonnes)

REGION	*Annual Production*	*Percentage to all India Production*
NORTH - EAST (West Bengal and Orissa)	83,812	3.7
SOUTH - EAST (Andhra Pradesh, Tamil Nadu and Pondicherry)	444,795	19.7
SOUTH - WEST (Kerala, Karnataka and Goa)	1,018,404	45.2
NORTH - WEST (Maharashtra and Gujarat)	689,594	30.6

Besides, Island Territories contributed 0.8%.

South-west coast recorded a phenomenal increase of 246,000 t in the landings in 1989 showing a 32% increase, over that of 1988. The varieties that contributed to this increased landings were mackerel and oil sardine, the former by 171,000 t and the latter by 115,000 t. *Nemipterus* spp. registered an increase of 15,000 t from 31,000 t of 1988. Similarly, tunas showed an increase of 11,000 t over 17,000 t of 1988. The landings of cephalopods in 1989 was of the order of 26,000 t, an increase of 9,000 t over the landings of 1988. However, *Stolephorus* spp. registered a decrease by 12,000 t from 65,000 t of 1988. Catfishes registered a decrease in its landing by 10,000 t and ribbonfishes by 7,000 t. The landings of penaeid prawns reduced by 14,000 t.

North-west region also registered a spectacular increase of 167,000 t (32%) in the production over that of 1988. This increase has been mainly accounted for by Bombay duck and non-penaeid prawns, the former by 49,000 t and latter by 28,000 t. Mackerel registered a catch of 22,000 t against a practically insignificant catch of 1,000 t of 1988. Similarly, oil sardine registered an increase of 15,000 t compared to 4,000 t of 1988. Among other commercially important varieties in this region, carangids increased by 10,000 t from 17,000 t and croakers by 8,000 t from 48,000 t; penaeid prawns and cephalopods showed increase of the order of 6,000 t each from 46,000 and 16,000 t respectively. However, catfishes registered a decrease by 7,000 t and pomfrets by 4,000 t.

Pelagic group formed 61% of the total production and demersal group 39%.

Pelagic group

Table 2

Estimated landings (in tonnes) of Pelagic fishes in India during 1988 & '89

Name of fish	*1988*	*1989*
CLUPEIDS		
Wolf herring	13142	15428
Oil sardine	131067	278851
Other sardines	76633	82018
Hilsa shad	2049	14558
Other shads	11534	7785
ANCHOVIES		
Coilia	21176	30083
Setipinna	1508	1558
Stolephorus	101168	70506
Thrissina	0	595
Thryssa	36056	22291
OTHER CLUPEIDS	42614	52324
BOMBAYDUCK	67392	120191
HALF BEAKS & FULL BEAKS	3701	2329
FLYING FISHES	4020	13204
RIBBON FISHES	68544	65191
CARANGIDS		
Horse Mackerel	20765	12924
Scads	39473	58935
Leather-jackets	4991	3484
Other carangids	60969	60701
MACKERELS		
Indian mackerel	104349	291605
Other mackerels	130	130
SEER FISHES		
S. commerson	20851	25762
S. guttatus	15412	18453
S. lineolatus	138	59
Acanthocybium spp.	78	327

TUNNIES		
E. affinis	15292	31606
Auxis spp.	5962	10179
K. pelamis	4806	5395
T. tonggol	1299	907
Other tunnies	3007	15511
BILL FISHES	802	1016
BARRACUDAS	8063	11121
MULLETS	8179	9288
UNICORN COD	871	557
MISCELLANEOUS	27967	36915
PELAGIC TOTAL	924008	1371787

Oil sardine : Oil sardine formed 20.4% of the total pelagic resources. An estimated 279,000 t was landed as compared to 131,000 t of 1988. The resource had an all India distribution, but 85.4% of the catch was from the south-west region. The ring seines in Kerala and purse seines in Karnataka and Goa contributed to 64% of the oil sardine catch. The resource formed 4.8% of the total production in the south-east region, 23.4% in the south-west region and 2.8% in the north-west region.

Mackerel : Mackerel accounted for 21.3% of the total pelagic resources. Phenomenal increase of 187,000 t over 104,000 t of 1988 was observed. The catch was mainly from the south-west region where the landings increased by 171,000 t compared to 79,000 t of 1988. The ring seines in Kerala and purse seines in Karnataka and Goa together accounted for 76%. Mackerel formed 24.6% of the total production in the south-west region, 4.1% in the south-east region and 3.3% in the north-west region.

Stolephorus spp : The landings of *Stolephorus* spp. declined this year by 31,000 t (31%) than that in 1988. In south-east region this reduced by 20,000 t and in south-west region by 12,000 t.

Bombay duck : Bombay duck landings were estimated at 120,000 t, an increase of 53,000 t from 67,000 t of 1988. While Maharashtra witnessed a fall of 5,000 t, Gujarat recorded steep increase of 54,000 t. An increase of about 3,000 t was observed in West Bengal. Bombay duck formed 8.8% of the total landings of pelagic group, 95% of which was landed in north-west region.

Carangids : Carangids registered an increase of about 10,000 t (7.8%) over 126,000 t of 1988 and comprised 9.9% of the total landings of pelagic group. The south-west region contributed 60.4% of the carangid catch. The north-west and the south-east regions contributed 19.9% and 17.4% respectively. It formed 2.1% of the total landings in the north-east region, 5.3% in the south-east region, 8.1% in the south-west region and 3.9% in the north-west region.

Ribbonfishes : The landings of ribbonfishes marginally declined by 3,000 t. While south-west region recorded a reduction of 7,000 t, the north-west region registered an increase of about 5,000 t. Ribbonfishes formed 5% of the total fish production of north-east region, 6.3% of the north-west region, 1.7% of the south-east region and 1.0% of the south-west region. North-west region accounted for 66.8%, south-west

region 14.9% and south-east region 6.4%.

Tunnies : The landings of coastal tunas also showed an increase of 32,000 t over 30,000 t of 1988. This increase was mainly in the south-east coast where the landings increased from 5,000 t of 1988 to 24,000 t in 1989. In the south-west region the landings increased to 28,000 t from 17,000 t of 1988. Tunnies formed 4.6% of the total landings of the pelagic group. It formed 5.3% of the total fish landings in south-east region and 2.7% in south-west region. North-east region contributed 0.1% of the total landings of tunas, south-east 37.1%, south-west 44.0% and north-west 35.4%.

Demersal group

Table 3

Estimated landings (in tonnes) of Demersal fishes in India during 1988 & '89

Name of fish	1988	1989
ELASMOBRANCHS		
Sharks	37016	29027
Skates	2532	2254
Rays	18210	19681
EELS	4309	4887
CATFISHES	64216	49440
LIZARD FISHES	25809	20926
PERCHES		
Rock cods	5104	5553
Snappers	4136	3705
Pig-face breams	3107	1941
Threadfin breams	53241	67677
Other perches	27043	24002
GOATFISHES	28500	21806
THREADFINS	4805	7819
CROAKERS	100221	101193
SILVERBELLIES	63757	49070
BIG-JAWED JUMPER	11700	6683
POMFRETS		
Black pomfret	15315	13098
Silver pomfret	28220	29861
Chinese pomfret	194	447
FLAT FISHES		
Halibut	1724	1688
Flounders	32	143
Soles	24974	31557
CRUSTACEANS		
Penaeid prawns	153073	146753
Non-penaeid prawns	49423	76385
Lobsters	1587	1590
Crabs	17424	16149
Stomatopods	68981	69283
MOLLUSCS	0	92
Bivalves	0	632
Gastropods	0	111
Cephalopods	38526	55516
MISCELLANEOUS	26630	23868
DEMERSAL TOTAL	879809	882837

Demersal group of fishes registered a marginal increase of 0.6% over that of 1988. It accounted for 49.2% of the total fish landings in north-east region, 42.5% in south-east region, 28.7% in south-west region and 52.0% in north-west region.

Catfishes : The landings of catfishes declined by about 15,000 t from 64,000 t of 1988. The reduction has been mainly in the south-west region where the landings decreased by 10,000 t from 23,000 t of the previous year and in north-west region by 8,000 t from 31,000 t of 1988. This was marginally offset by an increase of 3,000 t in the north-east region. Catfishes formed

11.0% of the total landings in north-east region, 1.0% in the south-east region, 1.2% in south-west region and 3.3% in the north-west region. North-east region accounted for 18.7% of the total landings of catfishes, south-east region for 9.4%, south-west region for 25.1% and north-west region for 46.5%.

Elasmobranchs : Landings of elasmobranchs declined by 7,000 t. The reduction from 58,000 t of 1988 to 51,000 t in 1989 has been primarily observed in south-west and north-west regions where the reduction was 6,000 t from 9,000 t in the former and 20,000 t from 23,000 t in the latter. Elasmobranchs accounted for 5.8% of the total landings of demersal group. It accounted for 2.8% of the total landings in north-east region, 4.7% in the south-east region, 0.6% in south-west region and 2.9% in north-west region.

Perches : Perch landings were estimated at 103,000 t this year, an increase of 10,000 t from 93,000 t of 1988. An increase of 11,000 t was observed in the south-west region, but in north-east region the catch declined by 1,000 t. Perches formed 11.6% of the total landings of demersal group. It formed 2% of the total landings in the north-east region, 5.1% in the south-east region, 5.3% in the south-west region and 3.3% in the north west region. North-east region accounted for 1.6% of the total perch landings, south-east region 22%, south-west region 52.9% and north-west region 22.3%.

Croakers : The landings of croakers showed a marginal increase of 1% over 100,000 t of 1988. Croakers accounted for 12.4% of the total landings in north-east region, 4.1% in south-east region, 1.6% in south-west region and 8.2% in north-west region. The resource contributed to 11.4% of the total landings of demersal group. North-east region accounted for 10.3% of the total landings of croakers, south-east region for 18.1%, south-west region for 15.9% and north-west region for 55.7%.

Silverbellies : Silverbellies sustained a reduction of 15,000 t from 64,000 t of 1988. Along the south-west region, the catch declined by 12,000 t from 51,000 t of 1988 and along the south-west coast it reduced by 2,000 t from 11,000 t. Silverbellies formed 5.5% of the total demersal resources exploited. It formed 0.4% of the total landings in north-east region, 8.7% in south-east region, 0.8% in south-west region and 0.2% in north-west region. The north-east region contributed 0.6% of the landings of silverbellies. South-east region accounted for 78.7% of the landings, south-west for 17.0% and north-west region for 2.7%.

Pomfrets: The pomfret landings remained at 43,000 t this year also. Pomfrets constituted 8.9% of the total landings in north-east region, 1.1% in south-east region, 0.5% in south-west region and 3.7% in north-west region. North-east region accounted for 17.2% of the pomfret landings, south-east region for 11.4%, south-west region for 10.8% and north-west region for 59%.

Penaeid prawns : Penaeid prawns sustained a reduction of 6,000 t (4.1%) when it decreased from 153,000 t to 147,000 t. The landings of penaeid

prawns in the south-west region decreased from 80,000 t to 66,000 t while, in the north-west region it increased from 46,000 t to 52,000 t. Penaeid prawns accounted for 16.6% of the demersal group. It formed 3.6% of the total landings in north-east region, 5.6% in south-east region, 6.5% in south-west region and 7.5% in the north-west region.

Non-penaeid prawns : Non-penaeid prawns recorded 76,000 t this year as compared to 49,000 t of 1988. An increase of 28,000 t was observed in the north-west region, while marginal decrease was observed in other regions. Non-penaeid prawns formed 8.6% of the total demersal group. North-east region accounted for 1.6% of the total landings of non-penaeid prawns, south-east region for 2% and north-west region for 93.3%.

Cephalopods : Cephalopods formed 6.3% of the total landings of demersal group. This year the landings increased to 56,000 t from 39,000 t of 1988. In the south-west region the landings increased to 26,000 t from 17,000 t and in the north-west region it increased from 16,000 t to 21,000 t. Landings of south-east region also increased from 5,000 t to 7,000 t. Cephalopods formed 0.1% in the total landings in north-east region, 1.6% in south-east region, 2.6% in south-west region and 3.2% in north-west region.

Mechanised and Non-mechanised landings

Landings by mechanised units contributed to 84% relegating the contribution from non-mechanised units to just 16%. 48% of the total production was accounted for by the units with mechanised fishing and 36% by units where mechanisation is only for propulsion. The indigenous crafts fitted with out-board engines has established in Kerala and is gaining importance in Gujarat, Karnataka and Maharashtra. Compared to 1988, the percentage contribution from units with mechanised propulsion has considerably increased from 28% to 36% with a matching increase in the landings from this sector by about 295,000 t (60%) from 491,000 t of 1988.

National Marine Living Resources Data Centre

During the year the marine fish landings data collected from all along the coast line of India were computerised. The software developed was used to make centrewise, gearwise, zonewise and specieswise estimates of landings, along with the effort expended. A new programme for faster merging of analysed data was developed. The raw data and analysed data were backed upon magnetic tapes. The estimated landings, seasonwise and statewise, were supplied to the end users as and when required.

FISHERY ECONOMICS AND EXTENSION DIVISION

Investigations on the efficiency of village adoption as a method of extension education (FE & E/22)

A survey of the coastal villages was carried out and Puduvaipu village under Elamkunnapuzha Panchayat, was selected as the project area. Discussions were held with the farmers and Panchayat board members of the area and local potentials were investigated for adoption of prawn culture in the project area. Agencies concerned with the input supply were contacted and information was collected.

Planned change in a coastal village — model for a first line extension programme (FE & E/19)

A programme was planned to encourage utilisation of homestead water bodies at Kandakkadavu for prawn culture. A water area of 320 sq. mts was selected to conduct the demonstration of prawn culture and 1,900 *Penaeus indicus* seeds were stocked. An yield of 5.4 kg was realised after 90 days. Field day and mass contact programmes were arranged in the project area. A training programme in prawn seed collection and fish processing was organised.

PELAGIC FISHERIES DIVISION

The division with the main objective to assess stocks of major pelagic groups and suggest better management of resources, took up integrated investigations on gearwise capture fisheries. The work involved monitoring the landings and species composition of 4 major gears viz. gill net (mesh 45 mm and above), dol net, purse seine and pole and line, their economics of operation, biology and population characteristics of dominant species and influence of environmental parameters on fisheries. Preparation of an atlas of pelagic resources and tagging of commercial species of fishes and shellfishes were also taken up.

Investigations on gill net fisheries (PF/IP/1)

Gill nets operated over a major part of the year along the east and west coasts, the main season, however, varying in different centres. The annual catches and catch rates (in parenthesis) at the centres were; Veraval 5,978 t (197 kg), Bombay 2,585 t (729 kg), Cochin 4,029 t (227 kg), Mangalore 455 t (118 kg), Tuticorin 1,830 t (129 kg), Mandapam 559 t (65 kg), Madras 254 t (244 kg) and Visakhapatnam 82 t (6 kg).

Seerfishes formed 60% and 33% of the total gill net landings at Mangalore and Madras respectively. The corresponding fishery seasons being June February and January - September. Highest catch was recorded at Cochin (635 t) followed by Tuticorin (218 t), Calicut (175 t), Vizhinjam (134 t), Mangalore (83 t) and Mandapam (34 t). *Scomberomorus commerson* was the dominant species at all centres. The fish had a total length ranging from 13-135 cm with a dominance of 35-120 cm length groups. Smaller fishes (20-30 cm) were observed at Tuticorin and Mandapam. *S. guttatus* and *S. lineolatus* were recorded at Cochin and Tuticorin respectively.

Tunas formed an important component at Tuticorin (40%), Cochin (30%), Madras (19%) and Mangalore (18%). Fishery season was August/September-November between Mangalore and Vizhinjam, May-September/October at Tuticorin and Mandapam and during January-September at Madras. High yields of 1,222 t (69 kg) were recorded at Cochin followed by Tuticorin 727 t (51 kg), Calicut 189 t (33 kg), Madras 47 t (45 kg) and Mangalore 46 t (23 kg). *Euthynnus affinis* was dominant at all centres except Calicut where *Auxis thazard* formed 63% of the catch. The other tuna species were *Thunnus tonggol, T. obesus, T. albacares, A. rochei* and *Sarda orientalis*. At Cochin, *A. thazard* had a length ranging from 22-46 cm with the mode at 36 cm. *T. tonggol* ranged from 20 - 56 cm with mode at 42 cm. Juveniles were recorded during July-September.

The contribution of mackerels to the gillnet fishery ranged between 2% at Mangalore and 27% at Mandapam.

Highest catch of 514 t (11 kg) was obtained at Vizhinjam followed by Mandapam 152 t (18 kg). At other centres the catch was low. The main fishery seasons were October-December at Mangalore, May-February at Cochin, August-March at Vizhinjam, September-February at Mandapam and November-May at Visakhapatnam. Larger fishes (25-26 cm) were dominant along the west coast and smaller (20-23 cm) ones along the east coast. Juveniles were common during August-November along the southern section of the peninsula, during November-December at Mangalore and during August and February at Visakhapatnam. The fish spawned mainly during January-May off Visakhapatnam.

Carangids contributed 6 t (3 kg) at Mangalore, 58 t (4 kg) at Cochin and 23 t (2 kg) at Visakhapatnam, the fishery season at these centres being September-December, August-September and April-October respectively. At Cochin, *Alepes djedaba* was the dominant species followed by *Megalaspis cordyla*, *Decapterus russelli* and *Carangoides malabaricus*. The first three species occurred in the length ranges of 19-36 cm, 16-82 cm and 16-20 cm respectively. At Visakhapatnam also, *A. djedaba* dominated followed by *M. cordyla*, *Selar crumenophthalmus* and *D. russelli*. *D. russelli* occurred seasonally during January - February and May and had a modal length of 15-19 cm. *M. cordyla* also occurred seasonally and was landed during August-December.

Elasmobranchs, catfishes and pomfrets were the important groups along the north-west region and they formed 18%, 7% and 13% respectively in the gill net catches. South of Maharashtra, these groups accounted for 6%, 3% and 1% respectively. Along the east coast they formed 8-17%, 1-5% and negligible amounts respectively.

The annual yields of elasmobranchs were 1,086 t (36 kg) at Veraval, 475 t (134 kg) at Bombay, 260 t (20 kg) at Mandapam, 228 t (13 kg) at Cochin and 18-44 t (3-42 kg) along Vizhinjam, Tuticorin and Madras sector. The main fishery seasons were May-December and February-March at Veraval, September - March at Bombay and Tuticorin, October-March at Mangalore, April-October and December-January at Cochin, December-May at Mandapam and January-September at Madras. Important species of elasmobranchs and their dominant sizes at the observation centres were *Scoliodon laticaudus* (46-48 cm) at Veraval and Bombay, *Carcharhinus melanopterus* (69-81 cm) at Mangalore, *Rhizoprionodon acutus* (80 cm) and *R. oligolinx* (60 cm) at Cochin, *Loxodon macrorhinus* (62 cm) and *C. sorrah* (70 cm) at Mandapam.

Catfish landings amounted to 467 t (15 kg) at Veraval, 133 t (37 kg) at Bombay, 148 t (9 kg) at Cochin and 2 t (1 kg) at Mangalore. The yields were poor 0.5-27 t (1.5 kg) along the east coast. Main fishery seasons were June-September and November-February at Veraval, September-March at Bombay, October-February at Mangalore, January-October at Cochin, November-March at Tuticorin, September-November and March-May at Mandapam and

May-June at Visakhapatnam. The major species and their dominant sizes were *Tachysurus thalassinus* (25-34 cm), *Osteogeneiosus militaris* (33-37 cm), juveniles being dominant during May-June and October-March at Veraval and Bombay, *T. serratus* (89-100 cm) at Mangalore, *T. thalassinus* (46-76 cm), *T. serratus* (90-102 cm) and *T. tenuispinis* (42-46 cm) at Cochin, *T. thalassinus* (60-77 cm) and *T. dussumieri* (76-86 cm) at Mandapam and *T. thalassinus* (24-45 cm) at Visakhapatnam.

Pomfrets had an annual yield of 484 t (16 kg) at Veraval and 49 t (3 kg) at Cochin. The fishery seasons in the above centres were May-August and August-January respectively. Two species contributed to the fishery with *Parastromateus niger* being dominant at Veraval and *Pampus argenteus* at Cochin. *P. niger* at Cochin had modal lengths at 25 and 32 cm and *P. argenteus* at 26 and 34 cm. Juveniles occurred during May-September.

Economics of gill net operation was studied at Cochin Fisheries Harbour. The average daily revenue was Rs. 950/-. The operating cost was worked out at Rs. 550/-, leaving a gross profit of Rs. 400/-. The net profit after deducting all costs came to Rs. 150/- per day.

Investigations on dol net fisheries (PF/IP/2)

Investigations were carried out on Bombay duck, pomfrets, *Coilia*, sciaenids and crustaceans with particular reference to their juvenile component at Veraval and Bombay. The annual catches and catch rates (catch per unit/catch per haul) at Jaffrabad, Navabunder and Rajpara monitored from Veraval were 34,244 t (1,672 kg/199 kg), 14,708 t (537 kg/132 kg) and 23,968 t (916 kg/146 kg) respectively. Fishing was carried out during October-May at Jaffrabad and September-January at the other two centres. Off New Ferry Wharf, Sassoon Dock and Versova of Bombay area, the annual catches and catch rates were 662 t (272 kg/99 kg), 1,799 t (153 kg/48 kg) and 1,134 t (13 kg/haul) respectively. The gear was operated throughout the year with the main season during June-August, July-October and September-February/April-May respectively.

Bombay duck accounted for 40-76% of the dol net catches in Saurashtra area with main fishing season during September-May. The catches and catch rates were 26,016 t (1,270 kg/151 kg) at Jaffrabad, 5,809 t (212 kg/52 kg) at Navabunder and 14,223 t (544 kg/87 kg) at Rajpara. At Versova, Bombay duck accounted for 12% with an annual catch and catch rate of 1,134 t and 13 kg/haul respectively. October-February and April-May were the peak seasons.

At Jaffrabad, Bombay duck had a length ranging from 30-360 mm with 195-280 mm fish forming the mainstay of the fishery. At other centres, smaller fishes (165-190 mm) dominated. Gravid fishes were common off Rajpara and the immature and spent fishes at other centres. Off Versova, 135-240 mm fishes dominated the catch. Juveniles were abundant during September-February.

Coilia formed 6-11% of the catch at Saurashtra area with a catch of 824-3,308 t. The catch rates were 30-162 kg/unit and 1-19 kg/haul. September-March/May were the peak seasons with a dominance of young fish in April. At Sassoon Dock, the catch and catch rates were 790 t and 9 kg/haul respectively. The main season was April-October.

The pomfrets contributed to only 0.2-0.5% of the catch in Saurashtra area with a catch and catch rate of 180 t and 0.4 kg/haul respectively. Fish of 80-230 mm length occurred in the catches.

Sciaenids formed 1% of the dol net catches at Sassoon Dock with an annual catch and catch rate of 21 t and 1.8 kg/haul respectively. In Saurashtra area the catch and catch/boat (in parenthesis) was estimated as 1,363 t (50 kg) at Navabunder, as 1,110 t (42 kg) at Rajpara and as 608 t at Jaffrabad. The dominant sizes observed in Saurashtra area were: 85-125 mm for *Otolithes cuvieri*, 115 mm for *O. ruber*, 135-165 mm for *Johnius glaucus*, 135-175 mm for *J. macrorhynus* and 168-175 mm for *J. dussumieri*.

Crustaceans formed 43-49% of the dol net catches in Bombay area. The annual landings were 284 t with catch rates of 117 kg/boat and 42 kg/haul at New Ferry Wharf and 881 t with catch rates at 75 kg/boat and 24 kg/haul at Sassoon Dock. Non-penaeid prawns comprising mainly of *Acetes* spp. (80%) dominated. At Navabunder, the catch rate for non-penaeid prawns was 33 kg/haul. Peak landings (1,637 t) were obtained in November and poor landings (25 t) in March. *Exhippolysmata ensirostris* had a length range of 41-100 mm. Penaeid prawns (15%) and stomatopods (1%) were the other crustacean items.

Penaeid prawns contributed 228 t at New Ferry Wharf and 741 t at Sassoon Dock with catch/boat at 94 kg and 63 kg respectively. *Parapenaeopsis stylifera* (50%), *Metapenaeus brevicornis* (26%), *P. sculptilis* (11%) and *P. hardwickii* (1%) contributed to the penaeid landings. At Jaffrabad, Navabunder and Rajpara the annual penaeid landings were estimated as 478 t, 320 t and 449 t with catch rates at 23 kg, 12 kg and 17 kg/boat respectively, the catch/haul being 3 kg at all the centres. The peak season was during October-January extending to May in some places.

Investigations on the purse seine fishery and its impact on the resources (PF/IP/3)

Investigations on the purse seine fishery were carried out at Karwar, Mangalore, Malpe and Cochin. The fishing season at Karwar, Mangalore and Malpe was August/September-December with peak landings in October. The depth of operation ranged between 11-20 m. At Cochin, the season was September-March with peaks in September and February and depth of operation 21-40 m.

An estimated 6,249 t was landed at Karwar and 66,582 t along Mangalore-Malpe coast. Malpe contributed to

63.7% of this catch. Of the 32,210 units operated, maximum fishing effort was expended at Mangalore (44.1%) followed by Malpe (40.1%). These two centres accounted for 31% and 57% respectively of the annual yield by purse seines along the Karwar/Cochin belt. The catch rates (catch/unit) were: Malpe 3.28 t, Cochin 3.04 t, Mangalore 1.70 t and Karwar 1.61 t.

Based on the estimates made at Mangalore, the total value of purse seine fishery was to the tune of Rs. 105.64 million of which the share of the landings at Malpe amounted to 62.8%. Of the total value, the contributions of mackerel, *Sardinella* spp. and pomfrets were Rs. 57.86, Rs. 26.50 and Rs. 2.36 million respectively.

Mackerel was dominant in the landings at Karwar (84.6%), Mangalore (50.5%) and Malpe (64.5%). Oil sardine dominated at Cochin (54.3%). The oil sardine contributed 14.9% at Karwar, 26.2% at Mangalore and 16.5% at Malpe. The contribution of other groups to the landings were tunas (0.3-9.0%), carangids (5.5 - 8.9%) and white baits (3.5-6.2%).

Rastrelliger kanagurta comprised the entire mackerel catch. Malpe (27,361 t), Mangalore (1,217 t and Karwar (4,856 t) mainly contributed to the mackerel fishery, with peak landings during August/September-November. The size of mackerel ranged from 65 mm - 260 mm. The 0 and 1 - year groups dominated the catch with multimodal size frequency distribution. Feeding condition was found to be good. The fish attained maturity at 215 mm with stages III and IV predominant during October-February.

Sardinella longiceps dominated the sardine catch. Malpe (7,007.5 t) and Mangalore (5,957 t) were good centres for oil sardine followed by Cochin (2,692 t) and Karwar (857 kg). Peak landings were during October-December. The size of oil sardine ranged from 75-201 mm with multimodal size frequency distribution. Juveniles (67%) dominated the fishery. Size at maturity was 145-150 mm.

S. dayi, S. gibbosa, S. fimbriata and *S. albella* were the important species among lesser sardines. *S. dayi* accounted for 68.78% of the catch off Karwar. *S. gibbosa* and *S. fimbriata* were important species at Mangalore, Malpe and Cochin. The size of *S. dayi* ranged from 135-185 mm with modes at 140 and 155 mm at Karwar. *S. gibbosa* ranged from 115 - 185 mm with modes at 125 mm, 140 mm and 180 mm. Size at first maturity was 135 - 140 mm.

Tunas contributed 2,164 t (8.9%) at Mangalore, 1,606 t at Malpe (3.8%), 27.7 t (0.44%) at Karwar and 16.1 t (0.34%) at Cochin. *E. affinis, A. thazard* and *A. rochei* were the important species. *A. thazard* (50.4%) was the major component at Karwar followed by *E. affinis* (32.8%) and *A. rochei*(16.8%).

White baits contributed 1,487 t at Mangalore and 1,501 t at Malpe. *Stolephorus devisi* was the most dominant species and had a size ranging from 60-95 mm with mode at 75-80 mm. The entire catch consisted of adult fishes. Developing (53.2%) and gravid (32.3%) fishes dominated.

Carangid catches totalled to 3,783.6 t (8.9%) at Malpe and 1,319.9 t (5.5%) at Mangalore. Peak landings were during September and October. *Decapterus russelli, Chorinemus* spp. and *Megalaspis cordyla* were the important species. The size of *D. russelli* ranged from 165-220 mm with a dominant mode at 180 mm. Pre-adults dominated in the catch. Sexes were equally distributed with the fishes in maturing stages dominant (64%) in the catch.

Pomfrets contributed 3 t at Karwar and were absent in Cochin. At Mangalore and Malpe 182.2 t (0.8%) and 87 t (0.2%) respectively were landed. Pomfrets were recorded in September, October and February at a depth of 21-40 m in Mangalore and 11-20 m in Malpe. *P. niger* having a length range of 110-250 mm and mode at 214 mm comprised the entire pomfret catch.

The average annual revenue per unit operating along the Karnataka coast was worked out at Rs. 7 lakhs and the total cost including depreciation and interest on investment was Rs. 6.3 lakhs, thus leaving a net profit of Rs. 70,000/-. At Cochin Fisheries Harbour, the average annual revenue per unit was Rs. 5 lakhs. The total cost was Rs. 4 lakhs with a net profit of Rs. 1 lakh.

Investigation on tuna fisheries and related aspects in the Lakshadweep (PF/IP/4)

An estimated 2,682 t of tuna was landed at Minicoy and Agatti islands. Agatti contributed 58% of the catch. Most of the tuna catch (99%) was from pole and line (TPL) fishing and the rest by troll line (TRL). In the TPL fishery of Minicoy, the catch rate increased by 10% from 261 kg to 287 kg this year. At Agatti, on the other hand, the catch, effort and catch rate decreased. The decline may be due to the local social developments and the non-availability of tuna-bait in required quantities. Tuna catch rate per 1 kg of bait fish employed (CPUB) decreased by 34.3% at Minicoy due to poor chumming behaviour and high mortality of baitfish during transportation.

Poor recruitment of the migrant caesionid baitfish into the lagoon at Minicoy resulted in fishing pressure on resident sprat population. Non-availability of the other baitfish species in fishable quantities was also seriously felt this year. The situation was similar in Agatti. The collections of conventional and non-conventional baitfishes made during the exploratory surveys of FORV *Sagar Sampada* were analysed for their distribution pattern and relative abundance in different localities. Population characteristics of *Spratelloides delicatulus* was studied.

Katsuwonus pelamis was the dominant species (53-94%) in TPL fishery at various areas. *T. albacares* formed the dominant fraction of the rest of the catch. In the case of *K. pelamis*, the fishery was constituted by fish in 50 cm and 60 cm modal size groups. Total mortality rates and length-weight relationship were estimated. The average weight of individual fish was 2.9 kg and about 107-120 fishes were caught per boat in TPL fishing. Wastage during processing was about 5% at Mini-

coy and 33% at Agatti. Price of *Masmin* varied between Rs. 29/- and Rs. 37/- at Minicoy and Rs. 17/- and Rs. 35/- at Agatti.

Tagging of commercial species of fish and shellfish (PF/IP/5)

One hundred and one sacred chanks were tagged with Letro 9 mm adhesive labels and released in the Palk Bay at a depth of 5 m off Pillaimadom lagoon at Mandapam. Similarly, 115 chanks were tagged and released in the harbour basin at Tuticorin. In addition 65 chanks were tagged and released in the open sea for the first time at Pulipoonder paar off Tuticorin.

Two tagged chanks were recovered from the harbour basin at Tuticorin after 9 months of release. The tags were overgrown with periostrucum and an increase of 2.5 mm in length and 5 g in weight was noticed.

Atlases of marine resources (PF/IP/6)

Draft figures (60 nos) on the biology, catch, distribution, etc. of the mackerel were prepared. These will be drawn by artists and then made ready for printing.

DEMERSAL FISHERIES DIVISION

Investigations on the resources exploited by small mechanised trawlers (14 m & below) (DF/IP/1).

The operation of small mechanised trawlers (14 m & below) and the catch brought by them were monitored from several centres along the coasts to study the effect of trawling on the resources. Species composition and biology of important groups were studied at all centres and population parameters of few species were estimated at selected centres. The landings were good at most places. The ban imposed on operation of small trawlers in Kerala during the monsoon months may have affected the landings of penaeid prawns at this centre. The mixed fisheries assessment (all species) at Kakinada showed that the maximum sustainable yield of all the species together can be obtained by increasing the present effort by 10.5%. However, this may not be remunerative as the increase in financial returns will be only 0.05%. Thus it appears that the present effort can be maintained and need not be reduced to ensure viable returns to each unit.

This year an estimated 1,765,000 trawler units operated and landed 763,000 t with a CPUE of 433 kg. This contributed to 34% of the total landings (2,220,000 t) by all gears. Prawns (127,000 t) dominated the catch followed by perches (85,000 t), stomatopods (68,000 t), croakers (64,000 t), cephalopods (49,000 t), silverbellies (40,000 t), anchovies (38,000 t), carangids (36,000 t), soles (25,000 t), elasmobranchs (21,000 t), catfishes (14,000 t) and others.

Among prawns, the penaeids accounted for 106,000 t (76%) and the non-penaeids, 21,000 t (24%). *Penaeus monodon* having a total length of 363 mm and weighing 440 g was recorded at Bombay. This is reported to be the largest record size for this species. Bombay also recorded very high landings of *Parapenaeopsis stylifera* during October and part of it was transported to Cochin and to Mangalore in refrigerated trucks. The size of *Solenocera crassicornis* ranged from 49-127 mm. The females were dominant in January. Growth parameters estimated for *P. stylifera, Metapenaeus affinis* and *M. monoceros* caught at Bombay are given in table 1. At Veraval, *M. kutchensis* and *P. stylifera* were observed in good numbers. Females dominated the *M.kutchensis* catch throughout the year except in December. Mature *P. stylifera* occurred during December and March. The important prawn species contributing to the fishery at other centres were : *P. stylifera, M. monoceros, M. dobsoni* (Kerala), *P. semisulcatus, M. stridulans* (Mandapam), *M. dobsoni, P. maxillipedo, P. indicus* (Madras) and *P. indicus, M. monoceros* and *Trachypenaeus* sp. (Visakhapatnam).

Panulirus polyphagus (76%) dominated the lobster catch at Bombay. The fishery was mainly sustained by the 200-300 mm (4-5 year) specimens. Berried females formed 23.9% and

Table 1. The growth parameters obtained by studying the length frequency of *P. Stylifera, M. affinis, M. monoceros* were as follows :

Name of the species		L	K	to	Z	M	F	U
P. stylifera	Males	124.4	0.142	0.04	12.66	2.62	10.04	0.79
	Females	142.4	0.23 (monthly)	—0.06 (months)	8.94	4.24	4.70	0.52
M. affinis	Males	151.3	0.146	—0.064	5.47	2.68	2.78	0.50
	Females	190.2	0.128 (monthly)	0.08 (months)	6.43	2.35	4.08	0.63
M. monoceros	Males	195.88	0.128	—0.374	6.76	2.36	4.40	0.65
	Females	226.09	0.126 (monthly)	0.236 (months)	5.44	2.32	3.12	0.57

were recorded throughout the year except in August. Juveniles were recruited in November. *Thenus orientalis* (24%) also contributed to the fishery. The berried females occurred during October-February and juveniles were recruited in March. *P. polyphagus* was the dominant (56.4%) species at Veraval also and berried females formed a peak in November. At Madras, *T. orientalis* dominated (96%) and the rest of the catch was *P. homarus.*

Sciaenids contributed 64,000 t of the trawl catch and formed an important fishery at Veraval, Bombay and Cochin. *Otolithes cuvieri, O. ruber, Johnius glaucus* and *J. dussumieri* were the dominant species at Veraval. *O. cuvieri* in gravid stages were observed during February and April and in developing stages during September-February. The females dominated and were mostly in the developing stages. Stomachs contained mainly *Acetes* spp. Sexes were equally distributed among *O. ruber.* Fishes in gravid stages occurred during February and the developing ones during April, October and December-February. Stomachs were empty. *J. glaucus* had a total length ranging from 125-205 mm. The females dominated with most of them in indeterminate (April, October-February) and gravid (April-May, September-February) stages. The male : female ratio for *J. dussumieri* was 2 : 3. Fishes in gravid stages occurred during April-May and those in resting and developing stages during December. Most had empty stomachs and those with ½ full or full stomach contained *Acetes* spp. and fishes. The mortality estimates and stock parameters of important species landed at New Ferry Wharf is given in

Table 2. The mortality estimates and stock parameters of various species based on the data of New Ferry Wharf (Bombay)

Name of the species	Total Mortality 'Z'	Natural Mortality 'M'	Fishing Mortality 'F'	Exploitation ratio 'E'	Exploitation rate 'U'	Yield in tonnes 'Y'	Total stock in tonnes Y/U	Standing stock in tonnes Y/F
J. macrorhynus	2.04	1.16	0.88	0.42	0.37	1900.667	5139.64	2160.98
J. vogleri	2.34	1.10	1.24	0.53	0.48	2014.956	4197.82	1624.96
O. cuvieri	1.41	1.30	0.11	0.07	0.05	2136.606	42732.12	19423.69
J. sina	3.05	1.82	1.23	0.40	0.38	1145.575	3014.67	931.361

Table 2. *Johnieops sina* formed the dominant species at Cochin. Their length ranged from 85-155 mm. Partially and fully spent fishes occurred during June and March respectively.

Threadfin breams formed a major fishery at several centres and an estimated 65,000 t were landed by the small trawlers. *Nemipterus japonicus* was the dominant species. At Veraval, *N. japonicus* in gravid stages were observed during October and January-March. More than 50% of the females were in advanced stage in February. The major food items were prawns and *Acetes* spp. Mortality and population parameters of *N. japonicus* landed at Bombay were estimated as : Z = 3.97, M = 1.30, F = 2.67, E = 0.67, U = 0.65 and Y = 2,019.196 t. The study indicated that 'E' (Exploitation ratio) was below the level of optimum exploitation. *N. mesoprion* also contributed to the fishery at Bombay. Fishes in gravid and spent stages were observed during April-July. The immature fishes were the mainstay during January-March. At Mangalore, *N. japonicus* in gravid stages were observed during November-March and the immature fishes during April-May. Sexes were equally distributed. *N. japonicus* in gravid stages were recorded at Malpe during January-May. Males in advanced stages were noticed in January and the females in February. The fishery at Cochin was dominated by the indeterminate and immature fishes. Gravid and spent fishes were noticed during May, July and September-October. Along the east coast, *N. japonicus* of 120-159 mm size range were landed at Madras. The males dominated and the fishes were either immature or in developing stages. Fishes, prawns, crabs and squilla were the major food items. At Visakhapatnam and Kakinada the 0-year fishes were the mainstay of the fishery.

Saurida tumbil had a size ranging from 110 - 490 mm at Bombay, 110-439 mm at Mangalore, 90-339 mm at Malpe and 75-335 mm at Cochin. Fe-

males in advanced maturity stage were observed during October at Veraval. At Mangalore, immature males were seen throughout the year and the gravid females occurred in December. In Cochin, the fully spent and spent recovering *S. tumbil* females were observed during May-July and September-December whereas the partially and fully spent *S. undosquamis* females were observed during April-July and October-January. The latter had a size ranging from 35-325 mm. The stomach content analysis of *S. tumbil* showed a dominance of fishes and *Loligo* spp. at Veraval and *Saurida* spp., *Solenocera* spp., *Loligo* spp., squilla and prawns at Bombay.

Among elasmobranchs, *Scoliodon laticaudus* was dominant at Veraval. Fishes in the size range of 221-680 mm contributed to the fishery. The females formed 55%. Prawns and *Acetes* sp. were the major food items. At Bombay, *S. laticaudus* had a size ranging from 200-620 mm. The male: female ratio was 45 : 55. A total of 73 pups were observed in 11 pregnant females. *Coilia dussumieri, Harpadon nehereus,* crustaceans and cephalopods formed the major food items here.

The catfish, *Tachysurus thalassinus* landed at Visakhapatnam had a size range of 160-539 mm. The females dominated (64.6%). Fishes in developing stages were observed throughout the year with a dominance in September and January. Gravid stages were observed during August-November and January-February. The partially spent fishes were noticed during September, November and January. The food items included crabs, *Loligo duvaucelii,* silverbellies, sciaenids, *Polynemus* spp., prawns, *Nemipterus* sp. and crabs.

Cyanoglossus macrostomus and *Pseudorhombus javanicus* contributed to the flat fish fishery at Cochin. *C. macrostomus* had a length ranging from 67-146 mm. Fishes in developing stages were recorded during April-July and September to February with peak during September-December. Fully spent fishes were observed during June and September-February. *P. javanicus* had a size ranging from 82-308 mm. Sexes were equally distributed. Developing and resting stages were observed during April-July and February-March. Fully spent fishes occurred in March.

Cephalopods were represented by both the squids and cuttlefishes. At Bombay, the DML of *L. duvaucelii* ranged from 60-200 mm and that of *Sepia aculeata* from 40-200 mm. The 'O' and 1-year groups formed the mainstay of the fishery. *S. pharaonis* had a DML of 160-330 mm. All of them were in the 1-year class.

Investigations on the resources exploited by the large vessels (DF/IP/2).

FSI vessels, M. V. *Matsya Darshini* and M. V. *Matsya Shikari* operated during April-August and December-February and landed mainly catfishes and nemipterids. Peak landings (1.78 to 52.78 kg/hr) of catfish were during April '89 and February '90. *T. thalassinus* (99.7%), *T. tenuispinis* (0.24%) and *T. dussumieri* (0.06%) occurred in the catch.

Fishing areas for *T. thalassinus* during April were 19/25/4B at a depth of 50-67 m (166.7 kg/hr) and 19/26/5C at depth of 44-50 m (1,200 kg/hr). During February they were caught in 20/27/1A area at a depth of 35-38 m. At 20/87/5D, *T. thalassinus* was caught at 37-45 m with a catch of 1,010 kg/hr. The size of *T. thalassinus* ranged from 220-559 mm with modes at 270, 310, 410, 450 and 510 mm. Females (71.4%) dominated and the partially spent fishes occurred in April and August. Majority (64.1%) of the fishes had empty stomachs followed by half full (25.0%), full (7.3%) and gorged (2.6%). Nemipterids, *Decapterus* spp., crabs, squids, prawns, sciaenids, etc. were the common food items.

M. V. *Matsya Shikari* expended 220.83 hrs of fishing at depths ranging from 22-340 m and landed 1.579 t of nemipterids. Operations were made at 18-34/2A, 18-34/3D, 19-35/4F, 19-36/4D areas in April and 18-35/6A, 19-35/2D, 19-35/3E, 18-34/5D areas in July. *N. mesoprion* having a size range of 95-170 mm and *N. japonicus* with a size range of 132-238 mm contributed to the fishery.

M. V. *Matsya Darshini* operated during April-June, August, December '89 and January-March '90 in 16-32/4C, 16-32/2A and 16-32/3B areas. She landed an estimated 791 kg of nemipterids with peak landings in April and December. *N. mesoprion* dominated and had a size ranging from 85-195 mm.

Data from 123 large trawlers and 45 mini trawlers stationed at Visakhapatnam were also collected. The fishing area for all the trawlers were the Sandheads off Chilka lake and Konarak, Kalingapatnam, off Gopalpur and Belasore. The highest c.p.h. was in Belasore (10.78 kg) followed by Konarak (10.7 kg) and Sunderbans (10.59 kg). An estimated 2,370 t of headless prawns were landed by 140 trawlers from 772 voyages and 209.1 fishing hours (c.p.h. = 11.3 kg). Depth of operation was mainly 31-80 m. Maximum catch was in October but highest c.p.h. was in August. *M. monoceros, M. ensis* and *M. affinis* constituted 61% of the prawn catch. Peak landing for these species were during July (212 t), October (221 t) and January (1,631 t) respectively. *P. indicus, P. merguiensis* and *P. penicillatus* formed 6% (148 t) of the catch. Due to poor catches after October most of the vessels moved to Cochin.

Fishing for deep sea lobsters, *Puerulus sewelli* was conducted along Ponnani, south-west coast of Alleppey, Quilon, Wadge Bank and Gulf of Mannar during April to May '89. The catch/boat ranged from 3-13 t/27 days voyage. Males dominated (61%) and had a size ranging from 105-185 mm with modes at 161-165 and 151-155 mm. Females were larger and had a size ranging from 118-191 mm with modes at 141-145 and 166-170 mm. An estimated 69,840 kg of deep sea lobsters valued at $ 983,085 were exported.

Investigations of hooks and line fishery (DF/IP/3).

An estimated 7.424 t of catfishes were landed by the gear at Visakhapatnam with a CPUE of 0.28 kg. This

constituted 67% of the total catch of the gear. September '89 and February-March 1990 recorded landing as high as 1,120 - 3,360 kg. *T. thalassinus* was the dominant species and had a size ranging from 220-759 mm.

Upwelling occurred during April and was indicated by the sudden drop in temperature and increase in nutrients and primary production. Upwelling was less intense during May and subsided by June. In November, salinity dropped due to heavy rainfall.

At Tuticorin, the gear landed 181 t (59.8%) of perches, 42.7 t (14.7%) of seerfishes, 29.05 t (9.6%) of elasmobranchs and 22.8 t of tunas. Perches recorded a peak during April with a CPUE of 47.2 kg. *Lethrinus nebulosus* (29.1%) was dominant and had a size ranging from 260-720 mm. *Epinephelus* spp. formed 13.4%. Maturity studies on *E. malabaricus* indicated a dominance of stages I and II. Among seerfishes, *Scomberomorus commerson* contributed to 94.4%. They occurred throughout the year with peak landings during September '89. The size range was 37.5 - 135.0 cm with multimodes from 65-110 cm. Elasmobranchs were represented by *Carcharinus sorrah* and *Loxodon macrorhinus*. Tunas recorded a high CPUE of 14.1 kg/unit during May. They were represented by *Euthynnus affinis* (51.9%) and *Thunnus albacares* (48.1%).

The physical properties of the water in the nearshore area of Tuticorin did not fluctuate greatly during the different months. The chemical properties however showed variations. Nitrite and nitrate contents were low during May-June and higher during July-September. Silicates were low during May-June. Primary production was high during May-August.

In the Gulf of Mannar, the zooplankton biomass was dominated by copepods, followed by decapod larvae, *Sagitta, Lucifer* and medusae. Blooms of *Trichodesmium* sp. were seen in May and swarms of the pteropod, *Cressis acicula* in July.

The mechanised and non-mechanised hooks and line units at Vizhinjam recorded 106 t of cephalopods. *S. pharaonis* and *L. duvaucelii* were the major species recorded. The catch rate for *S. pharaonis* in the mechanised and non-mechanised units were 2.6 and 2.5 kg/unit respectively. Tunas and mackerels were the other major groups landed.

The non-mechanised units landed 87 t of tunas with peak landings during October and March. The dominant species were *E. affinis* (58.7%) and *A. rochei* (32.2%). The mechanised units recorded 920 t with peak landings during May, August - October and March. *A. rochei* dominated (53.3%) and had a length ranging from 200 - 300 mm. *E. affinis* formed 34.3%.

Mackerel catch in the non-mechanised units were estimated as 13 t. Peak landings were during October and November. In the mechanised units, they comprised 41 t with peak landings during June and November. Their length ranged from 120-230 mm.

At Cochin, the gear landed an estimated 663 t of perches and sharks with a CPUE of 196.4 kg. Peak landings for perches were during January when 542.5 t were landed with a CPUE of 632 kg. *Pristipomoides typus* (21-70 cm) 51.40%, *E. diacanthus* (18-52 cm) 19%, *E. albomarginatus* (26-28 cm) 10.65%, *E. chlorostigma* 7.60% and *E. bleekeri* contributed to the perch catch.

Primary production was high in the surface and column waters during October '89 and January '90 at 20-30 m depths. Blooms were observed during April, July and October '89 and January 1990. Zooplankton swarms were abundant in the surface waters during April, August, September and October '89 and March '90. During October '89 and March '90 the surface waters contained medusae and ctenophores. Fishermen reported absence of fish in the inshore waters when planktonic organisms were abundant.

At Bombay, the gear landed 249 t of fish with a CPUE of 145 kg. Catfishes dominated and comprised 68.1% of the landings. High catch of 55 t with a CPUE of 197 kg/unit was recorded in November. *T. dussumieri* was the dominant species. The elasmobranchs comprised 32% with a catch of 55 t and CPUE of 15 kg/unit. Sharks formed 60% and rays 40%.

Results of the exploratory survey of the Indian EEZ by FORV *Sagar Sampada* (DF/IP/4).

The distribution, abundance, species composition and biology of fishes and crustaceans brought by pelagic and bottom trawls by FORV *Sagar Sampada* in cruise numbers 51 - 70 were studied.

Along the east coast, 43 stations were surveyed in 10 cruises. The bottom trawl brought more catches than the pelagic trawl and landed 29.832 t of fish with c.p.h. of 780 kg. The major productive areas were 19-85/2B (62 m depth) for *Decapterus* spp., *P. indicus* and *T. thalassinus* and 19-85/3B (65 m depth) for *P. indicus*.

At Andaman Nicobar Archipelago, 7 cruises wese operated and the bottom trawl yielded total catch of 1,411 kg with a c.p.h. of 112.18 kg. Sharks, rays, perches (*Epinephelus* spp., *Lutjanus* spp., *Lethrinus* spp.) and carangids were the dominant groups. Leptocephali of eels were abundant in areas 10-91/3F; 10-92/3E; 11-92/1C, E; 12-92/4C and 12-92/4A at a depth range of 200-1,000 m indicating a possible nursery area for eels. Feeding habits and maturity condition of conventional and non-conventional fishes were studied. *P. indicus* caught at a depth of 90 m had a size of 208 mm - 248 mm. Females dominated with a sex ratio of 60 females : 40 males. *Trichiurus lepturus* (350-463 mm) occurred at 62 m.

A total of 396.9 kg of crustaceans were caught from Machilipatnam (16-80/1C area; cruise No. 61). Penaeid prawns were represented by *Parapenaeus* spp., *Metapenaeus* spp. and *Metapenaeopsis* spp. *Exopalaemon styliferus* comprised the non-penaeid prawns. Other crustaceans were *Oratosquilla nepa* and *Antemeon* spp. Occurrence of *P. longipes* with a catch rate

of 1.75 kg/hr is significant as this species is known to form a seasonal fishery only at Mangalore.

Studies on artificial reefs (PF/IP/5)

At Vizhinjam, an estimated 35.3 t of fishes were landed from the artificial reefs (ARs). The cuttlefish, *Sepia pharaonis*, congregated around the ARs and an estimated 5.8 t were hooked from this area. Cuttlefish alone formed 4.1% of the catch at Valiathura landing centre. The cuttlefishes caught from the ARs during December-March were in the spawning condition. Furthermore, the occurrence of large quantities of cuttlefish egg mass in the trawl net operated in the vicinity of ARs possibly implies that these molluscs may be assembling around the ARs for egg laying. The fish catch of ARs comprised of *Selaroides leptolepis, Carangoides plagiotaenia, Lutjanus* sp. and *Lethrinus* sp. Cuttlefishes, *Decapterus* spp., *Nemipterus* spp. and mackerels occurred both in the AR and non-reef catches.

The Brotherhood Society of Valiathura constructed another artificial reef under the technical guidance of the Institute scientists. The AR was constructed at a depth of 33 m, using truck and car tyres, concrete rings, granite stones, broken earthen pots, branches of *Cassia* tree and coconut leaf fronds. ARs consisting of 23 modules of discarded car tyres in 3 designs were erected in the break waters off Tuticorin Major Harbour at a depth of 3 fathoms for experimental studies. Fishes (*Lethrinus* spp., *Lutjanus* spp., *Lates* sp., *Siganus* sp., *Selar* spp.) and crabs (*Portunus* sp.) inhabited the ARs from the 3rd month onwards. The well-type AR performed better than the tripod and cylinder type modules.

The ARs installed at Minicoy during November '88 was intact even after the monsoon period. Ornamental fishes recolonised the reef by the end of August. Large numbers of *Dascyllus aruanus, D. trimaculatus, Abudefduf sexfasciatus, A. bengalensis, Thalassoma umbrostigma, Chromis nigrurus, Arothron* sp. and juveniles of *Caesio* sp. were seen. Tidal variations influenced the quantitative distribution around the reefs with lesser numbers during low tide. In October-November the amphipods and larval stomatopods dominated whereas in December and January, fish eggs followed by copepods were the major plankters. Decapod larvae and mysids were also observed during January.

Young ones of the pearl oyster, *Pinctada* spp. were found attached to the AR made of dead coral boulders. Settlement of corals were also observed. Juveniles of *Sphyraena* spp., *Upeneus* sp., *Pranesus pinguis, Spratelloides japonicus*, etc. were observed in the ARs constructed by the Fisheries Department of U.T. of Lakshadweep. The plankton fauna consisted mainly of copepods, siphonophores, decapod larvae and fish larvae.

Atlases of marine demersal fishes (DF/IP/6)

Information on seasonal, spatial and bathymetric distribution, yield and abundance of commercially important

demersal fishes and their biological parameters were culled out from Institute's project reports, data centre, journals, Marine Fish Calendars and Annual reports. Statewise and seasonwise mapping of the resources was continued. Data for the preparation of a synoptic chart of all marine food fishes showing their seasonal landing at different maritime states, gears employed for exploitation, spawning season and frequency, size and age classes, length, weight, fecundity, chemical composition, etc. were collected, processed and mapped in a pictorial form.

Marine Finfish culture (DF/CUL/1.7)

At Madras, *Chanos chanos* fry (2,565 nos), having a size ranging from 19-65 mm were collected and transported to the farm. In the two polyculture experiments carried out with *Chanos* and mullets, uniform stocking and monthly fertilization (NPK 12/24/12) at the rate of 200 kg/ha was maintained. No supplementary feed was given. The growth rates recorded in 6 months for the different species in the first pond were *Liza cunnesius*, 166.3 mm (59.6 g), *Mugil cephalus*, 312.9 mm (269.8 g) and *L. tade*, 217.1 mm (101.8 g). The respective growth rates in the second pond were 218 mm (96.7 g), 336 mm (280.3 g) and 284 mm (210.2 g).

At Tuticorin, *C. chanos* cultured for 11 months showed a growth of 24.9 mm/17.80 g per month. L. *macrolepis* grown in two different ponds showed a growth of 15.9 mm/9.44 g and 15.6 mm/12.70 g per month respectively. Polyculture of milkfish (450 nos.) and mullets (900 nos.) were started in June '89. On completion of 5 months, *C. chanos* and *L. macrolepis* stocked at a size of 62.3 mm/2.00 g and 45.3 mm/1.60 g attained a size of 185.1 mm/56.50 g and 144.7 mm/41.20g with a growth rate of 23.0 mm/10.20 g and 19.2 mm/7.66 g respectively. In another pond, fingerlings of *C. chanos* (45.4 mm/1.0 g) attained a size of 191.3 mm/63.00 g after a period of 6 months, indicating a growth rate of 24.3 mm/10.33 g per month. Lab-lab was used as feed. Survival was poor due to poaching. *Lates calcarifer* cultured in cages for 10 months attained a size of 325.1 mm/344.10 g from 145.0 mm/37.30 g with a growth rate of 18.0 mm/30.68 g per month. Supplementary feed (trash fish) was given once in 2 days.

At Mandapam, 2,000 fry and 4,700 fingerlings of milkfish having a size of 20-25 mm and 30-100 mm respectively were collected. The growth rate after a period of 6 months was 11.7 mm (5.50 g) per month. Ponds 15, 16, 18, 19, 25 and 26 were stocked with milkfish (67.6 mm, 3.0 g) at the rate of 5,000/ha. The ponds were fertilized with organic manure and cowdung for the growth of lab-lab. Pond 15, 18 and 26 were fertilized at the rate of 1,000 kg/ha (100%) and 16,19 and 25 at the rate of 750 kg/ha (75%). On completion of 6 months, the fry and fingerlings registered a growth rate of 46.3 mm (58.20 g) and 50.0 mm (63.20 g) per month with 100% manure and 34.0 mm (21.50 g) and 35.6 mm (22.80 g) with 75% manure. The respective rate of production was 110-192 kg/ha and 87.5 - 100 kg/ha.

The survival ranged between 6.25 and 15.25%.

Four sets of breeding experiments on *C. chanos* were carried out during April '89 — March '90. Pituitary gland and HCG were used for administering the injections. The fishes did not respond to the treatment.

Soil and water management in fish culture ponds (DF/CUL/2)

Water level in selected ponds were monitored for a period of 1 year to study the rate of seepage. The maximum and minimum depths of water stored in the ponds were 66.34 cm and 34.58 cm. Water depths were higher in ponds having lower bed elevation. The studies indicated that lowering of bed levels in the culture ponds, retained the water depth levels and minimised seepage. Seepage rates were higher during June, July and August and the water level decreased during the period April-October. During November-March, the seepage rates were negligible. The water levels also increased during November-December due to monsoon. Annual average values showed that pond no. 13 had the highest seepage rate (4.42 cm/12 hrs) and pond no. 27 the lowest (0.76cm/12 hrs). The average annual sediment deposition rate for tide-fed and pump-fed ponds were 3.45 and 1.83 kg/m^2 of bottom/month. The drop in ground water level was more in Fezometers situated at farthest point from sea shore and vice-versa.

MOLLUSCAN FISHERIES DIVISION

Studies on clam, mussel and gastropod resources (MOL/RE/2)

The green mussel *(Perna viridis)* fishery along the Calicut-Tellicherry coast was estimated at 2,985 t. The fishery was mainly at Calicut, Elathur and Tellicherry with peak exploitation during January-March. The size of mussel in the catches ranged from 40 - 120 mm, with dominant modes at 65 mm and 85 mm. The brown mussel *(P. indica)* fishery on the Vizhinjam-Muttom area also was good during the year.

A newly established *Meretrix casta* bed was observed at the bar mouth of Mulki estuary, Mangalore. The stock here was estimated as 50 t with an average density of 1,846/m^2. *M. casta* supported a fishery at Cochin also. The fishery for the black clam, *Villorita cyprinoides* was good in Ashtamudi Lake and an estimated 185 t was landed at Cochin. In Korapuzha estuary, the fishery for this clam started only in the end of the year. The stock of *Katelysia opima* in the Ashtamudi Lake had declined and it was not available in fishable quantities. This may be due to over exploitation of the stock. *Paphia malabarica* was the only species fished for export from the Lake. The marine clam *Sunetta scripta* supported a good fishery along the Murukumpadam-Munambam area and about 3,450 t was exploited. The shell of this clam, used for manufacture of lime, fetched Rs. 190-200/t.

The peak chank fishery was in December 1989 and the total landings amounted to about 127,000 chanks of which over 60,000 were landed at Tuticorin and the rest at Thiruchendur. Under-sized chanks formed 15% and wormed chanks 35%.

Preparation of the atlas on molluscan resources (MOL/RE/3)

Relevant information on the identity, distribution, biological and ecological characteristics, present level of exploitation and utilization, future prospects and other aspects on various molluscan resources has been collected.

Development of techniques for production of shell bead nuclei for pearl culture (MOL/CUL/1.4.3)

The micro-hardness of *M. casta, Trochus niloticus, Tridacna* sp. and *Xancus pyrum*, was studied in colaboration with Indian Institute of Technology, Madras. The micro-hardness property of *Tridacna* sp. was similar to that of the American nigerhead shell and that of *X. pyrum* was still higher.

Development of hatchery technology for experimental/mass production of seed of gastropods, clams, mussels, edible oyster and pearl oyster (MOL/CUL/4)

The larvae obtained from *P. malabarica* which spawned in the hatchery

laboratory, Tuticorin, were reared at a temperature of 27-28°C. Settlement of larvae which started on the 10th day after spawning was completed in two days. The initial high survival rate declined to 25% on the 30th day and to 9.2% on the 104th day. A salinity range of 15-28‰ was favourable for the growth of the seed. Over 5.2 million seeds of the edible oyster *Crassostrea madrasensis* were produced from fourteen out of eighteen induced spawnings. The larval life ranged from 17 to 31 days. The rate of settlement was high during January-March. About 4 lakh seeds of the pearl oyster *Pinctada fucata* were produced. As in previous years, some hatchery-produced pearl oyster seeds were supplied to the Fisheries Department, Gujarat State. The fifth generation of *P. fucata* has been successfully raised in the hatchery. The rate of growth of these oysters was slow, probably due to inbreeding. The blacklip pearl oyster *P. margaritifera* was induce-spawned to produce 9.75 lakh seeds. Attempts to transport live topshell, *Trochus niloticus* onboard FORV *Sagar Sampada* from Andamans to Tuticorin did not fully succeed. Some of them spawned in the aquarium onboard. The fertilized eggs developed into trochophores, but did not survive further. Studies on induce-spawning of *P. viridis* at Madras, hatching and rearing of *Sepioteuthis lessoniana*, and *Sepia pharaonis* at Tuticorin and *Xancus pyrum* at Tuticorin and Mandapam were continued.

Sea-ranching of clam and pearl oyster (MOL/CUL/5)

Seeds of *M. casta*, produced in the laboratory at Madras for the first time, were ranched in the Muthukadu lagoon. Growth was rapid, with a length increment of 22.1 mm and weight of 14.7 g in five months. About 64,750 *P. malabarica* seeds produced in the Tuticorin hatchery were ranched in the Ashtamudi Lake. Growth was fast in the initial months but with the onset of the south-west monsoon there was heavy mortality due to steep fall in salinity. Over 64,000 hatchery-produced seeds of *P. fucata* were sea-ranched on a pearl oyster bed off Tuticorin in the Gulf of Mannar.

Pearl culture (MOL/CUL/6)

Three culture rafts were maintained in the Tuticorin Harbour and stocked with hatchery produced seeds (4 lakhs). Studies on nucleus implantation indicated that the graft from the marginal mantle yields good quality pearls, than the graft from the hinge region.

Oyster culture (MOL/CUL/7)

Hatchery produced seeds of the edible oyster *C. madrasensis* were reared in the Tuticorin Bay using the rack and ren method. In eleven months, the oysters attained a mean length of 83 mm. As in previous years, oyster meat (500 kg) was sold to the Integrated Fisheries Project, Cochin as well as locally. Hatchery produced seeds were also supplied to the Fisheries Department, Gujarat State.

A Trainers' Training Programme on oyster culture was conducted in April 1989.

CRUSTACEAN FISHERIES DIVISION

Investigations on the artisanal fisheries (CF/IP/1)

The indigenous gears operating at different centres landed together 1,070 t of prawns. Stake nets landed 513 t (34.2 kg/unit) at Calicut and 185 t at Cochin. Ring seines at Fort Cochin and Ambalapuzha recorded 147 t. Gill nets had a substantial catch of 83 t at Pentakota while at Mandapam it was only 8 t. Bamboo traps at Chilka Lake fished 68 t and the bottom set trammel net at Vizhinjam landed 83 t. 'Matabala' at Ullal and other indigenous gears (mini trawl, gill net and cast net) at Puthuvypeen landed 36 t and 20 t respectively. The landings by indigenous gears other than stake nets at Calicut, Bengare and Triplicane was poor with a catch of 2,6 and 2 t respectively.

Metapenaeus dobsoni (71%) was the dominant species in the stake net fishery at Calicut. Other species included *M. monoceros, Penaeus indicus* and *M. affinis*. In the Cochin back waters at Vypeen, the species composition was *M. dobsoni* (53.7%), *P. indicus* (21.5%), *M. monoceros* (19.9%) and *P. stylifera* (4.9%). At Thevara, it was *M. dobsoni* (66.5%), *M. monoceros* (19.4%) and *P. indicus* (14.1%).

The size ranges for *M. dobsoni* were 31-81 mm at Calicut and 26-100 mm at Cochin. The size of *M. monoceros* ranged between 51 and 110 mm at Cochin. The ring seines landed *P. indicus* (91-180 mm) at Fort Cochin and *P. stylifera* and *M. dobsoni* at Ambalapuzha. The gill nets at Pentakota landed *M. affinis* (46%), *P. indicus* (27%), *P. merguiensis* (22%) and *P. monodon* (3%). All of them were adults. At Mandapam, *P. semisulcatus* (66-165 mm) contributed to the catch.

The bamboo traps at Chilka Lake brought in *M. dobsoni* (32%), *P. indicus* (26%), *M. monoceros* (25%) and *P. monodon* (17%).

At Vizhinjam, from the 5 landing centres, 39 t of lobsters were captured by traps. The catch comprised entirely of *Panulirus homarus*. Gill nets at Mandapam landed 2 t of lobsters. *P. ornatus* dominated followed by *P. homarus*. *P. ornatus* had a size range of 160-350 mm for males and 175-330 mm for females. The respective size range for *P. homarus* was 230-265 mm and 185-205 mm.

At Calicut, gill nets landed 0.323 t of *Portunus pelagicus* from marine waters and 13 t of *Scylla serrata* from the estuaries. Size range of *S. serrata* was 71-211 mm.

Hatchery production of marine prawn seed (CF/CUL/1.1.2)

P. semisulcatus seeds were produced from the spawners collected from the wild as well as from the captive brood stock. Spawning performance from the wild specimens were better in the size 140-159 mm in TL. About 61.5% of the spawners released the eggs almost completely. The hatching rate varied from 22.6 - 95.0%.

Larvae reared in the indoor polycraft pools were fed with phytoplankton reared in fertilized seawater. About 22,500 postlarvae (PL_{10}) were obtained from 2,02,800 nauplii stocked in 12 ft. diameter pool. Survival rate from N_1 — PL_1 was 34.7%. Larval mortality was observed during October-December due to infection of protozoea by the fungus, *Lagenidium* spp. Rearing in the outdoor cement tanks was carried out from PL_1 to PL_{10-15}. Stocking in different experiments ranged from 4,26,000 - 1,36,500 postlarvae. No aeration was provided throughout the experiment. Water was fertilized with inorganic chemicals for the development of phytoplankton which formed the food of developing larvae. A total of 2,22,800 PL_{10-19} were produced in these tanks and the survival rate from N_1 - PL_{10-19} ranged from 3.1 - 8.7% in different tanks.

For the first time, *P. semisulcatus* rematured in captivity by unilateral eyestalk ablation and also without eyestalk ablation. The MATSYAFED of Kerala State, established a prawn hatchery at Mopla Bay, Cannanore, using the technology developed by CMFRI. The hatchery has been designed to produce 10 lakhs *P. indicus* seeds every month. Further, the staff of MATSYAFED were given training on seed production and hatchery management techniques.

A detailed study of the different larval stages of *P. maxillipedo* was carried out on the laboratory reared larvae. It was possible to distinguish 6 naupliar, 3 protozoeal and 5 mysis stages.

Sea ranching of marine prawns (CF/CUL/1.1.7)

P. semisulcatus larve (PL_{10-15}) numbering 4,70,556, produced in the indoor as well as outdoor nursery tanks were released into the Pillaimadam lagoon at Mandapam. The released stock was monitored in the regular fishery. One specimen of *P. semisulcatus* measuring 51 mm was encountered in a cast-net operation. There is a possibility that majority of the released stock might have migrated to the adjacent Palk Bay. The trend of fisheries of *P. semisulcatus* in the commercial catches this year was comparable to the corresponding period of previous year and the release of larvae into the sea was not reflected in the catch.

Growth pattern, survival and production rates of *P. semisulcatus*, raised in the hatchery were studied. The stocking density of the larvae in grow-out ponds was 50,000/ha. The stocked population were fed with the supplementary diet of squid meal/pellet diet. During the 85 days of stocking, the growth rates varied from 0.68 mm/day to 1.1 mm/day. Growth rate of 1.1 mm/day was recorded during the first two months of stocking but after 85 days, the production and survival rates realised were poor, being 38-94 kg/ha and 14-40% respectively. This was due to the sudden increase in the salinity and temperature of the pond water.

Seeds (37,500) were transported and stocked in the grow-out pond (0.5 ha) and a nursery pond (0.027 ha) at

Kannumanai (60 km from Mandapam) demonstration farms belonging to the Tamil Nadu Fisheries Department. Growth rate of 1.3 mm/day was obtained after one month of stocking. In the subsequent month the growth rate dropped, as observed at Mandapam, due to increase in salinity and temperature. Harvesting was done after 83 days of culture. Production in the grow-out pond was poor (84 kg/ha) and better in the nursery pond (444 kg/ha). The higher production in the latter was due to better water supply and higher water level as compared to the grow-out pond.

Sea farming of marine prawns and lobsters (CF/CUL/2)

At Tuticorin, 4 field culture trials on *P. indicus* initiated in February, May, June and August '89 were completed in October and December '89 after 138-225 days of rearing. The stocking density ranged from 30,000-60,000/ha. The reared prawns were fed with artificial feeds. The production rate realised was 607-1,069 kg/ha in 138/139 days, 764 kg/ha in 150 days and 967 kg/ha in 225 days. The single experiment conducted on *P. monodon* has shown that the prawn attained a size of 147 mm in TL and 25.3 g in TW in 100 days. This could be attributed to low salinity that prevailed in the culture pond during the north-east monsoon months.

At Mandapam, 3 field culture trials in rearing the hatchery raised postlarvae (PL_{27}) of *P. semisulcatus* were started on 27-11-89. The stocking density was 50,000/ha and stocking size 21.8 mm in TL. The prawns were fed with a feed containing cooked cuttle fish waste and artificial feed in 2 experiments. No feeding was done in the third experiment. The growth rate/day was 1.55-1.61 mm in prawns fed with supplementary feed and 2.23 mm in prawns reared without supplementary feed.

At Kovalam laboratory, spiny lobsters were reared from January to October '89. Experiments conducted to study the effect of unilateral eye ablation on growth in *Panulirus homarus* showed a monthly growth of 1.3 to 1.6 mm in carapace length and 9.2 to 11.8 g in total weight during 17-21 months' rearing. The effect of unilateral eye ablation on reproductive cycle of *P. homarus* was that, ablated females developed ovigerous setae and carried berry irrespective of mating. To reduce the duration of intermoult period, extracts of thoracic ganglia-saline solution (NaCl) and fat body of lobster were injected to juveniles of *P. homarus* (Size: 27.3 to 27.8 mm in CL). The time lapse between moults varied from 54 to 57 days in lobsters injected with the extracts of thoracic ganglion and saline solution, while it was 32 days for lobsters treated with fat body extract. *P. homarus* juveniles recorded a growth of 1.2 mm in CL and 5.8 g in TW when reared in a 6 t tank with a stocking rate of 12 numbers/m^2. These were released into an earthern pond at Muttukadu during the second week of October. All lobsters died within a few days after stocking, probably, due to starvation and effect of the hydrogen sulphide filled sandy bottom.

FISHERY ENVIRONMENT MANAGEMENT DIVISION

Investigations on environmental parameters in relation to inshore waters (FEM/ES/1)

The nearshore region between portmouth and 30 m depth zone off Cochin was monitored for changes in temperature, salinity and dissolved oxygen content.

The temperature of the surface as well as the bottom layers increased from 28°C in January — 30°C in April. The temperature decreased from May onwards from 26°C at the surface and to a little more than 21°C in the layers close to the bottom by August. In October the temperature of the upper layers increased to 29°C and remained the same till December. In the bottom layers, the temperature increased steadily from September and a temperature >28°C was recorded in December. Further increase was noticed from January 1990 onwards and both the surface and the bottom layers recorded temperatures above 29°C in March 1990.

The salinity of the surface waters showed seasonal changes. During the south-west monsoon season, the influx from the Cochin backwaters spread outward at the surface as a plume and reduced the salinity to less than 20 ppt. The salinity of the bottom layers seldom went below 30 ppt.

The oxygen content of the surface layers remained high throughout the year but that of the bottom layers decreased to less than 1 ml/l towards the end of May and remained low till October. The oxygen content was above 3 ml/l between January-April 1989 and November 1989 - March 1990.

Studies on chlorophyll *a* and phaeopigments were made both from surface and bottom waters of 10 m and 20 m depth zones from the inshore regions off Cochin. In 10 m, the surface chlorophyll *a* ranged from 1 mg/m^3 in February to 17.8 mg/m^3 in January 1990 whereas in the bottom waters it varied from 8 mg/m^3 in July and September 1989 to 1.2 mg/m^3 in January 1990. In the 20 m zone, the minimum surface values of 0.26 and 0.67 mg/m^3 were recorded in February and March. The maximum surface concentrations of 14 and 16.7 mg/m^3 were observed during June and July respectively. Concurrent higher bottom values were also registered during monsoon months. The maximum production was during the monsoon period followed by the post-monsoon and pre-monsoon months. The study revealed a normal cyclic rhythm of primary production in the inshore waters off Cochin in contrast to previous few years.

Weekly zooplankton samples were collected using Bongo - 20 net from the fishing grounds off Cochin, from 4 stations namely Aspinwall, 10 m, 20 m and 30 m depth zones. The monthly mean values of biomass and the numerical abundance of the different groups and the larval forms were estimated per

100 m^3 of water filtered. The highest monthly mean displacement volume recorded was 211.0 ml/100 m^3 in October at 30 m depth followed by 100.3 ml/100 m^3 in September at 20 m depth. The numerical abundance of the zooplankton also reached the peak in October. Copepods, cladocerans, chaetognaths, lucifers, siphonophores, euphausids, amphipods, ostracods, mysids, doliolids, pteropods, fish larvae, polychaetes and molluscs were found abundantly in the collections at one time or the other during August-October.

Among cladocerans, swarming of *Evadne tergestina* was observed in March at 15 m, in September at 20 m and at different depth zones during October-December. *Penilia avirostris* was recorded in the 10-20 m depth column during August. Fish eggs were abundant during November (14,255/100 m^3) at 30 m and during September (1,814/100 m^3) at 10 m. Larval decapods, comprising mainly of sergestid larvae, lucifers and *Acetes* sp., were abundant throughout the year and the maximum (13,855/100 m^3) was observed at the portmouth area near Aspinwall during January 1990. Penaeid larvae showed remarkable increase near the portmouth area (10 m depth) during November and January-February. A high value of 783/100 m^3 was obtained during January. The other components of the larval decapods included those of alpheidae, palaemonidae, pasiphaeidae, hippolytiddae, paguridae, callianassidae, porcellanidae, albuneidae and brachuridae.

Swarming of ostracods was observed in October at 10-30 m depths and the largest (285,030/100 m^3) was found at 30 m. Mysids were unusually abundant (9,000/100 m^3) at 30 m depth in October. Dense aggregations (40,102/100 m^3) of salps appeared during the first week of February at 30 m depth. Appendicularians (3,781/100 m^3) and ctenophores (1,967/100 m^3) were abundant during November whereas large number (45,393/100 m^3) of lammellibrach larvae were observed during September.

Among the pteropods, *Creseis acicula* was dominant followed by *Desmopterus papilio* and *Cavolina uncinata pulsata*. Cumaceans, larvae of cyphonautus, brachiopods and echinoderms were also found in appreciable numbers. Cirripede larvae occurred in the portmouth area throughout the year whereas the hydromedusae was abundant at the 20 and 30 m depths during September and November.

Large aggregations of radiolarians were observed in November and December. Blooms of *Coscinodiscus* appeared in February and March. Dense blooms of *Noctiluca miliaris* were observed during the second week of August at 10 m and during the last week of September at 20 m. Swarming of copepods, mainly by *Pseudodiaptomus serricaudatus* was observed in the 20 m depth zone as an orange-red long narrow strip extending to several kilometers parallel to the coast. Thick blooms of *Trichodesmium* were encountered in the first week of March 1990.

Environmental ecology of the coastal zone and mapping of potential sites for sea-farming (FEM/ES/5)

The Mobile Laboratory of the Institute was used to conduct seasonal

survey and diurnal studies in the coastal waterbodies around Mahe, Dharmadam, Valapatnam and Killai. The seasonal data collected for January-February, June-July and October-November during 1987-'89 were processed. The annual mean values of hydrographic parameters and primary productivity of different estuaries are given in Table 1.

Table 1: — Hydrography and productivity of different estuarine systems (annual average of surface & bottom values)

Estuary	Temp. (°C)	Salinity (‰)	Diss. O_2 (ml/l)	pH	Eh	Gross prod. $gC/m^2/day$	Net prod. $gC/m^2/day$
Mahe	28.6	20.77	3.34	6.79	+ 110	0.824	0.629
Dharmadam	28.3	29.92	3.43	7.55	+ 118	1.046	0.470
Valapatnam	28.6	16.94	3.80	7.23	+ 134	0.762	0.240
Killai	29.1	28.75	4.24	7.87	+ 168	2.300	1.673

Tidal influence extended further into the estuaries of Killai, Valapatnam and Dharmadam than at Mahe. Due to prolonged closure of one of the sea connections (Vellar mouth) and reduction in freshwater supply, hypersaline condition (>35.0 ppt) persisted in the Killai estuarine system during June-September 1989. Temperature, dissolved oxygen, pH and Eh of waterbodies were within the normal range in the surveyed ecosystems. The water at Dharmadam estuary had higher nutrient content than Killai. In general, silicate and nitrate values were higher in the surface samples and phosphate at the bottom, while nitrite content was very low in surface and bottom samples. Sediment analysis showed that Killai estuary was more fertile in organic carbon than Dharmadam with a mean clay content of 44.63 and 39.0% respectively. High productivity was recorded in all estuaries during February 1989 with the maximum mean values of 4.042 $gC/m^2/day$ (gross) and 3.28 $gC/m^2/day$ (net prod.) recorded in the Killai estuarine system.

Zooplankton biomass was relatively more in Dharmadam estuary. Although most of the zooplankton groups were present in the collections, copepods dominated at Dharmadam (87.67%), Killai (80.00%) and Mahe (50.22%) in the order of numerical abundance; while pelagic gastropods were more (76.62%) in Valapatnam estuary, with relatively very less copepod concentration (15.69%). Decapod larvae formed 12.00% at Mahe, 3.47% at Dharmadam and 1.34% at Valapatnam. In Killai waters, they were relatively more in the west zone. Fish eggs and larvae constituted less than 1% in all the estuaries.

Edible oyster and mullet resources were plenty at Killai. The western periphery of Killai (Zone I) and the eastern sector of Dharmadam estuaries were found to be relatively more productive and suitable for acquaculture practices. The semi-enclosed farming sites of Dharmadam East were found to be highly productive than the adjoining open estuarine system (Table 2).

Table 2 — Hydrography and primary productivity of farming sites and adjoining open estuarine system (annual mean surface values)

Parameters	Semi enclosed farming sites	Open estuary
Temperature (°C)	29.1	28.35
Salinity (‰)	29.27	27.06
Diss. oxygen (ml/l)	4.17	3.44
Gross prod. ($gC/m^2/day$)	1.256	0.895
Net prod. ($gC/m^2/day$)	1.076	0.430
% of N.P. in G.P.	85.7	48.0

Marine pollution (FEM/MP/1)

The project work was carried out at Cochin, Karwar, Tuticorin and Madras.

Cochin: Environmental monitoring was carried out in the inshore waters of upto 25 m depth. Water, sediment and biological samples were collected at fortnightly intervals from four stations and analysed. Water samples were analysed for hydrographic parameters and chlorophyll. Sediment and biological samples were analysed for metal levels. Bio-assay experiments were also conducted to evaluate the effect of metals on phytoplankton.

The finfish, shellfish and molluscan samples collected by fishing as well as from the landing centres were analysed for five metals. The bivalve, *Sunetta scripta* and crabs recorded higher metal levels compared to prawns and finfishes. However, the levels were within the recommended limits for marine seafoods.

The sediment samples contained higher levels of lead especially during October-December when it ranged between 16.80 - 18.65 ppm.

The effect of cadmium, nickel, chromium, lead and mercury on the phytoplankton was assessed by C^{14} up-

take rates. All these metals inhibited primary productivity of the phytoplankton even when present in low concentrations. Nickel was the least toxic and mercury the most toxic in their inhibitory effect. Synergistic effect of inhibition was more acute than each metal individually.

Studies carried out to evaluate loss of mercury added to algal cultures and sea water with *in situ* phytoplankton, showed that the rate of removal of mercury in the culture system was 54% and in the *in situ* phytoplankton 38%. Information on these lines will help to treat the mercury polluted aquatic systems.

Karwar : Regular monitoring of metal pollution with emphasis to mercury in water, sediment and biota were carried out. Samples were collected from the vicinity of discharge point as well as from unpolluted areas. Transplantation of normal animals in cages to polluted areas to assess the effects of pollution were also initiated. To evaluate precision and accuracy of estimations, certified materials obtained from International Laboratory of Marine Radioactivity, Monaco were analysed as intercalibration exercise. The precision and accuracy was well within the acceptable range.

The study in the area showed comparatively high mercury concentrations in the sea water, sediment and biota collected from the vicinity of discharge point of the industry. However, the mercury levels in the pelagic fish, squid and crustacean samples were found to be within the recommended safe limits. Maximum concentration of zinc and cadmium was observed in the kidney of mussels while maximum concentrations of copper and manganese were observed in the digestive gland. The physiological and cellular responses of mussels were found to be very sensitive to copper and mercury in experimental conditions.

Tuticorin : The effect of thermal effluents on the natural population of phytoplankton was investigated. Phytoplankton samples from the Bay as well as from the vicinity of the thermal station were collected and analysed. The stenothermal diatoms *(Nitzschia, Thalassionema* and *Skeletonema)* and dinoflagellates *(Ceratium* and *Diplopsalis)* dominated in the Bay waters whereas the eurythermal dinoflagellates *(Peridinium, Ceratium* and *Podolampas)* were abundant in the vicinity of the thermal station. Diatoms like *Chaetoceros, Coscinodiscus* and *Pleurosigma* were less abundant. The water temperature in the Bay region was between 29.5°C and 32.0°C while at the effluent discharging point the temperature was 38-40°C. The dissolved oxygen at the discharge point was 3.9 ml/l while in the Bay it was 5.1 ml/l.

Madras : Regular environmental monitoring of mariculture systems at Muttukadu was carried out. In the ponds, the water temperature varied from 28.6°C - 34.2°C. The mean monthly value of dissolved oxygen in the canal varied from 2.8 - 4.5 ml/l. In the 'A' series ponds it ranged from 3.1 - 4.7 ml/l and in the 'B' series ponds it ranged from 2.9 - 4.0 ml/l. The salinity ranged from 14.8 ppt (November -

34.8 ppt (May) in the canal, 24.2 - 40.1 ppt in the 'A' series ponds and from 36.8 - 57.7 ppt in the 'B' series ponds.

Resource assessment of seaweed and their culture (FEM/SW/1)

The seasonal variations in seaweed abundance and their growth at selected centres along Kerala coast was monitored. The total seaweed biomass was more in the south zone followed by the north and central zones. Maximum biomas was recorded in May followed by July and April. A total of 28 species comprising of 12 green, 9 brown and 17 red algae were recorded along the Kerala coast. The brown algae were totally absent in the central zone (Cochin area). *Porphyra kanyakumariensis* from north and south zones and *Spongomorpha indica* from the north zone were the two new species recorded this year. *Chaetomorpha linum, Valoniopsis pachynema, Sargassum tennerium, Turbinaria conoides, Spathoglossum asperum, Dictyota dichotoma, Hypnea* spp. and *Laurencia* spp. which occurred during January-March 1989 were completely absent during the latter part.

Experimental field cultivation of *Gracilaria edulis* was carried out at 1 metre depth in the Palk Bay. During April - June the growth was not encouraging. For 16 kg of seed material introduced in July, only 1.8 kg of harvest could be obtained after 20 days at Thonithurai and 0.1 kg after 70 days near the fish farm. The failure of crop may be due to high water temperature and heavy epiphytic growth.

During April, seed material of *G. edulis* pre-treated with different concentrations (10, 20, 30, 40, 50 mg/l) of I.A.A. for a period of 12 hours were introduced in long line rope in Palk Bay. No growth could be observed and they degenerated after 30 days.

Fragment culture of *G. edulis* was carried out in cement and fibreglass tanks. Two coir rope nets each of 2 x 2 m size introduced in the cement tank (240 sq. ft.) with 4 kg of seed material showed complete discoloration and degeneration of plants with a final yield of 550 and 750 g. Nutrients such as phosphate, silicate, nitrite and nitrate of the medium decreased and dissolved oxygen increased during the time of harvest. The experiment when repeated using urea as fertilizer (0.238 mg/lit) yielded 2.7 and 2.8 kg material from 4 kg of seed material introduced. The bleaching of seed material may be due to exposure to direct sunlight.

Spore culture work was carried out in the laboratory as well as in the nursery tank. In the laboratory the spores were treated with different concentrations of antibiotic solutions and Germannin-di-oxide to overcome bacterial contamination and diatom growth. 3 mg/lit was sufficient to control ciliate flagellates and diatom growth. 100 mg of pencillin G, 25 mg of streptomycin SO_4 and 15 mg of chloramphenicol/l was effective to control bacterial growth.

The spores of *G. edulis*, liberated in the lab on cement blocks were transplanted into the Gulf of Mannar after 2 days of spores output. The plants

grew to a length of 30-50 mm within two months of spore liberation.

A collaborated deep water seaweed survey of Manapad-Kanyakumari was initiated on 6-3-90. The bottom was found to be sandy with rocks here and there. Algal growth was restricted to the nearshore area only.

Minicoy

Seaweed culture operations were initiated in Minicoy Island during October-November 1989. Fragments of *Gelidiella acerosa* were tied to the nails fixed on the coral stone. A total quantity of 8.5 kg seed material was introduced. Growth hormones like ascorbic acid (100 mg/l), kinetin, gibberellin and indole acetic acid (10 mg/l) were used in pre-treating the seed material. The quality and quantity of crop harvested after 5 months were found to be very low due to heavy epiphytic growth.

Acanthophora spicifera (5 kg) was also introduced as seed material, but due to heavy sedimentation and deposition of other seaweeds on the nets, the growth was hampered.

In the month of March 1990, four culture sites were selected in the lagoon side, one opposite to the helipad, the second one near the light house, the third one near the fisheries jetty and fourth one opposite to the Navodaya school. *G. edulis* was introduced on coir rope nets and long line coir ropes at three locations. Similarly, 10 kg of *G. edulis* collected at Mandapam and transported to Minicoy in live condition were also introduced on coir rope nets at these four places. The seeds showed good growth. The seed material of *G. acerosa* collected from the intertidal region in the open sea side and sub tidal region in the lagoon near Wringli Island were also introduced at the four culture sites on coir rope nets and coral stones. The growth was good at all the sites except at fisheries jetty.

Seed material of *Gracilaria edulis* collected from Kavaratti was introduced at 3 places in the lagoon viz., near light house, fisheries jetty and near Navodaya school. *G. edulis* showed good growth near the light house area and fisheries jetty. The growth of *G. edulis* was not good at Navodaya school area because of the epiphytic growth of *Bryopsis pinnata* on the culture nets and ropes. The sedimentation of coral debris was maximum on the nets introduced near the helipad and the light house areas, minimum at Navodaya School area and absent at fisheries jetty. The environmental characters of the ambient waters were also monitored during the above study.

G. edulis 150 g collected from Kavaratti was cut into fragments and cultured in perspex tanks (of 75 x 30 x 30 cm size) from 10.3.90 onwards. The quantity of sea water used in the tank was 40 l and the height of the water level 16 cm. The seawater in the tanks was changed twice a week and aeration provided throughout the day time. The weight of the plants increased to 185 and 190 g after 10 and 20 days respectively. Further work is in progress.

Fishery oceanography of the offshore regions in the Indian EEZ (FORV/SS/1).

Oceanographic and meteorological data collected on board FORV *Sagar Sampada* were analysed. The zooplankton biomass of the Lakshadweep area was treated in relation to the thermocline. The results indicated that the depth and intensity of the thermocline were inversely related to the plankton biomass; the shallower the thermocline, the more the amount of biomass. The vertical distribution of phosphate, nitrate and nitrite in this area were also studied.

The contrasting conditions of the T-S diagrams of the Quilon Bank, the Wadge Bank and the Gulf of Mannar regions during the south-west monsoon were studied in relation to catch composition of barracudas and nemipterids. The results indicated that the physiological conditions of these species are governed more by the subsurface and bottom water temperature than the salinity of the water. Nemipterids preferred the colder upwelled waters of the Quilon-Wadge Bank regions and barracudas the non-upwelled and turbulent waters of the Gulf of Mannar.

Two sets (each of 24 hrs) of meteorological data were collected during August and September 1988 from the Port Blair Bay. The data was used to study the latent heat and sensible heat exchanges between the sea surface and the air above it. The sea surface temperature, barometric pressure, wind speed and direction over a diel period of 24 hours were transformed into the cascade waves (diurnal waves), semi-diurnal waves and quarter-diurnal waves. These oscillated over the study value of the respective parameters.

Oceanographic data were collected on board FORV *Sagar Sampada* during monsoon cruises No. 16, 17, 30 and 59 around the Indian peninsula. Data from cruise No. 30 indicated a possible convergence zone north of Madras, with a clockwise eddy circulation with its coastal wing heading towards Andhra coast. This system of currents probably causes the occurrence of oil sardine in that area.

Results of the exploratory surveys of the Indian EEZ by FORV *Sagar Sampada* (FORV/SS/3)

Studies on zooplankton biomass, secondary production and tertiary production of the EEZ and contiguous seas based on material collected on board FORV *Sagar Sampada* during the years 1985 - '88 was completed and the data processed in the computer. The studies pertained to the geographical distribution, seasonal and diurnal variations of zooplankton.

Detailed studies on the zooplankton groups namely euphausids, mysids, pteropods, heteropods, amphipods, ostracods, lucifers, planktonic gastropods and foraminifera of the above mentioned areas were also completed. The results indicated that the zooplankton production in the eastern Arabian Sea was double than that in the Bay of Bengal. Similarly, the shelf area was richer by about three times than the oceanic area. The various zooplank-

ton groups also showed the same trend. From the zooplankton biomass, the rate of secondary production as well as the total fish production of the EEZ have been estimated. Accordingly, the secondary production was found to vary from 0.5 - 20.0 mg C/m^2/year in the EEZ. The EEZ is found to contain a total fish stock of about 7 million t of which the share of the west and east coasts is 4.0 and 1.5 million t respectively. The Andaman and Nicobar seas have a fish stock of about 1.6 million t.

Detailed studies on the geographic distribution, seasonal and diurnal abundance of groups such as copepods, chaetognaths, stomatopod larvae and crab larvae were also carried out.

PHYSIOLOGY, NUTRITION AND PATHOLOGY DIVISION

The research work of the division mainly involved studies on reproduction of fishes and shellfishes; development, evaluation and farm trial of compounded feeds for fishes and shellfishes and impact of environmental pollution on physio-pathological condition of animals. Research on genetic damage induced by environmental mutagens and population genetics of Indian mackerel was also conducted.

PHYSIOLOGY

Studies on cryopreservation and its influence on storage and viability of sperms in mullets (PNP/38)

Examination of fresh milt of the mullet, *Liza parsia* showed that the sperms were in active motile phase for about 60-120 seconds only, after which their activity slowly reduced. Among the various media used to preserve the motility of the sperms under low temperature, 10% dimethyl sulfoxide (DM SO) was the most suitable medium. DMSO in different combinations with different dilutents like Alsever's solution, buffer mixture[a], buffer[b], buffer[c], buffer[d], and buffer[f] was tried to preserve the motility of the sperms at — 180°C using Liquid Nitrogen. DMSO in combination with Alsever's solution and buffers b and c were better cryoprotectants as 50% of the sperms were moderately active in this media after thawing from their 24 hrs preservation. To understand the protein profile of stored seminal fluid (30 days preservation), disc gel electrophoretic studies were carried out. Three protein fractions were observed. The first appeared very thin (3-5 mm), the second was 8-23 mm and the third fraction was largest and measured 46-52 mm.

Determination of various tolerance limits of certain environmental factors affecting physiological behaviour of cultivable finfishes (PNP/40)

The main objective of the project was to find out the tolerance limit of *L. macrolepis* to salinity and temperature. Seven ranges of salinity media (35-65%) with an increase of 5% at each range were prepared. The fishes were introduced into these media and the temperature kept constant. LC_{50} value was between 55-60% salinity. In another experiment fishes were introduced into the above salinity ranges for a period of 60 days and biochemical constituents like protein, lipid and ash contents were determined. The protein and ash content of the fishes were normal in all salinity ranges but the lipid content increased with increase in salinity. This showed that animals adapt to high salinity by loss of water and increase in lipid content.

The effect of the effluents (fly ash) discharged from the thermal power plant near Tuticorin on the flora and the fauna was investigated. The water was clear near the light house area and the flora and fauna here were normal. The depth of ash deposited near the

thermal plant ranged from 75 - 100 cm and it gradually decreased towards the bay side (30-10 cm). The flora and fauna decreased in the water near the thermal power plant. Physiochemical parameters like salinity, temperature, oxygen levels and productivity of the water near the thermal power plant and bay side were also determined for comparison.

Endocrinological factors influencing maturation in selected species of finfishes and prawns (PNP/39)

The endocrinological factors influencing maturation in finfishes and prawns were analysed. The eyestalks of matured prawns (*Metapenaeus dobsoni* and *Parapenaeopsis stylifera*) had denser neurosecretory material in their nuerosecretory cells when compared to immature ones. Histochemical examination of pituitary of maturing and mature mullet (*L. parsia*) revealed higher glycoprotein material in mature fishes when compared to immature fishes.

NUTRITION

Development, evaluation and farm trial of compounded feeds for fish and prawns (PNP/35)

The prawn and fish farmers in India expressed that feeds were not easily available to feed their cultured stock. In this context, a survey was carried out to assess the status of commercial fish and prawn feed industry in the country. The information provided by the companies, in response to a questionnaire designed for the purpose, revealed that in India, 12 companies had facilities for commercial scale prawn feed production. The FCR of the feeds ranged from 2 - 5, their cost from Rs. 2.50 - Rs. 12/kg and the protein content from 14 - 40%. Few companies had imported machinery while others used indigenous equipment to manufacture prawn feeds. The major constraints of the feed manufacturers were poor market demand; non-availability of quality marine protein sources, feed grade vitamins and mineral premixes. One company had the technology to produce specialised medicated feeds.

In addition to commercial feed manufacturers, some farmers had small feed plants at their farm site and prepared their own feeds. A free advisory service was offered to prawn farmers and feed manufacturers regarding the type and quality of raw materials to be used in prawn feeds; balancing nutrient levels in the feeds specially prepared for semi-intensive and intensive prawn culture practices; optimum processing conditions to achieve good water stability and FCR and the need for a market demand survey for the commercial feed manufacturers. A study has also been initiated to assess the quality of feeds used, the feeding practices adopted, and the constraints faced by the prawn farmers in the Nellore District of Andhra Pradesh to suggest measures to augument production.

Experimental studies showed that milkfish (*Chanos chanos*) fry utilised gelatinised starch upto a level of 45% in the diet with relatively high survival, growth and best feed efficiency. High crude fibre levels were detrimental to

the effective utilization of the feeds and induced severe mortality. Preliminary observations indicated that post-larvae of *Penaeus semisulcatus* required 35% protein in the diet for maximum growth.

PATHOLOGY

Physio-pathological studies of chemical pollutants on selected species of finfishes (PNP/34)

Lead nitrate had haemolytic effect on the R. B. C. of *L. parsia* and *Tilapia mossambica*. Histological studies revealed degenerative changes in kidney and hepatic cells. Mild to moderate gliosis was noticed in brain.

Histopathological studies of D.D.T. treated fishes revealed demylination in brain. Severe necrosis and desquamation of epithelial cells in gill lamellae was seen. The liver showed extensive vacuolations.

Disease investigation and disease control in culture system (PNP/37)

Septicaemic diseases due to infection of *Aeromonas salmonicida* and *Pseudomonas* spp. were identified in *T. mossambica*. *Vibrio damsela* and *V. algniolyticus* were isolated from *P. indicus* and *P. monodon*. Brown spot disease was detected in *P. monodon* in Kakinada and Sherthalai. Hatchery infection of larvae and eggs of *P. monodon* with fungi was identified in Karnataka (Honavar). Besides, a number of soft prawn cases were also studied.

GENETICS

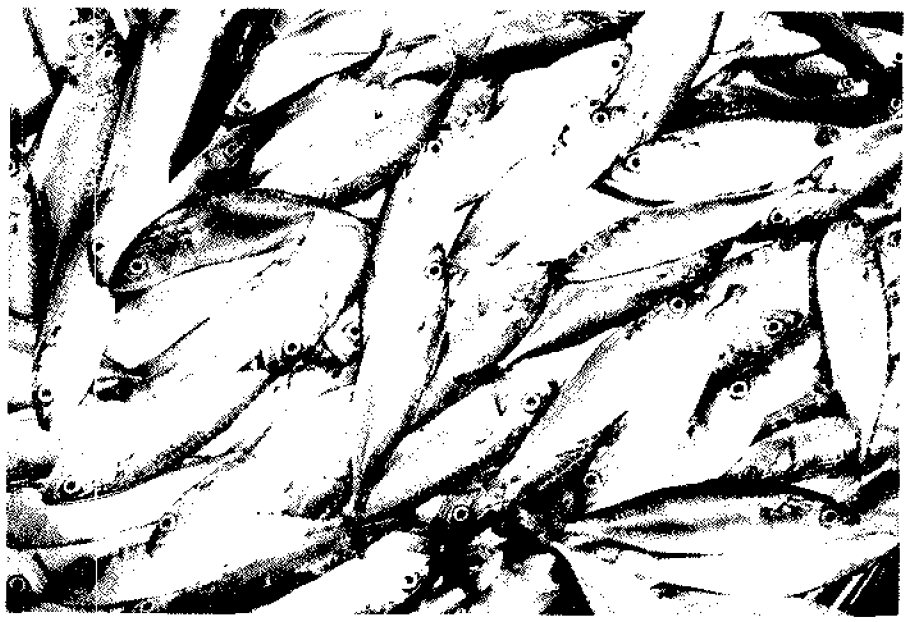
Genetic damage induced by environmental mutagens using cytogenetic models (PNP/30)

The diploid numbers (2n) in *Villorita cyprinoides* and *Lates calcarifer* were 38 and 48 respectively. The Sister Chromatid Exchanges (SCEs) were successfully demonstrated in *Therapon* sp. and *L. parsia* for the first time. Mutagenic experiments revealed that malathion induced chromosomal breaks and gaps in *L. parsia*.

Identification of genetic stocks in Indian mackerel *(Rastrelliger kanagurta)* (PNP/41)

Preliminary comparison of electrophoretic patterns of lactate dehydrogenase (LDH) and isocitric dehydrogenase (IDH) enzymes of mackerel showed similar monomorphic patterns in 70 specimens tested from Cochin and 10 specimens tested from Madras.

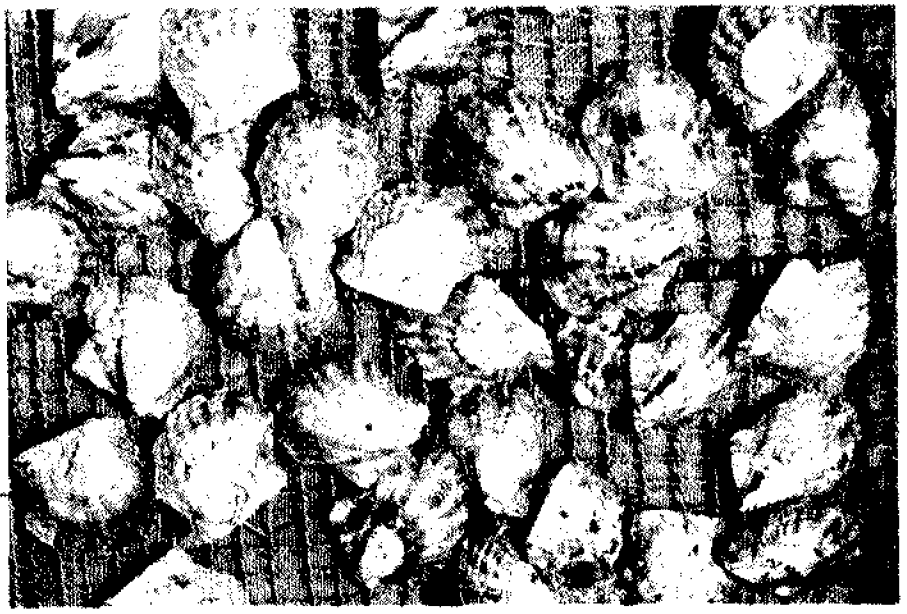
IMPORTANT PELAGIC RESOURCES



The Indian mackerel *(Rastrelliger kanagurta)* and the Indian oil sardine *(Sardinella longiceps)* - two major resources whose landings increased this year by 187,000 t and 148,000 t respectively

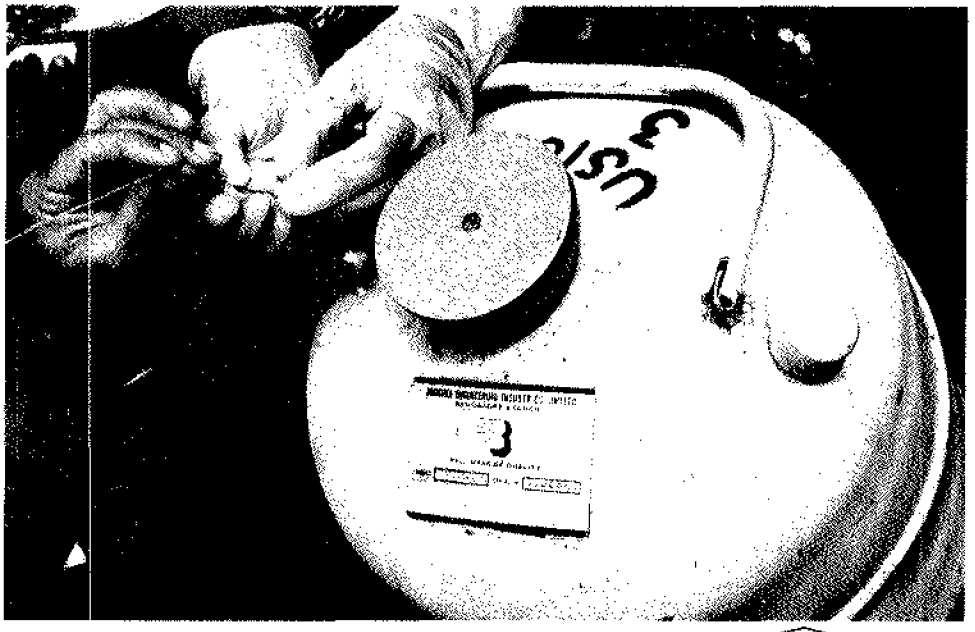
MOLLUSCAN RESOURCES

Cuttlefish catch landed by trawlers at Cochin Fisheries Harbour.

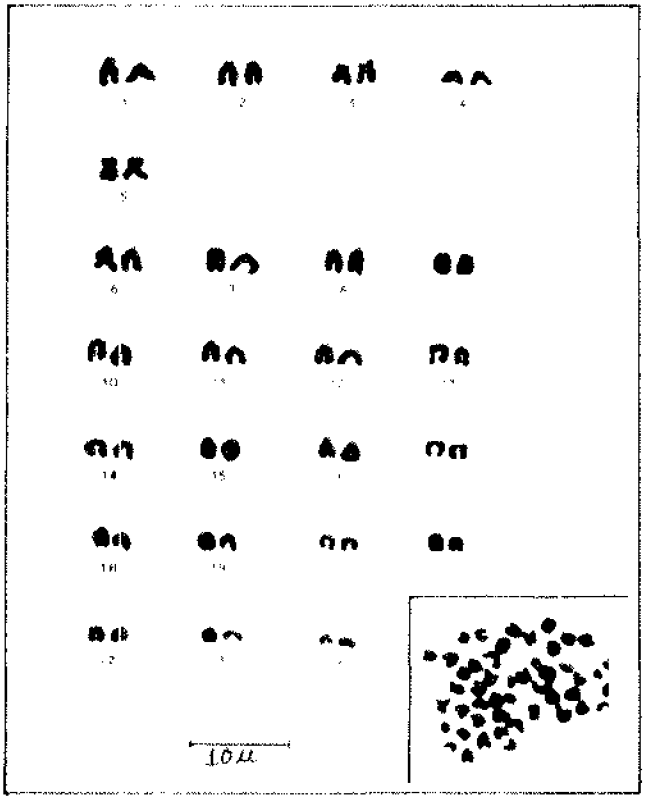


Young pearl oyster *(Pinctada fucata)* produced in the hatchery at Tuticorin

PHYSIOLOGY AND GENETICS



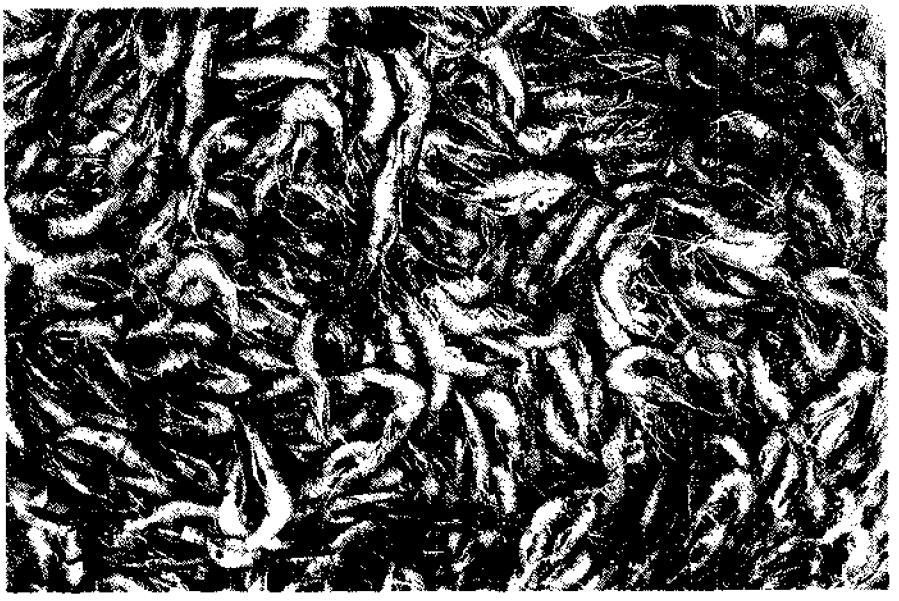
CRYOPRESERVATION
Milt sample of fish after collection in semen chamber ready for transfer into cryocan.



CYTOGENETICS
Karyotype of fish, *Lates calcarifer.*

EXTENSION PROGRAMME

Harvesting in progress at the Kandakkadavu farm.



A view of the harvested prawn.

FISHERY ECONOMICS AND EXTENSION DIVISION

Investigations on the efficiency of village adoption as a method of extension education (FE & E/22)

A survey of the coastal villages was carried out and Puduvaipu village under Elamkunnapuzha Panchayat, was selected as the project area. Discussions were held with the farmers and Panchayat board members of the area and local potentials were investigated for adoption of prawn culture in the project area. Agencies concerned with the input supply were contacted and information was collected.

Planned change in a coastal village — model for a first line extension programme (FE & E/19)

A programme was planned to encourage utilisation of homestead water bodies at Kandakkadavu for prawn culture. A water area of 320 sq. mts was selected to conduct the demonstration of prawn culture and 1,900 *Penaeus indicus* seeds were stocked. An yield of 5.4 kg was realised after 90 days. Field day and mass contact programmes were arranged in the project area. A training programme in prawn seed collection and fish processing was organised.

LIBRARY AND DOCUMENTATION SECTION

During the year several books, periodicals and non-book materials were procured for the libraries at the Headquarters, the Regional Centre and Research Centres. Reference facilities were provided for visitors both within and outside the country.

The following publications were issued :

1.	Indian Journal of Fisheries	:	Vol. 35 (Nos. 1, 2 & 3), Vol. 36 (No. 1)
2.	Bulletin	:	Nos. 43, 44 (Part I & II)
3.	Special Publication	:	Nos. 45, 46 and 47
4.	Marine Fisheries Information Service	:	Nos. 91-98
5.	Newsletter	:	Nos. 40 - 44
6.	a) Research highlights	:	1987-88 (English & Hindi version)
	b) Research highlights	:	1988 (English version)

7. Brochures on the "Activities And Achievements" of the following establishments :
   - i) Regional Centre, Mandapam Camp
   - ii) Research Centre, Calicut
   - iii) Research Centre, Vizhinjam
   - iv) KVK, Narakkal
   - v) FORV *Sagar Sampada*
8. Handbook on Beche-de-Mer (in Tamil)
9. Abstracts of the National Workshop on Beche-de-Mer.
10. Report on the 'Seaweed Resources off the Tuticorin - Tiruchendur Coast'.
11. CMFRI Annual Report 1988.

POST-GRADUATE EDUCATION AND RESEARCH PROGRAMME IN MARICULTURE

Ph.D. Programme :

Three Senior Research Fellows were awarded Ph.D. degrees by the Cochin University of Science and Technology for their work on:

1. Physiology of moulting in the penaeid prawn, *Penaeus indicus* H. Milne Edwards ... K. K. VIJAYAN

2. Nutritional requirements of the fry of Gold-spot mullet *Liza parsia* (Hamilton) ... KIRON VISWANATH

3. Reproductive endocrinology of the penaeid prawn *Penaeus indicus* H. Milne Edwards ... K. SUNIL KUMAR MOHAMED

Six research fellows have submitted their theses to the Cochin University of Science and Technology. Five research fellows passed the qualifying examination held by the Cochin University of Science and Technology. Twenty four research fellows are actively pursuing their research work.

M.Sc. Programme :

All the junior research fellows of the 7th batch successfully completed the course and 2 of them secured distinction in the University examination. The results of the 8th batch has been declared and one has secured distinction. The students of the 9th and 10th batch are progressing well.

KRISHI VIGYAN KENDRA

Courses conducted under K. V. K., Narakkal

Sl. No.	Subject	No. of courses	No. of Trainees Male	Female	TOTAL
1.	Crop production	7	62	61	123
2.	Live stock production	23	102	234	336
3.	Fisheries	26	166	256	422
4.	Home Science	29	...	415	415
5.	Social forestry	5	12	47	59
	TOTAL	90	342	1013	1355

In addition to the regular courses, special demonstrations were also conducted.

Training courses organised under the Trainer's Training Centre

Sl. No.	Subject	Duration (days)	No. of participants
1.	Prawn farming (for bank officials)	5	26
2.	Prawn farming (for extension officials	10	5
3.	Post harvest technology in fisheries	10	5
4.	Hatchery production of marine prawn seeds	15	4
5.	SCUBA diving	30	6

Several film shows, radio talks and T.V. programmes were organised and conducted for the benefit of trainees and villagers. An agricultural exhibition was also organised for the benefit of the farmers.

Centre-wise list of Scientists and the Code Numbers of projects in which the scientist is Project Leader or Associate

Centre/ Name of the scientist	Designation	Project Codes
COCHIN		
Dr. P. S. B. R. James	Director	
Dr. A. V. S. Murty	PS	FORV/SS/1
Dr. K. C. George	PS	DF/IP/2, CF/IP/1
Dr. K. Alagaraja	PS	FSS/FRA/1.3, FSS/FRA/ST. 1, FSS/FRA/1.18, DF/IP/1
Shri M. S. Rajagopal	PS	FEM/ES/5, FEM/RS/1
Dr. A. Noble	PS	PF/IP/1, PF/IP/3, PF/IP/5, PF/IP/6, CF/IP/1
Shri D. Sadananda Rao	PS	FEM/ES/5, FEM/BA/1
Dr. V. S. K. Chennubhotla	PS	FEM/SW/1
Shri G. Subbaraju	PS	FEM/RS/1
Shri V. N. Bande	PS	PF/IP/3, DF/IP/1, DF/IP/2, DF/IP/4, DF/IP/6
Shri K. N. Krishna Kartha	PS	LD/DI/1.1
Dr. V. Narayana Pillai	PS	FORV/SS/1
Dr. S. C. Mukherjee	S(S-3)	PNP/34, PNP/37, PNP/40
Dr. P. Bensam	PS	DF/CUL/1.7, FORV/SS/3
Dr. A. D. Diwan	S(S-3)	PNP/38
Shri D. B. S. Sehara	S(SG)	PF/IP/1, PF/IP/3, DF/IP/1, CF/IP/1
Dr. C. Suseelan	S(SG)	DF/IP/1, DF/IP/4, CF/RE/2, FORV/SS/3
Shri V. Kunjukrishna Pillai	S(SG)	FEM/MP/1, PNP/34
Dr. K. J. Mathew	S(SG)	DF/IP/1, DF/IP/3, CF/IP/1, FORV/SS/3, LD/DI/1.1

Dr. K. Rengarajan	S(SG)	FORV/SS/3
Dr. (Ms.) S. Sivakami	S(SG)	PF/IP/1, PF/IP/3, DF/IP/1, DF/IP/2, DF/IP/4, CF/IP/1
Shri G. S. Daniel Selvaraj	S(SG)	DF/IP/1, DF/IP/3, CF/IP/1, FEM/ES/1, FEM/ES/5, LD/DI/1.1
Shri K. Narayana Kurup	S(SG)	FSS/FRA/1.1, FSS/FRA/ST.1, FSS/FRA/1.18, PF/IP/3,
Shri G. Nandakumar	S(SG)	PF/IP/5, DF/IP/1, DF/IP/2, CF/IP/1, CF/RE/2
Ms. Mary K. Manissery	S(SG)	On study leave
Shri N. Surendranatha Kurup	S(SG)	DF/IP/1, CF/IP/1, FEM/ES/5
Shri A. Regunathan	S(SG)	FE&E/22
Dr. N. Gopinatha Menon	S(SG)	PF/IP/1, PF/IP/5, DF/IP/1, DF/IP/4, DF/IP/6, FORV/SS/3
Shri K. Balan	S(SG)	FSS/FRA/ST.1, FSS/FRA/1.18, CF/IP/1
Dr. (Ms.) V. Chandrika	S(SG)	FEM/ES/1
Dr. K. S. Scariah	S(SG)	FSS/FRA/ST.1, FSS/FRA/1.18 FSS/FRA/1.19, DF/IP/1
Shri R. Sathiadas	S(SG)	On study leave
Shri K. V. Somasekharan Nair	S(SG)	DF/IP/1, DF/IP/2, CF/IP/1
Shri K. K. P. Panikkar	S(SG)	PF/IP/1, PF/IP/3, DF/IP/1, CF/IP/1, PNP/35
Dr. N. Gopalakrishna Pillai	S(SG)	PF/IP/1, PF/IP/3
Shri K. N. Rajan	S(SG)	DF/IP/1, DF/IP/4, CF/IP/1, CF/RE/2
Shri M. Srinath	S(SG)	FSS/FRA/1.3, FSS/FRA/ST.1, FSS/FRA/1.18, PF/IP/4
Dr. George John	S(SG)	PNP/30, PNP/41
Shri P. C. Thomas	S(SG)	PNP/41
Dr. K. C. George	S(SG)	PNP/34, PNP/37
Dr. M. K. George	S(SG)	PNP/41

Shri R. N. Misra	S(SG)	FEM/ES/5, FEM/MP/1
Shri K. Prabhakaran Nair	S(SG)	DF/IP/3, CF/IP/1, MOL/RE/2, MOL/RE/3, FORV/SS/3
Shri P. E. Sampson Manickam	S(SG)	CF/CUL/1.1.2, CF/CUL/1.1.7, CF/CUL/2
Shri S. Muthusamy	S(SG)	FEM/ES/1
Shri K. R. Manmadhan Nair	S(SG)	DF/IP/1, DF/IP/2, FORV/SS/3
Ms. Krishna Srinath	S(SG)	FE&E/19, LD/DI/1.1
Ms. Grace Mathew	S-2	PF/IP/1, DF/IP/1, DF/IP/2, DF/IP/3
Shri I. David Raj	S-2	FEM/ES/1, FEM/ES/5, FEM/MP/1, LD/DI/1.1
Ms. T. S. Naomi	S	FEM/ES/1, FORV/SS/3
Ms. K. Vijayalakshmi	S	FSS/FRA/ST.1, FSS/FRA/1.18, FSS/FRA/1.19, PF/IP/2
Dr. P. Kaladharan	S	FEM/MP/1, FEM/BA/1, PNP/39
Ms. Jancy Gupta	S	FE&E/19, FE&E/22
Dr. Mohan K. Zachariah	S	PNP/39
Dr. N. Sridhar	S	PNP/39
Shri Sankar V. Alavandi	S	FEM/MP/1, FEM/BA/1, PNP/35, PNP/37
Ms. Puthran Prathibha	S	PF/IP/3, DF/IP/1, CF/IP/1
Ms. V. Kripa	S	DF/IP/1, MOL/RE/2
Shri M. Karthikeyan	S	FSS/FRA/1.3, FSS/FRA/ST.1, FSS/FRA/1.18, PF/IP/1
Dr. (Ms.) M. K. Sanhotra	S	PNP/35, PNP/39
Dr. A. K. Pandey	S	PNP/34, PNP/39
Dr. Naresh Kumar Varma	S	PNP/30, PNP/41
Dr. I. D. Gupta	S	PNP/30, PNP/41

MANDAPAM

Dr. P. Vedavyasa Rao	PS	CF/CUL/1.1.7
Shri N. Neelakanta Pillai	S(SG)	FEM/SW/1, CF/CUL/1.1.2, CF/CUL/1.1.7, FORV/SS/3
Dr. N. Kaliaperumal	S(SG)	FEM/SW/1
Shri A. A. Jayaprakash	S(SG)	PF/IP/1, PF/IP/6, DF/IP/1, CF/IP/1
Shri P. Livingston	S(SG)	PF/IP/1, DF/IP/1
Shri V. Gandhi	S(SG)	DF/CUL/1.7
Shri A. Raju	S(SG)	DF/CUL/1.7
Shri A. P. Lipton	S(SG)	PF/IP/5, DF/IP/1, DF/IP/3, PNP/37, MOL/RE/2
Shri Atmaram Mishra	S	DF/CUL/2
Shri S. Krishna Pillai	S	DF/IP/1, DF/IP/3, CF/IP/1, FEM/ES/1
Shri P. Jayasankar	S	PF/IP/1, DF/IP/1
Ms. Reeta Jayasankar	S	FEM/SW/1
Shri G. Maheshwaradu	S	DF/IP/1, CF/CUL/1.1.7, CF/IP/1

VERAVAL

Dr. E. Vivekanandan	S(SG)	PF/IP/1, DF/IP/1
Shri Alexander Kurian	S(SG)	PF/IP/1, PF/IP/2, DF/IP/1
Dr. S. Shanmugham	S(SG)	PF/IP/2, DF/IP/1
Dr. C. Gopal	S	PF/IP/1, PF/IP/2, DF/IP/1

BOMBAY

Dr. (Ms.) P. V. Kagwade	PS	DF/IP/1
Dr. Kuber Vidyasagar	S(SG)	DF/IP/1
Shri S. K. Chakraborthy	S(SG)	PF/IP/2, DF/IP/1
Shri K. S. Sundaram	S(SG)	DF/IP/1
Shri M. Zaffar Khan	S(SG)	PF/IP/1, PF/IP/2, DF/IP/1
Shri V. D. Deshmukh	S(SG)	PF/IP/2, DF/IP/1
Shri S. G. Raje	S(SG)	PF/IP/1, DF/IP/1, DF/IP/3
Shri M. Aravindakshan	S	PF/IP/2, DF/IP/1
Dr. V. V. Singh	S	PF/IP/1, PF/IP/2, DF/IP/1, DF/IP/3, FEM/ES/1

KARWAR		
Shri M. H. Dhulkhed	PS	PF/IP/3, DF/IP/1, CF/IP/1
Shri G. G. Annigeri	PS	PF/IP/3, PF/IP/5, CF/IP/1
Dr. V. S. Kakati	S(SG)	DF/IP/1, FORV/SS/3
Shri K. Y. Telang	S	PF/IP/3, DF/IP/1, CF/IP/1,
Dr. P. K. Krishna Kumar	S	PF/IP/3, DF/IP/1, CF/IP/1 FEM/ES/1, FEM/MP/1
Shri P. K. Asokan	S	DF/IP/1, CF/IP/1, MOL/RE/2
MANGALORE		
Shri K. V. Narayana Rao	PS	PF/IP/3
Dr. M. Vasudev Pai	PS	PF/IP/1, PF/IP/3
Shri K. K. Sukumaran	S(SG)	PF/IP/3, PF/IP/5, DF/IP/1, CF/IP/1
Shri Madan Mohan	S(SG)	PF/IP/1, PF/IP/3, DF/IP/1
Shri G. M. Kulkarni	S	PF/IP/1, PF/IP/3, DF/IP/1
Shri P. U. Zacchariah	S	PF/IP/1, PF/IP/3, DF/IP/1 CF/IP/1
Dr. Sunil Kumar Mohamed	S	DF/IP/1, MOL/RE/2
Ms. M. P. Molly	S	PF/IP/1, DF/IP/1, DF/IP/3 CF/IP/1, FEM/ES/1, FEM/ES/5
CALICUT		
Shri M. Kumaran	PS	DF/IP/1, CF/IP/1
Dr. R. S. Lal Mohan	PS	DF/IP/1, CF/IP/1, MOL/RE/3
Dr. P. S. Kuriakose	S(SG)	DF/IP/1, MOL/RE/2, MOL/RE/3
Shri M. Sivadas	S	PF/IP/1, DF/IP/1, CF/IP/1
Shri C. V. Mathew	S	PF/IP/4, DF/IP/5, FEM/ES/1
Shri M. Feroz Khan	S	PF/IP/1, DF/IP/1, DF/IP/3, CF/IP/1
Ms. P. T. Sarada	S	DF/IP/1, CF/IP/1
VIZHINJAM		
Dr. C. S. Gopinatha Pillai	PS	CF/IP/1, FEM/ES/1
Shri C. Mukundan	S(SG)	DF/IP/3, CF/IP/1
Dr. P. A. Thomas	S(SG)	FEM/ES/1, FEM/BA/1

Shri K. K. Appukuttan	S(SG)	On study leave
Dr. S. Lazarus	S(SG)	PF/IP/1, DF/IP/4, DF/IP/5
Ms. Rani Mary George	S(SG)	PF/IP/1, CF/IP/1, FEM/ES/1
Shri G. P. Kumaraswamy Achary	S(SG)	MOL/RE/2, MOL/RE/3, MOL/CUL/4, FORV/SS/3
Shri G. Gopakumar	S(SG)	PF/IP/1, PF/IP/5, DF/IP/3, CF/IP/1
Dr. N. Ramachandran	S-2	MOL/RE/2, MOL/CUL/5
Shri K. K. Philippose	S	CF/IP/1
Ms. S. Jasmine	S	CF/IP/1, FEM/ES/1
TUTICORIN		
Shri S. Mahadevan	PS	MOL/RE/2, MOL/CUL/4
Dr. K. A. Narasimham	PS	MOL/RE/3, MOL/CUL/4, MOL/CUL/5
Dr. M. Peer Mohamed	PS	PNP/40
Dr. A. C. C. Victor	S(SG)	MOL/RE/3, MOL/CUL/5, MOL/CUL/6
Shri A. Chellam	S(SG)	MOL/CUL/1.4.3. MOL/CUL/4, MOL/CUL/6
Shri S. Dharmaraj	S(SG)	MOL/CUL/4, MOL/CUL/6
Shri M. E. Rajapandian	S(SG)	MOL/CUL/4, MOL/CUL/7
Shri P. Muthiah	S(SG)	MOL/CUL/4, MOL/CUL/7
Shri K. Ramdoss	S(SG)	PF/IP/5, MOL/RE/2, MOL/RE/3, MOL/CUL/4
Shri P. Sam Bennet	S(SG)	DF/IP/1, DF/IP/1
Shri K. M. S. Ameer Hamsa	S(SG)	DF/IP/1, DF/IP/3, DF/CUL/1.7
Dr. H. Mohamed Kasim	S(SG)	PF/IP/1, DF/IP/3, DF/CUL/1.7
Dr. D. B. James	S(SG)	CF/CUL/2
Dr. M. Rajamani	S(SG)	DF/IP/1, DF/IP/5, CF/IP/1
Dr. C. P. Gopinathan	S(SG)	DF/IP/1, DF/IP/3, CF/IP/1 MOL/CUL/4, FEM/ES/1, FEM/MP/1
Shri R. Marichamy	PS	On study leave

Dr. D. C. V. Easterson	S(SG)	PNP/40
Shri D. Kandasamy	S(SG)	PNP/40
Shri T. S. Velayudhan	S(SG)	MOL/CUL/4, MOL/CUL/6
Shri D. Sivalingam	S-2	DF/IP/1, MOL/CUL/4, MOL/CUL/5
Shri V. S. Rengasamy	S-2	PF/IP/1, DF/IP/1, DF/CUL/1.7, CF/IP/1
Ms. Rani Palanisamy	S	MOL/CUL/4, MOL/CUL/7
MADRAS		
Dr. K. Satyanarayana Rao	PS	MOL/RE/3, MOL/CUL/5
Shri M. S. Muthu	PS	CF/CUL/1.1.2, FORV/SS/3
Shri N. S. Radhakrishnan	S(SG)	DF/IP/1, CF/IP/1
Shri R. Thiagarajan	S(SG)	PF/IP/1, DF/IP/1
Dr. P. Devadoss	S(SG)	PF/IP/1, PF/IP/5, DF/IP/1, DF/IP/4, CF/IP/1
Dr. P. Nammalwar	S(SG)	DF/IP/1, DF/CUL/1.7, PNP/35
Shri J. C. Gnanamuthu	S(SG)	DF/IP/1
Shri G. Mohanraj	S(SG)	DF/IP/1, DF/CUL/1.7, PNP/35
Shri K. Devarajan	S(SG)	CF/CUL/1.1.2, PNP/35
Dr. E. V. Radhakrishnan	S(SG)	DF/IP/1, CF/CUL/1.1.2, CF/CUL/2, CF/IP/1
Shri M. Kathirvel	S(SG)	CF/CUL/1.1.2, CF/CUL/2, FORV/SS/3
Shri R. Sarvesan	S(SG)	DF/IP/1, CF/IP/1, MOL/RE/2, FORV/SS/3
Dr. P. V. Sreenivasan	S(SG)	MOL/CUL/4, MOL/CUL/5
Shri M. Vijayakumaran	S(SG)	CF/CUL/2, PNP/35, PNP/37
Shri K. G. Garijavallabhan	S(SG)	DF/IP/1, CF/IP/1, FEM,ES/1, FEM/BA/1
Shri M. Rajagopalan	S(SG)	FEM/ES/1, FEM/ES/5, FEM/MP/1
Dr. R. Paul Raj	S(SG)	PNP/35
Shri M .M. Meiyappan	S(SG)	DF/IP/1, DF/IP/2, DF/IP/4, FORV/SS/3

Shri S. Srinivasarengan	S-2	DF/IP/1, CF/IP/1
Shri V. Thangaraj Subramanian	S-2	DF/IP/1, CF/IP/1
Shri P. Natarajan	S-2	CF/IP/1, MOL/RE/2
KAKINADA		
Dr. V. Sriramachandra Murty	S(SG)	DF/IP/1, DF/IP/4, CF/IP/1
Shri C. Muthiah	S(SG)	DF/IP/1, CF/IP/1
Dr. G. Syda Rao	S(SG)	DF/IP/1, MOL/RE/2, MOL/CUL/3
Dr. (Ms.) Lalitha Devi	S(SG)	DF/IP/1, CF/IP/1
Dr .P. N. Radhakrishnan Nair	S(SG)	PF/IP/1, DF/IP/3, CF/IP/1
VISAKHAPATNAM		
Dr. K. Radhakrishna	PS	DF/IP/1, DF/IP/3, FEM/ES/1
Dr. G. Luther	PS	PF/IP/1, CF/IP/1
Dr. T. Appa Rao	PS	DF/IP/1, DF/IP/2, DF/IP/4
Shri S. Reuben	S(SG)	PF/IP/1, PF/IP/5, DF/IP/1, CF/IP/1
Dr. G. Sudhakara Rao	S(SG)	DF/IP/1, DF/IP/2
Shri Y. Appanna Sastry	S(SG)	PF/IP/1, DF/IP/1, DF/IP/2, DF/IP/3
Shri G. Radhakrishnan	S	DF/IP/1, DF/IP/2
Shri K. Vijayakumaran	S	DF/IP/1, DF/IP/3, FEM/ES/1
MINICOY		
Dr. P. Parameswaran Pillai	S(SG)	PF/IP/4, DF/IP/5, FORV/SS/3
Shri T. M. Yohannan	S(SG)	PF/IP/4, DF/IP/5
Shri Pon Siraimeetan	S(SG)	DF/IP/1, DF/IP/3, DF/IP/5, CF/IP/1, FEM/ES/1
Shri K. P. Said Koya	S	PF/IP/4
KVK/TTC		
Dr. M. M. Thomas	PS	Extension & Training
Dr. D. Noble	S(SG)	Extension & Training

वार्षिक रिपोर्ट 1989-90

केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान
भारतीय कृषि अनुसंधान परिषद

संक्षिप्त विवरण,

अधिदेश और संगठन व्यवस्था

केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान 1947 में कृषि एवं सिंचाई मंत्रालय द्वारा स्थापित हुआ और बाद में 1967 में इसे भारतीय कृषि अनुसंधान परिषद के अधीन लाया गया। संस्थान का मुख्यालय कोचीन में और क्षेत्रीय केन्द्र मंडपम कैंप में स्थित है। इसके 11 अनुसंधान केन्द्र और 29 क्षेत्र केन्द्र पूर्वी और पश्चिमी तटों में स्थित हैं।

संस्थान में ग्रहण और संवर्द्धन मात्स्यिकी में सक्रिय अनुसंधान कार्य गठित किए जा रहे है। देश की समुद्री मात्स्यिकी के समग्र विकास में इस संस्थान द्वारा महत्वपूर्ण योगदान दिया गया है। संस्थान को, शोषित मात्स्यिकी संपदाओं का निर्धारण और मानीटरन द्वारा संपदाओं का युक्ति-युक्त शोषण, परिरक्षण और प्रबंध; अनन्य आर्थिक मेखला का शोषण नहीं की गई समुद्री मात्स्यिकी संपदाओं का निर्धारण; पोत पर आधारित कार्यक्रम द्वारा पर्यावरण के परिवर्तन से समुद्री मात्स्यिकी संपदा की प्रचुरता में आती उतार-चढ़ाव सम्बन्धी अध्ययन; फिनफिश और कवचप्राणी के उत्पादन के लिए अनुयोज्य समुद्री संवर्द्धन तकनोलजी का विकास; तकनोलजी का स्थानांतरण; अल्पकालिक और दीर्घ कालिक प्रशिक्षण और स्नातकोत्तर कार्यक्रम में अनुसंधान गठित करने का, अधिकार है।

निम्नलिखित आठ प्रभागों द्वारा संस्थान अपने अनुसंधान कार्य कार्यान्वित करता है: मात्स्यिकी संपदा निर्धारण प्रभाग, वेलापवर्ती मात्स्यिकी प्रभाग, तलमज्जी मात्स्यिकी प्रभाग, क्रस्टेशियाई मात्स्यिकी प्रभाग, मोलस्क मात्स्यिकी प्रभाग, मात्स्यिकी पर्यावरण प्रबंध प्रभाग, देहिकी पोषण और रोगविज्ञान प्रभाग और मात्स्यिकी अर्थशास्त्र और विस्तार प्रभाग।

शास्त्र एवं तकनोलजी का कोचीन विश्वविद्यालय से संयोजित करके समुद्री संवर्द्धन के स्नात-कोत्तर कार्यक्रम के अधीन समुद्री संवर्द्धन में एम एस सी और पी एच डी कार्यक्रम गठित किए जा रहे हैं। पुस्तकालय और प्रलेख केन्द्र में संस्थान के छात्रों और कर्मचारियों के लिए और देश के अंदर और बाहर के आगंतुकों केलिए हवाला देने की सुविधाएं हैं। संस्थान के प्रकाशनों केलिए भी यह केन्द्र उत्तरदायी है। नारक्कल के कृषि विज्ञान केन्द्र और प्रशिक्षकों का प्रशिक्षण केन्द्र विस्तार कार्यक्रमों में सम्मिलित हैं और ग्रहण और संवर्द्धन मात्स्यिकी के प्रशिक्षण में भाग ले रहे है।

प्रभागवार सारांश

मात्स्यिकी संपदा निर्धारण प्रभाग

वर्ष 1989 का समुद्री मछली उत्पादन करीब 2.2 मिलियन टन आकलित किया। यह वर्ष 1988 में 1.8 मिलियन टन था। अत: इस साल में 451,000 टन (25%) की वृद्धि अंकित की। पश्चिम तट में 32% और पूर्वी तट में 7.7% की वृद्धि अंकित की। इस वर्ष में पकड का 61% मछलियाँ वेलापवर्ती वर्ग का था और इसकी पकड में 443,000 टन की वृद्धि भी दिखाई। तलमज्जी वर्गों में 6,000 टन की वृद्धि दिखाई पडी।

वर्ष में चारों क्षेत्र के स्थलन में बढ़ती हुई। उत्तर-पूर्वी क्षेत्र से 83,812 टन का स्थलन हुआ। यह 1988 की अपेक्षा 25,000 टन अधिक है। हिल्सा के स्थलन में 12,000 टन की वृद्धि हुई और पाम्फ्रेट्स में 5,000 टन की भी। क्रॉकर्स के स्थलन में 9,000 टन की घटती दिखाई पडी।

दक्षिण-पूर्वी क्षेत्र में 445,000 टन के स्थलन के साथ 1988 की अपेक्षा 13,000 टन की उपांतिक वृद्धि अंकित की। तारलियों के स्थलन में 18,000 और टनियों के स्थलन में 14,000 टन की वृद्धि हुई। लेकिन स्टोलिफोरस जाति और मुल्लन के स्थलन में यथाक्रम हुई 20,000 व 12,000 टन की घटती ने कुल स्थलन को करीब पिछले वर्ष के समान बना दिया।

दक्षिण-पश्चिम तट से 1,018,404 टन का स्थलन आकलित किया और 246,000 टन की गोचर वृद्धि अंकित की। बांगडा के स्थलन में 171,000 टन की वृद्धि हुई, इस के बाद तारली (115,000 टन), नेमीप्टेरस जाति (15,000 टन), ट्यूना (11.000 टन) और शीर्षपाद (9,000 टन) आये हैं। स्टोलिफोरस जाति, शिंगटी, फीतामीन और पेनिआइड झींगों में क्रमश: 12,000 टन, 10,000 टन, 7,000 टन और 14,000 टन की घटती दिखाई पडी।

उत्तर-पश्चिम क्षेत्र में 9,594 टन की पकड के साथ 167,000 टन की वृद्धि अंकित की। बंबिल के 49,000 टन का वर्द्धित स्थलन और नॉन-पेनिआइड झींगों की 28,000 टन की वृद्धि इस क्षेत्र के स्थलन की वृद्धि के कारण बन गए। बांगडा का स्थलन 20,000 टन अधिक हो गया, तारली का 11,000 टन, कैरंजिड का 10,000 टन, क्रॉकर्स का 8,000 टन, पेनि-आइड झींगों का 6,000 टन और शीर्षपादों का स्थलन 6,000 टन भी अधिक हो गया।

कुल वेलापवर्ती वर्ग (1,371,787 टन,) के 21.3% और 20·4% क्रमश: बांगडा (291,000 टन) और तारली (278,851 टन) थे। केरल के वलय संपाशक और कर्नाटक और गोआ के कोष संपाशकों ने मिलाकर बांगडों के स्थलन का 76% और तारलियों के स्थलन का 64% योगदान किया। वेलापवर्ती मछली स्थलन के योगदान के लिए अन्य प्रमुख मछलियों में बंबिल (120,191 टन) और कैरंजिड (136,000 टन) शामिल थे।

तलमज्जी वर्गों (882 837 टन) में पर्चेस ने 103,000 टन (11.6%) और क्रॉकेर्स ने 101,193 टन (11.4%) का योगदान किया। पेनिआइड झींगों के स्थलन में इस वर्ष में घटती हुई फिर भी तमलज्जी वर्ग के 16.6%, (147,000 टन) इसका योगदान था। नॉन–

पेनिआइड झींगों की पकड 8.6% (76,000 टन) थी । शीर्षपादों की पकड 6.3% (56,000 टन) थी ।

स्थलन में यंत्रीकृत एककों का योगदान 84% और अयंत्रीकृत एककों का 16% था । केरल में बाहरी इंजन से यंत्रीकृत देशज क्राफ्ट का अच्छा प्रतिष्ठान हुआ और गुजरात, कर्नाटक और महाराष्ट्र में भी इसकी प्रचुरता होने लगी है ।

वेलापवर्ती मात्स्यिकी प्रभाग

वेलापवर्ती वर्ग के संग्रहण का निर्धारण करने केलिए प्रग्रहण मात्स्यिकी पर गिअरवाइज समग्र अन्वेषण चलाए गए । वृद्धि और प्रवास का अध्ययन करने केलिए वाणिज्य प्रमुख मछलियों और कवचप्राणियों का टैगन किया गया ।

वर्ष में पूर्वी एवं पश्चिमी तटों में मुख्यत: गिल जाल का परिचालन किया । केन्द्रों की वार्षिक पकड और पकड दर (कोष्ठक में चिह्नित संख्या) वेरावल 5978 टन (197 कि ग्रा), बंबई 2585 टन (729 कि ग्रा), कोचीन 4029 टन (227 कि ग्रा), मांगलूर 455 टन (118 कि ग्रा) टूटिकोरिन 1830 टन (129 कि ग्रा), मंडपम 559 टन (65 कि ग्रा), मद्रास 254 टन (244 कि ग्रा) और विशाखपट्टणम 82 टन (6 कि ग्रा) थे । कोचीन के गिल जाल परिचालन की वार्षिक आय 950 रु. थी । परिचालन व्यय 400 रु के कुल लाभ को छोडकर 550 रु था । सभी खर्चों को काटकर वास्तविक लाभ प्रतिदिन 150 रु था ।

उत्तर-पश्चिम क्षेत्रों के प्रमुख वर्ग उपा-स्थिमीन, शिंगटी और पाम्फ्रेट्स थे और गिल जाल पकड के 18%, 7% और 13% योगदान यथाक्रम इनके थे । शिंगटियों में टैकीस्युरस थालासिनस और अस्थिओजनिसिस मिलिटन्स प्रमुख जातियाँ थी और पाम्फ्रेट की पकड में प्रमुख रूप से पैरास्ट्रोमैटियस नाइगर था । मांगलूर, कालिकट कोचिन, विषिजम, मंडपम और टूटिकोरिन में सीरफिश और ट्यूना से एक मात्स्यिकी बन गई है । सभी केन्द्रों में स्कोम्बेरोमोरस कम्मेर्सन प्रमुख सीर फिश जाति थी । कालिकट को छोडकर सभी केन्द्रों में ट्यूना में यूथिनस एफिनिस प्रमुख थी । कालिकट में अक्सिस ताज़ार्ड प्रमुख थी । अन्य ट्यूना जातियाँ थन्नस, टोंगोल, आइ ओबेसस, आइ आलबकार्स, ए. रोचेय और सार्डा ओरियन्टालिस थी । कोचीन और विशाखपट्टणम में कैरंजिड्स की मात्स्यिकी मिली जिसमें एलप्स जेदाबा प्रमुख जाति थी और इसके पीछे मेगालाप्सिस, कोडिला, डेक्काप्टीरस नुसेल्ली और कैरंजोइड्स मालाबारिकस प्राप्त हुई ।

वेरावल और बंबई में डोल-नेट मात्स्यिकी का मॉनीटरन किया । वेरावल में से, जाफ़ाबाद नवाबंदर और राजपरा की वार्षिक पकड और पकड दर (कोष्ठक में चिह्नित संख्या) का मॉनीटरन किया और ये क्रमश: 34, 244 टन (1672 कि ग्रा), 14,708 टन (537 कि ग्रा) और 23,968 टन (916 किग्रा) थे । न्यू जेरी वार्फ, सासून डॉक और वेरसोवा में ये क्रमश: 662 टन (272 कि ग्रा) 1799 टन (153 कि ग्रा) और 1134 टन (13 कि ग्रा) थे । सौराष्ट्र क्षेत्र की डोल नेट पकड में बंबिल 40-76% और कइलिया 6-11% थे । बंबिल की मात्स्यिकी का प्रमुख मौसम सितंबर -मई है । जाफ़ाबाद में, 195-280 मि मी आकार वाली मछलियाँ पकड में प्रमुख थी और अन्य केन्द्रों में छोटी मछलियाँ (165-190 मि मी) प्रमुख थी । सयनिड्स में ओटोलिथस क्यूवीरी, ओ. रुबर, जानियस ग्लाकस, जे. माक्रोरिनस और जे. डुसुमेरी भी थी । बंबई क्षेत्र की पकड का 43-49% क्रस्टेशियाई थे । नॉन-पेनिआइड में प्रमुख रूप से ऐसीटीस जाति (80%) शामिल थी । पेनिआइड में पैरापेनिओप्सिस स्टाईलिफेरा (50%), मेटापेनियस ब्रेविकार्निस (26%), पी. स्कलप्टिलिस 11% और पी. हार्डविक्की (1%) शामिल थी ।

कारवार, मंगलूर, माल्प और कोचीन में कोष संपाशक मात्स्यिकी पर अन्वेषण किए गए। कोष संपाशक मात्स्यिकी में बांगडा, तारली, लधु तारली, ट्यूना कैरंजिड, वाइट-बेट और पॉम्फ्रेट का योगदान था। कारवार (84.6%) मॉंगलूर में (50.5%) और माल्प में (64.5%) के साथ बांगडा प्रमुख था। तारली की उपस्थिति कोचीन में 54·3%, कारवार में 14·9%, मॉंगलूर में 26 2% और माल्प में 16·5% थी। ट्यूनाओं का योगदान मॉंगलुर में 8·9%, माल्प में 3·8%, कारवार में 0 44% और कोचीन में 0·34% था। कर्नाटक तटों के प्रति एकक के परिचालन की वार्षिक आय 7 लाख रु आंकलित किया। निवेश का मूल्य ह्रास और ब्याज को मिलाकर और वास्तविक लाभ 70,000/रु को छोडकर कुल व्यय 6·3 लाख रु था। कोचीन के मात्स्यिकी बंदरगाह के प्रति एकक की औसत वार्षिक आय 5 लाख रु· थी। कुल व्यय 4 लाख रु था और लाभ एक लाख रूपये।

लक्षद्वीप में ट्यूना पकड मुख्य रूप से कास्टूओमस पेलामिस के 99% का स्थलन पोल एंड लाइन द्वारा हुआ। शेष की पकड ट्रोल लाइन द्वारा थी। मिनिकोय में पोल एंड लाइन द्वारा पकड 10% अधिक हो गई लेकिन अगत्ती में घटती हो गयी। अनुमान किया जाता है कि यहाँ की घटती स्थानीय सामाजिक विकास और पर्याप्त मात्रा में ट्यूना बेट की अनुपलब्धि के कारण है। एफ ओर आर वी सागर संपदा के अन्वेषणात्मक सर्वेक्षणों द्वारा पकडी रूढी और अरूढी बेट मछलियों का वितरण-नमूना और विभिन्न स्थानों में उनकी प्रचुरता जानने केलिए उनका विश्लेषण किया गया।

टैगन परीक्षणों में टैगन किये 101 पक्वित प्रशंखों को पाक उपसागर में, 115 प्रशंखों को टूटिकोरिन के हार्बर बेसिन में और 65 प्रशंखों को टूटिकोरिन के पुलिपूंडर पार के खुले सागर में छोड दिये। छोड देने के 9 महीनों के बाद दो प्रशंखों को टूटिकोरिन के हार्बर बेसिन से वापस मिला। इनके पेरिओस्ट्राकम के साथ टैग भी बढ़ गया था और लंबाई में 2·5 मि मी और भार में 5 ग्रा की वृद्धि भी नोट कर ली।

तलमज्जी मात्स्यिकी प्रभाग

कई केन्द्रों में छोटे और बडे ट्रालरों द्वारा संग्रहित प्रमुख संपदाओं का मॉनीटरन किया। अनुमान है कि 17,65,000 छोटे यंत्रीकृत ट्रालरों का परिचालन किया और 433 कि ग्रा सी पी यू ई के साथ 7,63,000 टन तलमज्जी संपदा का स्थलन हुआ। यह योगदान सभी गिअरों द्वारा संग्रहित कुल स्थलन का 34% (2,220,000 टन) था। पकड में प्रमुख झींगे थे (1,27,000 टन) इसके नीचे पर्वस (85,000 टन), स्टोमाटोपोड (68,000 टन) क्रोकेर्स (64,000 टन) शीर्षपाद (49 000 टन), मुल्लन (40,000 टन) ऐंचोवी (38,000 टन), कैरंजिड्स (36,000 टन), सोल्स (25,000 टन), उपास्थिमीन (21,000 टन), शिगटी (14,000 टन) और अन्य आये थे।

झींगों में 1,06,000 टन (76%) पेनिआइड और 21,000 टन (24%) नॉन-पेनिआइड शामिल थे। बंबई में 363 मि मी लंबाई और 440 ग्रा भार वाला पेनिअस मोनोडोन प्राप्त हुआ। रिपोर्टों के अनुसार बडाई में यह इस जाति के सब से बडा रिकोर्ड है। बंबई में भी पैरापेनिओप्सिस स्टाइलिफेरा की उच्च पकड अंकित की। अन्य केन्द्रों की प्रमुख झींगा जातियां पी. स्टाइलिफेरा, मेटापेनिअस मोनोसिरस, एम. डोबसोनी (केरल) पी. सेमीसुल्केटस, एम. स्ट्रिडुलन्स (मंडपम), एम. डोबसोनी, पी. मैकिसल्लिपेडो और ट्रकीपेनिअस (विशाखपट्टणम) थीं। बंबई और वेरावल में महाचिगट पैन्यूलिरस पोलिफैगस प्रमुख थे और मद्रास में थेनस ओरिएन्टेलिस भी। बंबई से स्थलन किए गए पी. स्टाइलिफेरा, एम. एफिनिस, एम. मोनोसिरस की वृद्धि प्राचल अंकित किया। सभी केन्द्रों में सूत्ररश्म क्रीम नेमिटेरस

जापोनिकस प्रमुख था। बंबई से स्थलन की गई इस जाति के मृत्युदर और जनसंख्या प्राचल आकलित किया। सयनिड मात्स्यिकी के लिए ओटोलिथस क्युवीरी, ओ. रुबर, जोनिअस ग्लाकस, जे. डुसुमेरी और जीनियोप्स सिना का योगदान प्रमुख था। काकिनाडा की मिश्रित मात्स्यिकी के निर्धारण (सभी जातियाँ) से यह दिखाया पडा कि सभी जातियों की अधिकतम वहनीय प्राप्ति वर्तमान प्रयास को 10.5% बढ़ाने से अर्जित की जा सकती है। फिर भी, वित्तीय आय की वृद्धि सिर्फ 0.05% होने के कारण यह लाभकारी न हो जाएगा। अतः वर्तमान प्रयास ही जारी रखना अच्छा है।

एफ एस आइ के बडे ट्रालरों द्वारा मुख्य रूप से शिंगटियों और नेमीटेरिड्स का स्थलन हुआ। विशाखपट्टणम के सेंड हेड में परिचालित बडे ट्रालरों ने प्रमुख रूप से झींगों का स्थलन किया। एम. मोनोसिरस, एम. एन्सिस और एम. एफिनिस प्रमुख जातियाँ थी। आलप्पी, कोयलोन, वाड्ज बैंक और मान्नार खाडी के दक्षिण-पश्चिम तटों में अप्रैल-मई, 89 के दौरान गभीर सागर महाचिंगटों के लिए मत्स्यन कार्य किया गया।

हूक एंड लाइन द्वारा विशाखपट्टणम और बंबई से मुख्यतः शिंगटियों का स्थलन, टूटिकोरिन से पर्चस, सीर फिश, उपास्थिमीन और ट्यूना, विषिजम से शीर्षपाद और कोचीन से पर्चस का स्थलन हुआ।

एफ ओ आर वी सागर संपदा ने पूर्वी तट के 43 स्थानों में सर्वेक्षण किया। तलीय ट्रॉल वेलापवर्ती ट्रॉलों से अधिक प्रभावकारी दिखाया पडा और 780 कि ग्रा सी.पी.एच. के साथ 29·83 टन का स्थलन भी हुआ। डेकाटीरस जाति, पी. इंडिकस और टी. थैलेसिनस का मुख्य उत्पादन क्षेत्र 19-85/2 बी (62 मी. गहराई) था और पी. इंडिकस का 19-85/3 बी (65 मी) था। आंदमान निकोबार द्वीपसमूह में तलीय ट्रॉल द्वारा 112·18 कि ग्रा के सी. पी. एच. के साथ 1,411 कि ग्रा की प्राप्ति हुई। मुरा, रे, पर्चस और कैरेजिड्स प्रमुख वर्ग थे। 10-91/3 एफ, 10-92/3 ई, 11-92/1 सी ई, 12-92/4 सी और 12-92/4 ए क्षेत्रों में 200-1000 मी के गहराई रेंज में ईल के लेप्टोसिफैली प्रचुर मात्रा में दिखाए पडे जिससे ईल के लिए एक नर्सरी क्षेत्र की संभाव्यता व्यक्त होती है। 16-80/1 सी क्षेत्र से कुल 396.9 कि ग्रा क्रस्टेशियनों को पकडा।

विषिजम की कृत्रिम भित्तियों के चारों ओर बडी मात्रा में कटलफिशों को अंडजनन की स्थिति में देखा गया। बडी मात्रा में अंड पुंजों की उपस्थिति से व्यक्त हुआ कि कट्टलफिश अंडजनन के लिए यहाँ एकत्र करते हैं। यहाँ की मछलियों में कैरंजिड, पर्चस और नेमीटेरिड्स शामिल थी। वलियतुरा के बदर हुड सोसाइटी द्वारा संस्थान के वैज्ञानिकों के तकनीकी मार्गनिर्देशन से एक नयी कृत्रिम भित्ति का निर्माण किया। टूटिकोरिन के मुख्य बंदरगाह में 23 कार टयरों से कृत्रिम भित्तियों के 3 भिन्न नमूना तैयार किये। तीसरे महीने में इन कृत्रिम भित्तियों में मछलियाँ निवास करने लगी। मिनिकोय की कृत्रिम भित्ति मानसून के बाद अविकल रह गयी और अगस्त के अंत में भित्ति में अलंकृत मछलियों का पुनर्निवेशन हुआ। छोटी मुक्ता शुक्तियों और प्रवालों को भी देखा गया।

मद्रास और मडपम में पालमीन और वोई के मोनो और पोलीकलचर जारी रखे। मछली संवर्धन तालों की मिट्टी और जल प्रबंध पर किए गए अध्ययनों द्वारा देखा गया कि संस्तर का स्तर कम करने से जल की गहराई संभालकर रख सकी और निस्यंदन कम कर सका। समुद्र तट से दूर स्थित फेज़ोमीटर में भौम जल का तल बहुत कम था।

क्रस्टेशिया मात्स्यिकी प्रभाग

विभिन्न केन्द्रों में परिचालित भिन्न प्रकार के देशज गिअरों द्वारा 1,070 टन झींगों का स्थलन हुआ। कालिकट और कोचीन में परिचालित स्टेक नेट द्वारा क्रमशः 513 और 185 टन का

स्थलन हुआ। पकड में मेटापेनिअस डोबसोनी प्रमुख था और इसके नीचे एम. मोनोसिरस, पेनिअस इंडिकस और एम. एफिनिस आये थे। फोर्टकोचिन और अबंलपुषा केन्द्रों के वलय संपाशकों द्वारा 147 टन का स्थलन हुआ। फोर्ट-कोचिन में पी. इंडिकस प्रमुख था और अबंलपुषा में पी. स्टाइलिफेरा और एम. डोबसोनी का योगदान भी हुआ। मंडपम और वेंटाकोटा में गिलनेट द्वारा क्रमश: 83 टन और 8 टन का स्थलन हुआ। लेकिन चिल्का झील में परिचालित बॉस पाशक द्वारा 68 टन का स्थलन हुआ। विषिंजम में, तल में परिचालित गिल नेट द्वारा 83 टन का स्थलन हुआ। उल्लाल में "मटाबला" और पुतुवैपीन में अन्य देशज गिअरों (मिनि ट्राल, गिल नेट और कास्ट नेट) द्वारा क्रमश: 36 और 20 टन के स्थलन अंकित किए। कालिकट, बेंगेर और ट्रिप्लिकेन में स्टेक नेट के अलावा अन्य देशज गिअरों द्वारा हुए स्थलन क्रमश: 2, 6 और 2 टन थे। विषिंजम में पाशक द्वारा 39 टन महाचिंगटों का स्थलन हुआ। जिसमें पूरी तरह पैन्युलिरस होमारस थे। मंडपम में गिल नेट द्वारा मात्स्यिकी में 2 टन पी. आर्नेटस और पी. होमारस का योगदान हुआ।

समुद्री झींगा बीज, पी. सेमीसुल्कैटस के हैचरी उत्पादन में वाइल्ड और कैप्टीव ब्रूड स्टॉक से संग्रहित अंडजनकों से बीज का उत्पादन किया। स्फुटन दर 22.6 से 95.0% तक बदलता रहता है। 12 फुट व्यास के कुंड में संग्रहित 2,02,800 नौप्लियों से लगभग 22,500 पश्चडिंभकों को प्राप्त किया। एन-पी एल का अतिजीविता दर 34.7% था। अक्तूबर-दिसंबर में, कवक (फंगस) लेजीनिडियम जाति द्वारा प्रोटोज़ोआ के संक्रमण के कारण डिंभकों की मृत्यु दिखायी पडी। एक-पार्श्विक नेत्र-वृन्त अपक्षरण द्वारा और अपक्षरण के बिना पी.सेमीसुल्कैटस का बंद्ध स्थिति में प्रथम बार पुन: परिपक्वन किया।

सी एम एफ आर आइ द्वारा विकसित तकनो-लजी के प्रयोग से केरल सरकार के "मत्स्यफेड" ने कण्णूर के मोप्ला उपसागर में एक झींगा स्फुटन-शाला की स्थापना की। प्रतिमाह पी. इंडिकस के 10 लाख बीजों के उत्पादन केलिए स्फुटनशाला का रूपांकन किया है। बाद में "मत्स्यफेड" के कर्मचारियों को बीज उत्पादन और स्फुटनशाला प्रबंध के तकनीकों के बारे में प्रशिक्षण दिया गया। भीतर और बाहर के नर्सरी टैंकों में उत्पादित पी. सेमिसुल्कैटस के 7,70,556 डिंभकों को मंडपम के पिल्लैमडम लैगून में छोड दिया। स्फुटनशाला में उत्पादित पी. सेमिसुलकैटस की वृद्धि का नमूना, मृत्यु दर एवं अतिजीविता दर का अध्ययन किया गया। डिंभकों को संपूरक खाद्य से खिलाया। लवणीयता और ताप में हुई तुरंत वृद्धि के कारण झींगों में मंद वृद्धि दिखाई पडी।

टूटिकोरिन में पी. इंडिकस और पी. मोनो-डोन का खेती संवर्द्धन किया गया और मंडपम में पी. सेमिसुल्कैटस का भी। पी. होमारस के जनन चक्र पर एकपार्श्विक नेत्र अपक्षरण के प्रभाव का अध्ययन करने के परीक्षणों से यह देखा गया कि अपक्षरण की गई स्त्री जातियों में अंडवाही सीटे उत्पन्न हुए। पी. होमारस के किशोरों में महाचिंगट के वसापिंडक के सारसत्त का इंजेक्शन करने पर उनके निर्मोचनों की अवधि 32दिनों तक कम हो गयी।

मोलस्क मात्स्यिकी प्रभाग

मांगलूर में मुलकी ज्वारनदमुखी के बार माउथ में मेरेट्रिक्स कास्टा का नया संस्तर दिखाया पडा। यहाँ का संग्रहण 1,846% मी^{2} की औसत सघनता के साथ 50 टन आकलित किया। इसके अतिरिक्त, अष्टमुडी झील में कैटेलाइसिया ओपिमा के स्टॉक में घटती हुई और भत्स्यन करने योग्य मात्रा में ये उपलब्ध नहीं थे। इसका कारण संपदा का अधिक समुपयोजन होगा। इस क्षेत्र से निर्यात करने योग्य जाति पैफिआ मालाबारिका थी। मुरुक्कुमपाडम-मुनम्बम क्षेत्र में प्रमुख सीपी

सनेटा स्क्रिप्टा की अच्छी मात्स्यिकी हुई । इस सीपी के निकाले गए कवच को प्रति टन 190-200रु प्राप्त हुआ । हरित शंबु की मात्स्यिकी मुख्य रूप से कालिकट-टेल्लिचेरी तटों से हुई और यहाँ से 2,985 टन का आकलित मत्स्य हुआ ।

तकनोलजी का भारतीय संस्थान के सहयोग से मुक्ता संवर्द्धन के लिए उपयुक्त शुक्ति मणिका न्यूक्ली के उत्पादन के लिए एम. कास्टा, ट्रोक्सा नीलोटिकस ट्राइडेक्ना जाति और जैक्स पाइरम की सूक्ष्म कठोरता का अध्ययन किया गया। ट्राइडेक्ना जाति की सूक्ष्म कठोरा अनरीकी नाइगर के समान थी और एक्स. पाइरम की सूक्ष्म कठोरता अधिकतम थी । न्यूक्लियस रोपण पर किए गए अध्ययनों से व्यक्त हो गया कि हिंज भाग से लिए गए ग्राफ्ट की अपेक्षा मार्जिनल मैंटल से लिए गए ग्राफ्ट द्वारा अच्छे गुण वाले मुक्ताओं की प्राप्ति हुई ।

टूटिकोरिन की हैचरी प्रयोगशाला में पी. मालाबारिका का अंडजनन किया गया और डिभकों का पालन 27-28°C में किया । बीज की वृद्धि के लिए 15-28% का लवणीयता रेंच अनुकूल रह गया । प्रयोगशाला में खाद्य शुक्ति और मुक्ता शुक्ति के बीजों का उत्पादन भी किया गया । पी. फ्यूकेटा की पाँचवीं पीढ़ी को प्रयोगशाला में सफल रूप से उठाया गया । खाद्य और मुक्ता शुक्ति के बीज गुजरात मात्स्यिकी विभाग को भेज दिए । खाद्य शुक्ति के छिल्का उतारे गए मांस एकीकृत मात्स्यिकी परियोजना, कोचीन को भेज दिए गए । मद्रास में पी. विरिडिस के प्रेरित अंडजनन, टूटिकोरिन में सीपियोट्यूथिस लेस्सोनियाना और सीपीया फारोनिस के और मंडपम में एक्स. पाइरम के स्फुटन और पालन पर अध्ययन जारी रखा ।

मात्स्यिकी पर्यावरण प्रबंध प्रभाग

कोचीन के पोर्टमाउथ और 30 मी गहराई के बीच के निकट तट क्षेत्र के ताप, लवणीयता और विलीन ऑक्सीजन का मानीटरन किया । बहिस्तल और निम्नभाग का ताप जनवरी-अप्रैल महीनों के दौरान 28°C से 30°C तक बढ़ गया मई से लेकर बहिस्तल में यह 26°C से कम हो गया और अगस्त के दौरान निम्न भाग के स्तर में यह 21°C से कुछ अधिक हो गया । सितंबर के दौरान ताप अधिक होकर 28°C तक अभिलिखित किया और दिसंबर, 89 से मार्च 90 तक यह 29°C हो गया । बहिस्तल जल की लवणीयता में मौसमी परिवर्तन दिखाए पड़े और मानसून महीनों में माप 20 पीपीटी से कम हो गया । निम्न स्तर की लवणीयता 30 पीपीटी से कम थी । विलीन आक्सीजन का अंश बहिस्तल जल में पूरे वर्ष में उच्च रह गया और निम्न जल में मई-अक्तूबर के दौरान यह । मिलि / लि से कम हो गया । क्लोरोफिल ए का अधिकतम उत्पादन मानसुन के समय में था और इसके बाद मानसुनोत्तर और पुर्वमानसून महीने आते हैं । इस वर्ष में प्राथमिक उत्पादन का चक्रीय आवर्तन पिछले कुछ वर्षों की अपेक्षा साधारण दिखाई पड़ा ।

बोंगो नेट द्वारा संग्रहित प्राणिप्लवक के नमूनों के विश्लेषण से अक्तूबर के दौरान 30 मी की गहराई में उच्चतम माहिक मीन डिस्प्लेस्मेन्ट वोल्यम (211.0 मिलि / 100 मी^{3}) दिखाया पड़ा । अगस्त-अक्तूबर के दौरान संग्रहण में अरित्रपाद (कॉपिपोड), शाखाश्रृंगिक (क्लाडोसिरस), कीटोग्नैथ, ल्युसीफर, साइफोनोफोर, युफाजिड्स, उभयपाद (ऐम्फिपोड), ऑस्ट्रैकोड्स, माइसिड्स, डोलियोलिड्स, नेट्रोपोड्स, मछली डिंभक, पॉलीकीट्स और मोलस्क अधिक थे।

किल्लै, वल्लापट्टणम, धर्मडम और माही के ज्वारनदमुखियों में अध्ययन गठित किए । किल्लै ज्वारनदमुखी में, जून-सितंबर के दौरान समुद्र से अत्यधिक समीपस्थ होने और अलवणीय जल का वितरण कम होने के कारण उच्च लवणीयता हुई थी । सभी ज्वारनदमुखियों में डी ओ 2, पी एच और ई एच साधारण रेंच के अंदर थे । फरवरी'

1989 के दौरान सभी ज्वारनदमुखियों में उच्चतम लवणीयता अंकित की । बहिस्तल के नमूनों में सिलिकेट और नाइट्रेट का माप उच्चतम था और निम्न स्तरों में फोस्फेट । लेकिन बहिस्तल और निम्न नमूनों में नाइट्राइट के अंश बहुत कम थे । वल्लापट्टणम को छोडकर सभी ज्वारनदमुखियों के प्राणिप्लवक के संग्रहण में अरित्रपाद (कोपिपोड) प्रमुख थे बल्कि वल्लापट्टणम में वेलापवर्ती जठरपाद अधिक प्रमुख थे । किल्ले के पश्चिम परिसर और धर्मडम के पूर्वी क्षेत्र की ज्वारनदमुखी अधिक उत्पादन योग्य और जलकृषि के लिए अनुयोज्य दिखाई पडी ।

मत्स्यन द्वारा और स्थलन केन्द्रों से संग्रहित फिनफिश, कवचप्राणी और मोलस्क को, पाँच धातू के लिए विश्लेषित किया गया । द्विकपाटी (बाइवाल्व) और कर्कटों में झींगों और फिनफिशों की अपेक्षा धातू स्तर उच्चतम अंकित किया । फिर भी स्तर निश्चित सीमा के अंदर थे । कैडमियम, निकैल, क्रोमियम, लैड और मर्करी थोडी सांद्रता में उपस्थित होने पर भी वे प्राणिप्लवक के प्राथमिक उत्पादन के निरोधक थे । मर्करी अधिक विषैला और निकैल कम विषला था ।

केरल तट की समुद्री शैवाल संपदाओं का मानीटरन किया गया । कुल 28 जातियों में 12 हरे 9 भूरे और 17 लाल शैवाल देखे गये । दक्षिण क्षेत्र में कुल समुद्री शैवाल जीवमात्रा अधिक थी इसके बाद उत्तर और मध्य क्षेत्र आते हैं । मध्य क्षेत्र में भूरा शैवाल पूर्ण रूप से अनुपस्थित थे । उत्तर क्षेत्र में और दक्षिण क्षेत्र में पॉरफाइरा कन्याकुमारिएन्सिस और उत्तर क्षेत्र में स्पान्गोमोरफा इंडिका इस वर्ष अंकित की गई दो नई जातियाँ थी । पाक उपसागर की एक मीटर की गहराई में की गई ग्रेसिलेरिया इडुलिस की प्रयोगात्मक क्षेत्र कृषि से प्रोत्साहक प्राप्ति न मिली । प्रयोगशाला से निकाले गए जी. इडुलिस के बीजाणुओं को निकालने के 2 दिन के बाद मान्नार खाडी में प्रतिरोपित किया । 2 महीनों के अंतर्गत ये 30-50 मिमी लंबाई तक बढ़ गए । इस वर्ष में मिनिकोय द्वीपों में समुद्री शैवाल संवर्द्धन कार्य आरंभ किए । सजीव बीज सामग्रियों को मंडपम से मिनिकोय तक ले जाकर कृषि के स्थानों में कोयर रोप जालों में लगाया । बीजों की अच्छी वृद्धि दिखाई पडी । कवरत्ती से जी. इडुलिस के बीजों का संग्रहण करके प्रयोगशाला के टैंकों में उनका संग्रहण आरंभ किया । संवर्द्धन के 10 और 20 दिन के बाद उनका भार 185 और 190 ग्रा तक बढ़ गया ।

एफ ओ आर वी सागर संपदा द्वारा समुद्र-विज्ञानीय और मौसमवैज्ञानिक आंकडों का संग्रहण और विश्लेषण किया । अध्ययन से यह देखा गया कि ताप प्रवणता की गहराई और तीव्रता प्रतिलोम रूप से प्राणिप्लवक जीवमात्रा पर संबंधित है। कोयलोन वाड्ज बैंक और मान्नार खाडी के अध्ययनों द्वारा व्यक्त हो गया कि मछलियों (बैराकुडा और नेमीटेरिड्स) की शरीरक्रियात्मक स्थिति जल की लवणीयता की अपेक्षा अधस्तल और निम्न जल के ताप के आधार से प्रभावित होती है। नेमीटेरिड्स कोयलोन-वाड्ज बैंक के ठंडा उत्प्रवाही जल पसंद करते हैं और बैराकुडा मान्नार खाडी का उत्प्रवाहहीन व विक्षुब्ध जल पसंद करते हैं ।

दैहिकी, पोषण और रोग विज्ञान प्रभाग

परियोजनाओं में मुख्यत: मछलियों और कवचप्राणियों के जनन, मछलियों और कवचप्राणियों के लिए मिश्रित खाद्य का खेत में परीक्षण, विकास और इसका मूल्यांकन, प्राणियों के शारीरिक-रोग-विज्ञान स्थितियों पर पारिस्थितिक प्रदूषण के प्रभाव और भारतीय बांगडा की जनसंख्या आनुवंशिकी सम्मिलित हैं ।

परिपक्व होने वाले और परिपक्व लिज़ा पारसिया के पियूष के ऊतक - रासायनिक परीक्षणों से व्यक्त हो गया कि परिपक्व मछलियों में ग्लाइकोप्रोटीन अधिक था । एम. सिफैलस के

शुक्राणुओं के क्रयोप्रिसर्वेशन और संग्रहण और जीवनक्षमता में इसके प्रभाव का अध्ययन किया गया। निम्न ताप में शुक्राणुओं के परिरक्षण करने केलिए उपयुक्त विभिन्न रासायनिक द्रव्यों में, 10% डाइमेथिल सल्फोक्साइड (डी एम एस ओ) अधिक अनुयोज्य दिखाया पडा। एल्सेवर विलयन और बफर बी और सी के साथ डी एम एस ओ का मिश्रण प्रभावकारी देखा गया जिसमें, परिरक्षण के 24 घंटों बाद 50% शुक्राणु क्रियाशील थे। संग्रहित शुक्रीय तरल (30 दिन) के जेल इलक्ट्रो-फोरेटिक अध्ययन से तीन प्रोटीन घटकों को दिखाया पडा।

लवणीयता के प्रति एल. माक्रोलेपिस की सहन सीमा का अध्ययन, लवणीयता मीडिया से 7 रेंजों (35-65%) में मछली को परिचित करके किया गया। एल सी 50 मूल्य 55-60% के बीच में दिखाया पडा। 60 दिनों के लिए इन लवणीयता रेंजों में रखी गई मछलियों में प्रोटीन और भस्म का अंश साधारण था लेकिन लवणीयता अधिक होने पर लिपिड अंश भी अधिक देखा गया। इससे यह दिखाया गया कि जल की कमी और लिपिड अंश की बढ़ती के कारण मछली उच्च लवणीयता अपनाती है।

टूटिकोरिन के तेर्मल पवर प्लैंटों से छोड देनेवाले बहि.स्राव (फ्लाई ऐश) निकटतम जल के वनस्पति जात और प्राणी जातों पर प्रतिकूल प्रभाव डालते है। तेर्मल प्लैंट के पास जमा किए गए ऐश की गहराई 75–100 से मी है, उप सागर के पास आते आते यह 10 से मी तक क्रमिक रूप से कम हो जाती है।

रासायनिक प्रदूषकों के अध्ययनों से यह दिखाया गया कि एल. पारसिया और टाइलैपिया मोसाम्बिका के आर. बी. सी. एस पर लेड नाइट्रेट का रूधिरलयी (हीमोलिटिक) प्रभाव पडा है। हिस्टोलोजिक्कल अध्ययनों द्वारा वृक्क और यकृतीय कोशिका और मस्तिष्क के ग्लायोसिस में, अपहासात्मक परिवर्तन व्यक्त हो गया। डी. डी. टी का प्रयोग किए गए मछलियों में मस्तिष्क में डीमाइलिनेशन, गिल एपिथेलियल सेल का गंभीर ऊतकक्षय और अपशल्कन और जिगर में रसधानी-भवन दिखाए पडे।

टी. मोसाम्बिका में, एरोमोनस साल्मोनिसिडा और स्यूडोमोनस जाति के संक्रमण द्वारा सेप्टी-सीमिक रोग पहचान गया। विब्रियो डामसेला और वी. एलिगनोलिटिकस को पी. इन्डिकस और पी मोनोडोन से वियुक्त किए गए।

वाणिज्य मछली और झींगा खाद्य उद्योग की स्थिति के निर्धारण करने के लिए गठित सर्वेक्षण से यह दिखाया पडा कि भारत में 12 कंपनियों में वाणिज्य रूप से खाद्य उत्पादन की सुविधाएं हैं। एक कंपनी में औषधयुक्त खाद्य निर्माण की तकनो-लजी है। अधिकांश किसानों द्वारा खाद्य की उपलब्धि में कठिनाई प्रकट करने पर उत्पादकों ने, बाज़ार में मांग की कमी, गुणयुक्त समुद्री प्रोटीन संपदाओं, विटामिन और खनिज पदार्थों की अनुपलब्धि के बारे में शिकायत की। झींगा खाद्य में उपयुक्त करने वाले कच्चा माल के किस्म और गुण और खाद्य में पोषक की मात्रा के संतुलन के बारे में झींगा किसानों को मुफ्त परामर्श सेवा की वादा दी गई।

विल्लोरिटा सैंप्रिनोइड्स और लेट्रस कैल्केरिफा में द्विगुणित क्रोमसोम की संख्या क्रमशः 38 और 48 थी। थेरापोन जाति और एल. पारसिया में प्रथम बार सिस्टर क्रोमसोम का आदान-प्रदान सफल रूप से स्पष्ट हुआ। उत्परिवर्तजनी परीक्षणों से यह दिखाया पडा कि एल. पारसिया में मैलथायान ने क्रोमसोम भंजन के लिए प्रेरित किया है। बांगडा के लैक्टेट डीहाइड्रोजेनेस और आइसोसाइट्रिक डीहाइड्रोजेनेस एनज़ाइम का विद्युतकण-संचलन स्वरूप कोचिन से लिए गए 70 नमूनों और मद्रास के 10 नमूनों में समान था।

मात्स्यिकी अर्थशास्त्र और विस्तार प्रभाग

गांवों में विस्तार शिक्षा–एफ ई व ई/22 पर अनुसंधान

तटीय गांवों का एक सर्वेक्षण किया गया और एलंकुन्नपुषा पंचायत के पुतुवैप्पु गाँव को परियोजना क्षेत्र के रूप में चुन लिया। किसानों और पंचायत बोर्ड के सदस्यों के साथ चर्चा की गई और परियोजना क्षेत्र में झींगा संवर्द्धन स्वीकार करने के लिए स्थानीय खाद्यों का अन्वेषण किया गया। आगत पूर्ति से संबंधित एजेन्सियों से संपर्क करके सूचना प्राप्त की।

प्रथम स्तर विस्तार कार्यक्रम-एफ ई व ई 19 पर अनुसंधान

कंडक्कडवु में झींगा कृषि के लिए वासभूमि के जल की उपयोगिता को प्रोत्साहन देने केलिए एक कार्यक्रम आयोजित किया। झींगा संवर्द्धन के प्रदर्शन केलिए 320 स्क्वायर मी. का जलक्षेत्र चुन लिया और पेनिअस इंडिकस के 1990 बीजों का संग्रहण किया। 90 दिन बाद 7 ग्रा (औसत) के 4-5 कि ग्रा की प्राप्ति हुई। परियोजना क्षेत्र में क्षेत्र दिवस और जन संपर्क कार्यक्रम भी आयोजित किए थे। झींगा बीज संग्रहण और मछली संसाधन में प्रशिक्षण कार्यक्रम भी आयोजित किया।

पुस्तकालय व प्रलेखन अनुभाग

वर्ष के दौरान मुख्यालय के पुस्तकालय और क्षेत्रीय और अनुसंधान केन्द्रों के लिए पुस्तकों पत्रिकाओं और पुस्तकेतर सामग्रियों का प्रापण किया गया।

निम्नलिखित प्रकाशनों की जारी की गई :

1.	इंडियन जर्नल ऑफ फिशरीस	खंड 35 (सं 1,2 व 3)
		खंड 36 (सं.-1)
2.	बुल्लटिन	सं 43,44 (भाग-1 व 11)
3.	स्पेशल पब्लिकेशन	सं 45, 46 और 47
4.	समुद्री मात्स्यिकी सूचना सेवा	सं 91–98
5.	न्यूज़लेटर	सं 40-44
6.	(क) अनुसंधान मुख्य अंश	1987-88 (अंग्रेजी और हिन्दी)
	(ख) अनुसंधान मुख्य अंश	1988 (अंग्रेजी)

7. निम्नलिखित स्थापनाओं के कार्यकलापों और उपलब्धियों की विवरणिकाएं

   i. क्षेत्रीय केन्द्र, मंडपम कैंप

   ii. अनुसंधान केन्द्र, कालिकट

   iii. अनुसंधान केन्द्र, विषिजम

   iv. के वी के, नारक्कल

   v. एफ ओ आर वी सागर संपदा

8. बेश-द-मेर पर पुस्तिका (तमिल में)

9. बेश-द-मेर पर राष्ट्रीय कार्यशाला के सार

10. टुटिकोरिन-तिरुचेन्दूर तट की समुद्री शैवाल संपदा पर रिपोर्ट

11. सी एम एफ आर आइ वार्षिक रिपोर्ट 1988

समुद्री संवर्द्धन में स्नातकोत्तर शिक्षा और अनुसंधान कार्यक्रम

तीन वरिष्ठ शोध विद्यार्थियों को शास्त्र एवं तकनोलजी का कोचीन विश्वविद्यालय द्वारा पी.एच.डी की उपाधि प्रदान की और छः विद्यार्थियों ने भी पी. एच. डी. की उपाधि के लिए शास्त्र एवं तकनोलजी का कोचीन विश्व-विद्यालय को अपने थिसीस प्रस्तुत किए हैं। एम. एस. सी के सातवां और आठवां सत्रों के छात्रों के परीक्षा परीणाम घोषित किए गए। सातवां सत्र के दो विद्यार्थियों और आठवां सत्र का एक विद्यार्थी ने विश्वविद्यालय परीक्षा में उत्कृष्ट योग्यता प्राप्त की। नवां और दसवां सत्रों के छात्र पढाई में अच्छी तरह आगे बढ रहे हैं।

कृषि विज्ञान केंद्र और प्रशिक्षकों का प्रशिक्षण केंद्र

के वी के के अधीन के पाठ्यक्रमों में, फसल उत्पादन, जीवंत स्टॉक उत्पादन, मात्स्यिकी, गृह विज्ञान और समाजिक वन विज्ञान शामिल थे। सभी विषयों में 90 कोर्स आयोजित किए और 1355 लोगों (342 पुरुष और 1013 स्त्रियां) को प्रशिक्षण दिया। किसानों के लाभ के लिए विशेष प्रदर्शन, फिल्म, रेडियो भाषण और दूरदर्शन कार्यक्रम भी आयोजित किए गए। टी.टी.सी. के अधीन भागीदारों को झींगा कृषि पर प्रशिक्षण, पोस्ट हार्वेस्ट तकनोलजी, झींगा बीजों का स्फुटनशाला में उत्पादन और स्कूबा निमज्जन में प्रशिक्षण दिया गया।

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Centre-wise list of Technical/Ministerial/Supporting and Auxiliary Staff as on 31st March 1990

(Not a gradation list)

CMFRI — Headquarters, Cochin

Technical Staff

T-7

Shri B. S. Ramachandradu — *Farm Engineer*
Shri P. R. Leopold — *Skipper*
Shri S. Natarajan — *Field Officer*
Shri P. K. Velayudhan — *Mate*
Shri G. Balakrishnan — *Field Officer*

T-6

Field Officers
Shri U. K. Satyavan
Shri Varughese Philippose
Shri V. Rajendran

T-5

Technical Officers
Shri K. Kanakasabapathy — *Library & Documentation*
Shri P. Raghavan — *Photography*
Shri K. C. Yohannan
Shri M. Ayyappan Pillai
Shri V. K. Balachandran
Shri K. N. Gopalakrishnan
Shri P. Karunakaran Nair
Shri Varughese Jacob
Shri G. Krishnankutty Nair
Shri P. Sivaraman
Ms. K. S. Leela Bhai
Ms. V. P. Annam
Shri E. Johnson — *Library & Documentation*
Shri B. Ramesh — *Bosun*

T-4

Sr. Technical Assistants
Shri P. M. Aboobaker
Shri R. Reghu
Shri A. A. Thankappan
Ms. Geetha Antony
Ms. C. Nalini
Shri K. L. K. Kesavan — *Sr. Artist*
Shri N. P. Kunhikrishnan
Shri V. Suresh

T.II.3

Technical Assistants
Shri K. Thulasidas
Shri Joseph Andrews
Ms. A. Kanagam
Shri A. Kanakkan
Shri S. Haja Najeemuddin
Shri C. J. Prasad
Shri A. Nandakumar
Ms. P. L. Ammini
Shri K. Balachandran

T.I.3

Shri V. A. Narayanan Kutty — *Tech. Asst.*
Ms. S. Girija Kumari — *Lib. Asst.*
Shri C. D. Davis — *Motor Driver*

T-2

Junior Technical Assistants
Shri M. P. Sivadasan
Shri K. Ramadoss Gandhi
Shri K. Chellappan
Ms. K. K. Valsala
Shri Mathew Joseph
Shri M. N. Kesavan Elayathu
Shri J. Narayanaswamy
Shri L. R. Khambadkar
Shri M. Abdul Nizar

Punch Card Operators
Shri K. P. George
Shri M. B. Seynudeen
Shri P. P. Pavithran
Ms. M. R. Beena
Ms. P. T. Mani

Shri M. Ramachandran
Shri K. Anandan
Ms. Latha Khambadkar
Jr. Library Assistants
Ms. P. Geetha
Ms. K. Ramani
Shri V. Mohan
Shri K. K. Sankaran — *Artist*
Shri K. Chacko — *Projector Operator*
Motor Drivers
Shri S. Yadavaiah
Shri K. J. Mathew
Shri M. N. Appukuttan Nair
Shri C. S. Xavier
Sr. Deckhands
Shri K. P. Vijayan
Shri T. R. Sreekumaran — *Oilman*
Shri P. D. Chidambaram — *Oilman-cum-Deckhand*
T-1
Field Assistants
Shri R. Anilkumar
Shri P. K. Baby
Ms. K. P. Salini
Shri K. M. Venugopalan
Shri K. Soloman
Shri K. G. Baby
Shri K. N. Pushkaran
Shri V. R. Arunachalam
Shri Thomas Kuruvilla
Shri K. C. Pradeep Kumar
Shri A. Y. Jacob
Ms. P. K. Seetha
Shri V. K. Suresh
Shri A. Udayakumar
Ms. T. N. Anandalakshmy
Shri G. Subharaman — *Punch Card Operator*
Ms. P. M. Geetha — *Museum Assistant*

Ministerial Staff

Shri P. James Abraham — *Sr. Adm. Officer*
Shri E. Athmanathan — *Adm. Officer*
Shri M. P. Lakshmanan — *Asst. Adm. Officer*
Shri T. V. Asari — *Sr. Finance & Acc. Officer*
Ms. P. J. Sheela — *Hindi Officer*
Superintendents
Shri S. Subramanian
Shri A. K. Balakrishna Pillai
Shri G. V. Padnekar
Shri R. Kuppuswamy
Shri V. Chemutty
Shri M. Selvadhas
Shri J. M. Vaz
Assistants
Shri M. Ramakrishnan
Shri M. J. John
Shri A. Narayanaswamy
Shri P. Ganeshan
Shri S. Abdulla
Shri K. L. K. Padmanabhan
Ms. T. K. Ponnamma
Shri M. Ganapathy
Shri K. Nagarajan
Shri P. J. Davis
Shri K. Arumugham
Shri M. Velu
Ms. M. A. Seetha — *Senior Stenographer*
Stenographers
Shri K. M. Surendran
Ms. D. Geetha
Shri C. Yohannan
Ms. A. K. Omana
Jr. Stenographers
Ms. N. Ambika
Ms. N. R. Letha Devi
Ms. K. V. Sajitha
Shri R. Chandrakesa Shenoy
Ms. K. J. Malathi Devi
Ms. N. Yesodha
Shri C. G. Thomas
Shri C. N. Chandrasekharan
Ms. Christina Joseph
Ms. V. K. Sobha
Sr. Clerks
Ms. T. Madhavi
Shri V. V. Lakshminarayanan
Ms. P. V. Mary
Shri V. P. Unnikrishnan
Ms. P. K. Sridevi

Ms. M. O. Leela
Shri V. Mohanan
Ms. K. Vijayalekshmi
Ms. K. C. Karthiayini
Shri A. P. Balakrishnan
Ms. M. Suseela
Shri N. Govindan
Shri M. K. Abdulla
Shri T. N. Padmanabha Kurup
Ms. K. C. Girija
Ms. Alice Valooran
Ms. M. M. Teresakutty

Jr. Clerks

Ms. K. Santha
Shri Thomas Joy
Ms. N. K. Suseela
Ms. G. Ambika
Shri K. J. Mathew
Shri P. M. Bhaskaran
Ms. N. S. Sarala
Shri V. Chandrasekharan
Ms. P. S. Sumathy
Ms. M. G. Chandramathy
Shri C. K. Sivadas
Ms. K. M. Annamma
Ms. A. Renjini
Shri M. Samuthiram
Shri K. Baburajan
Shri V. C. Antony
Ms. I. M. Baby Rajalakshmi
Ms. V. Parukutty
Ms. A. K. Kunjupennu
Shri. M. Balaraman
Shri K. Ramadasan
Ms. K. K. Kousallia
Shri Benny Mathew
Shri V. C. Subhash
Ms. V. Jayalakshmi
Shri M. J. Tomy Prince — *Telephones*
Shri K. Sadanandan
Ms. K. Balamani
Ms. N. G. Supriya
Ms. P. K. Mary

Supporting Staff

SSG - IV

Lab. Attendants

Shri P. A. Vasudevan
Shri K. P. Joseph
Shri P. A. Vasu — *Fieldman*
Shri T. A. John — *Khalasi*
Shri M. K. Peethambaran — *Fieldman*
Ms. N. Leela — *Daftry*

SSG - III

Shri A. Alagarsamy — *Lab. Attendant*
Shri K. S. Vaidyalingam — *Fieldman*
Shri M. L. Antony — *Lib. Attendant*

SSG - II

Peons

Shri A. P. Sebastian
Shri T. A. Vijayan
Shri N. T. Velappan

Watchmen

Shri B. Zainudheen
Shri E. F. Francis
Shri K. Ganesan
Shri C. Chandran
Shri G. Mithralal

Messengers

Ms. R. Devalakshmi
Shri T. Sreedharan
Shri A. Gopinathan
Shri K. Velayudhan — *Safaiwala*

SSG - I

Watchmen

Shri K. Velayudham
Shri G. Vijayan
Shri P. K .Achuthan
Shri K. T. Rajappan
Shri P. K. Suresh Babu
Shri E. J. James
Shri V. T. Ravi
Shri P. K. Ravindran

Messengers

Shri T. Vijayakumar
Shri M. P. Mohandas
Shri T. M. Abdul Aziz
Shri B. Prabhakaran

Shri D. Prakasan
Shri R. Ravindranathan Nair
Shri V. K. Kuttappan
Shri T. I. Soman
Shri H. C. Hezhakiel
Ms. Pennamma Joseph
Shri N. K. Harshan
Ms. R. M. Sarasamma
Shri S. Mohan — *Lift Operator*
Shri T. K. Antony — *Lift Operator*
Shri K. G. Radhakrishnan Nair — *Helper*
Shri V. Krishnan — *Messenger*
Shri P. V. Gopalan — *Messenger*
Shri V. H. Venu — *Binder*
Shri N. V. Thambi — *Lab. Attendant*
Ms. Sudha Devi — *Cane weaver*
Fieldmen
Shri T. P. Renil Kumar
Shri V. K. Aravindakshan
Safaiwala
Shri C. O. Viswambharan
Shri P. D. Karunakaran
Ms. K. K. Kalyani
Ms. B. Savithri
Shri N. P. Mohanan
Shri V. C. Gopi
Shri K. N. Balan
Shri B. Babu
Ms. A. Lata
Shri N. K. Shanmughan
Gardeners
Shri T. Lawrence
Shri K. C. Jayaprasad

Auxiliary Staff

Ms. E. K. Uma — *Sr. Hindi Translator*
Ms. E. Sasikala — *Hindi Translator*
Drivers for Light vehicles
Shri M. B. Xavier
Shri V. A. Surendran
Shri A. Rajan
Shri M. R. Bharathan — *Deckhand*
Shri M. Krishnan — *Sr. Binder*
Shri N. Ravindranathan Nair — *Sr. Gestetner Operator*

Chavakkadu Field Centre

Shri C. K. Krishnan — T - 4

Quilon Field Centre

Shri Babu Philip — T - 4
Shri S. B. Chandrangathan — T - 4

Alleppey Field Centre

Shri V. S. Gopal — T - 2

Mandapam Regional Centre

Technical Staff

T - 5
Shri C. Kasinathan — *Curator*
T - 4
Sr. Technical Assistants
Shri S. Kalimuthu
Shri M. Badrudeen
Shri P. Thankappan — *Foreman*
T.II.3
Technical Assistants
Dr. K. Muniyandi
Shri A. Ganapathy
Shri V. Edwin Joseph — *Lib. Asst.*
Shri T. K. Sudhakaran — *Bosun*
T.I.3
Technical Assistants
Shri J. R. Ramalingam
Shri M. Najmuddin
Shri M. R. Arputharaj
Shri A. Muniyandi — *Artist*
Shri Md. Jaffar — *Bosun*
Motor Drivers
Shri P. Krishnan
Shri O. Muthukaruppan
Shri R. Marimuthu — *Painter-cum-Polisher*
Shri S. Mohideen Meerasa — *Sr. Deckhand*
T - 2
Jr. Technical Assistants
Shri P. Thillairajan
Shri R. Subramanian
Shri M. Bose

Deckhands

Shri V. Vedanayagam

Shri Muniswamy

Shri M. Ibrahim

Shri T. P. Haridasan — *Carpenter*

Shri M. Reghu — *Cook* (Boat)

T-1

Shri N. Ramamurthy — *Museum Asst.*

Shri R. Sekhar — *Deckhand*

Shri A. Gandhi — *Field Asst.*

Shri V. Sethuraman — *Field Asst.*

Ministerial Staff

Shri A. Sethubhaskaran — *Asst. Adm. Officer*

Shri P. K. Sakkarai — *Superintendent*

Shri V. M. Mariappan — *Assistant*

Shri A. Kajendran — *Assistant*

Senior Clerks

Shri K. Margathavadivelu

Shri S. Nagarajan

Shri V. Chandran

Shri P. Selvaraj

Ms. N. Gomathy — *Jr. Stenographer*

Junior Clerks

Shri A. Yagappan

Shri N. Natarajan

Shri S. Muthumari

Shri S. Parisa

Ms. M. Rameshwari

Supporting Staff

SSG-IV

Lab. Attendants

Shri S. Mohamed Yousuff

Shri K. Muthuramalingam

Shri K. Gopalakrishnan

SSG-III

Lab. Attendants

Shri S. Kaliappan — *Khansama*

Shri M. Chinnasamy

Shri R. Vellayan

Shri S. Muthuramalingam

Shri M. Ibrahimsha

Shri A. Muniasamy

Fieldmen

Shri A. Raman

Shri A. Subramanian

Shri S. Mani

Shri R. Nagan

Shri S. S. Pitchai — *Daftry*

Shri R. Sonai — *Watchman*

Shri K. Muthiah — *Watchman*

Safaiwala

Shri R. Sevugan

Shri M. Muthu

Shri V. Sanathanan

Shri K. Kuruvan

SSG-II

Shri M. Athimoolam — *Cook*

Watchmen

Shri K. Muniasamy

Shri M. Govindaraj

Shri P. Karuppiah

Shri G. Saivadurai

Shri K. Vellayan

Shri P. Ramu

Shri S. Arulsamy

Safaiwala

Shri L. Sathan

Shri R. Thottichi

Shri G. Ankaiah

Ms. J. Kondamma

Shri R. Alagan

Shri M. Veliayan

Shri A. Mari

Shri K. Gurusamy

Shri S. Nagammal

Shri R. Sonaimuthu

Shri K. Subramanian

Shri S. Arumugham

SSG-I

Lab. Attendants

Shri S. Muruga Boopathy

Shri N. Ramakrishnan

Shri C. Ramadas

Shri E. Natarajan

Shri A. Yesudhas

Fieldmen
Shri M. Kuberaganeshan
Shri K. Thangavel
Shri A. Vairamani
Shri N. Boominathan
Shri S. M. Sikkender Batcha
Shri T. Thangarajan — *Oilman*
Messengers
Shri A. Palanichamy
Shri M. Sahul Hameed
Shri J. Padmanathan — *Lascar*
Shri S. Kaliappan — *Khansama*
Pump Drivers
Shri J. Hameed Sultan
Shri G. K. Rajan
Lab Attendants
Shri K. Jeevananthan
Shri M. Bareen Mohan
Shri B. Ramesh — *Daftry*
Watchmen
Shri S. Balakrishnan
Shri V. Alagan
Shri N. Rajavelu
Safaiwalas
Shri V. Narasimmabharathi
Shri U. Rajendran
Shri S. Murugan

Nagapattinam Field Centre
Shri V. Sivasamy — T.I.3
Shri V. Thanapathi — T-2
Shri A. Somu — T-2

Pattukottai Field Centre
Shri A. A. P. Mudaliar — T-4
Shri P. Palani — T-2
Shri K. Muthiah — T-2
Shri A. Kumar — T-2
Shri N. Vaithanathan — T-2

Veraval Research Centre
Technical Staff
T. I. 3
Shri Y. D. Savaria — *Tech. Asst.*
T-2
Jr. Technical Assistants
Shri H. K. Dhokia
Shri B. P. Thumber
T-1
Feld Assistants
Shri Ladani Amruthalal Arjanbhai
Shri B. A. Ponchabhai
Shri P. J. Premji
Shri M. S. Zala
Shri J. D. Vanvi
Shri G. N. Chudasama — *Motor Driver*

Ministerial Staff
Shri J. N. Jambudiya — *Jr. Clerk*

Supporting Staff
SSG - II
Watchmen
Shri Asiri Abu Bin Mehsan
Shri I. M. Waghela
Shri H. M. Bhint — *Messenger*
SSG - I
Shri M. K. Makvana — *Fieldman*

Rander Field Centre
Shri M. Chellappa — T - 2

Jamnagar Field Centre
Shri B. V. Makadia — T - 1

Bombay Research Centre
Technical Staff
T - 4
Senior Technical Assistants
Ms. Abha Kant
Shri M. Shriram
T.I.3
Technical Assistants
Shri K. B. Waghmare
Shri J. L. Oza
T - 2
Jr. Technical Assistants
Shri C. J. Josekutty

Shri A. D. Sawant
Shri J. D. Sarang
Shri R. Dias Johny
T - 1
Field Assistants
Shri B. B. Chavan
Shri A. Y. Mistry
Shri P. S. Gadankush — *Motor Driver*
Shri A. Srinivasan — *Driver for Light Vehicle*
Shri B. G. Kalbate
Shri S. K. Kamble
Shri Jayadev S. Hotagi

Ministerial Staff

Shri B. Vijayakumar — *Assistant*
Senior Clerks
Ms. P. V. Shanbhag
Shri M. R. Wadadekar
Shri Rama D. Medar — *Jr. Steno*
Shri J. N. Jambudiar — *Jr. Clerk*

Supporting Staff

SSG - IV
Shri B. T. Talpade — *Lab. Attendant*
Shri R. B. Bhangare — *Fieldman*
SSG - II
Shri K. G. Tawade
SSG - I
Watchmen
Shri B. D. Janagan
Shri S. M. Tandel
Shri M. P. Jadav
Ms. V. V. Kharalia — *Safaiwala*
Shri P. S. Selvi — *Messenger*
Shri K. K. Baiker — *Fieldman*

Janjira Murud Field Centre

Shri D. G. Jadhav — T - 2

Dahanu Field Centre

Shri S. D. Kamble — T - 1
Shri Suresh Krishnaras Kamble — T - 1

Ratnagiri Field Centre

Shri B. N. Katkar — T - 1
Shri David Dattatray Sawant — T - 1

Malvan Field Centre

Shri Kishore Regunath Mainkar — T - 1

Karwar Research Centre

Technical Staff

T - 2
Jr. Technical Assistants
Shri C. K. Dinesh
Shri N. Chennappa Gowda
Shri V. Varadaiah — *Motor Driver*
T - 1
Field Assistants
Shri V. M. Dhareshwar
Shri D. B. Harikantra
Shri U. V. Arghekar
Shri Satyanarayana V. Pai
Shri K. C. Pandurangachar
Shri Arvindhan N. Bardhotkar
Shri M. M. Bhaskaran
Shri Narayana G. Vydya
Shri Mahadev N. Moger

Ministerial Staff

Shri G. K. Kudalkar — *Assistant*
Shri Y. H. Gamanagatti — *Sr. Clerk*
Junior Clerks
Shri Gangadhar B. Naik
Shri Ganesh R. Nadig

Supporting Staff

SSG - IV
Shri G. M. Korar — *Fieldman*
SSG - III
Shri G. V. Naik — *Fieldman*
SSG - II
Shri M. P. Harikantra — *Oilman*
Shri M. E. Durgekar — *Lascar*
Watchmen
Shri L. K. Suvarna
Shri M. R. Kotharkar
Shri M. B. Kotharkar

SSG - I
Ms. Somi M. Harijan — *Sweeper*
Shri Chandrakant G. Ulvekar — *Fieldman*
Watchmen
Shri Jhimmappa B. Gonda
Shri Somayya S. Gonda
Shri H. C. Naik
Shri C. Togalekar — *Messenger*

Goa Field Centre

Shri Ramesh B. Kamble — T - 1
Shri Prakash C. Shetty — T - 1
Shri Subash K. Naik — SSG - I

Mangalore Research Centre

Technical Staff

T.I.3
Technical Assistants
Shri G. Subramanya Bhat
Ms. Alli C. Gupta
Ms. Uma S. Bhat
T - 2
Jr. Technical Assistants
Shri K. Chandran
Shri B. Shridhara
Shri D. Nagaraja
Shri S. Kemparaju
Shri Y. Muniyappa
Shri Maruthi Sankar Naik
T - 1
Field Assistants
Shri C. Purandhara
Shri H. S. Mahadevaswamy
Shri Baramu S. Melinmani
Shri H. Vasu — *Serang*

Ministerial Staff

Shri Balakrishna Naik — *Assistant*
Shri K. M. Abdulla — *Sr. Clerk*
Junior Clerks
Shri K. Rama Naik
Ms. Martha R. Mascarenhas

Supporting Staff

SSG - III
Shri H. Rajaram — *Fieldman*
SSG - II
Shri U. B. Sadashiva — *Lascar*
Shri Mohan S. Puthran — *Oilman*
Watchmen
Shri G. Sampath Kumar
Shri Ramanna Sapaliga
Shri A. Keshava
Shri D. Gangadhara Gowda
SSG - I
Shri P. K. Retnakaran
Ms. Padmavathy — *Safaiwala*

Auxiliary Staff

Shri P. Narayana Naik — *Motor Driver*

Bhatkal Field Centre

Shri Ganesh Bhatkal — T - 1
Shri R. Appayya Naik — T - 1
Shri C. H. Vamana Naik — T - 1

Calicut Research Centre

Technical Staff

T - 4
Sr. Technical Assistants
Shri K. Nandakumaran
Shri K. K. Balasubramanian
Shri T. Girijavallabhan
Shri K. Soman
Ms. S. Lakshmi
Ms. K. Koumudi Menon
Shri Nirmal Mathew — *Bosun*
T.I.3
Shri K. P. Vishwanathan — *Tech. Asst.*
Shri M. A. Vincent — *Boat Driver*
Shri P. Bhaskaran — *Deckhand*
T - 2
Jr. Technical Assistants
Shri V. G. Surendranathan
Ms. P. Swarnalatha
Ms. V. K. Janaki

Ms. Lalitha Sekharan
Shri M. K. Gopalakrishnan — *Deckhand*
Shri K. S. Leon — *Deckhand*
Shri K. C. Devassy — *Deckhand*
Shri K. Raju — *Cook* (Boat)
T - 1
Ms. Emiliyamma K. G. — *Field Assistant*

Ministerial Staff

Shri B. D. Puthran — *Assistant*
Ms. P. Subhadra — *Senior Clerk*
Junior Clerks
Shri R. Sreenivasan
Ms. Shylaja K. P.

Supporting Staff

SSG - IV
Lab. Attendants
Shri P. K. Haridas
Shri P. Abdurahiman
Shri K. Janardhanan — *Fieldman*
SSG - III
Lab. Attendants
Shri V. K. Krishnankutty
Shri M. Ramadasan
Fieldmen
Shri Raveendran Andi
Shri K. Kumaran
SSG - II
Shri K. E. J. Victor — *Watchman*
SSG - I
Ms. P. Renuka — *Lab. Attendant*
Shri K. T. Mohanan — *Messenger*
Fieldmen
Shri P. Dasan
Shri T. Haridasan
Watchmen
Shri A. Sivadasan
Shri K. Chekutty
Shri Palaniappan — *Safaiwala*
Shri B. Raju — *Lab. Attendant*

Auxiliary Staff

Shri B. K. Velukutty — *Driver for Light Vehicle*
Shri P. Harsha Kumar — *Driver for Light Vehicle*

Cannanore Field Centre

Shri T. Krishnan Kutty — T -2
Shri K. C. Purushothaman — T - 1

Vizhinjam Research Centre

Technical Staff

T - 5
Technical Officers
Shri K. Ramachandran Nair
Shri P. S. Sadasiva Sarma
Shri R. Bhaskaran Achari
Shri Jacob Jerald Joel
Shri S. G. Vincent
Shri K. Ramakrishnan Nair
T - 4
Sr. Technical Assistants
Shri T. G. Vijaya Warrier
Shri R. Vasanthakumar
T.II.3
Shri Thomas Teles — *Bosun*
T.I.3
Shri V. M. Alwaris
T - 2
Jr. Technical Assistants
Ms. T. A. Omana
Shri K. T. Thomas
Shri A. K. Velayudhan
Shri S. Ramachandran Nair — *Motor Driver*
Deckhands
Shri P. M. Hariharan
Shri V. P. Bensiger
Shri P. Hilary
Shri K. C. Gopalan — *Cook*
T - 1
Field Assistants
Shri K. Sasidharan Pillai
Shri C. Unnikrishnan

Ministerial Staff

Senior Clerks
Shri M. Abdul Salam Sahib
Shri S. Erishikesan
Junior Clerks
Shri C. Johnson
Shri M. Reghunathan

Supporting Staff

SSG - IV

Lab. Attendants

Shri J. Anselam

Shri C. M. Rajappan

Shri V. Sasidharan Pillai

SSG - II

Shri A. Ayyappadas — *Peon*

Shri K. Chandran — *Safaiwala*

Watchmen

Shri V. Vishwanathan

Shri R. Madhusudhanan Nair

SSG - I

Shri V. Kochunarayanan Nair — *Watchman*

Shri S. Antony — *Messenger*

Tuticorin Research Centre

Technical Staff

T - 5

Technical Officers

Shri R. Gurusamy

T - 4

Sr. Technical Assistants

Shri C. T. Rajan

Shri P. Feroz Khan — *Bosun*

Shri A. A. P. Mudaliar

Shri T. S. Balasubramanian

T.II.3

Technical Assistants

Shri J. X. Rodrigo

Shri A. D. Gandhi

Shri N. Palanisamy

T.I.3

Technical Assistants

Shri D. Sundararajan

Shri O. M. M. J. Habeeb Mohamed

Shri M. Selvaraj

Shri M. Manickaraja

Skin Divers

Shri A. Dasman Fernando

Shri F. Soosai V. Rayan

Shri C. K. Dandapani — *Serang*

T - 2

Jr. Technical Assistants

Shri K. Sreenivasagan

Shri A. Prosper

Shri M. Enose

Shri G. Arumugham

Shri S. Rajapackiam

Shri P. Muthikrishnan — *Skin Diver*

Shri Xavier Mohandoss — *Motor Driver*

Shri E. Shivanandam — *Boat Cook*

Shri N. Jesuraj — *Skin Diver*

Shri M. Antony Salaya Moduthoms — *Driver* (Boat)

T - 1

Field Assistants

Shri R. Ponnaiah — *Electrician*

Shri K. Shanmugasundaram

Shri S. Mohamed Sathakthullah

Shri A. Athipandian

Shri K. Jayabalan

Shri K. Paul Sigarmony

Motor Drivers

Shri K. Alagirisamy

Shri S. K. Gurusami — *Light Vehicle*

Deckhands

Shri D. Bosco Fernando

Shri S. Enasteen

Shri R. Arockiasamy

Shri D. Anandan

Ministerial Staff

Shri N. Rajamunisamy — *Superintendent*

Shri D. Ganajebamani — *Assistant*

Senior Clerks

Shri N. Sivaramakrishnan

Shri S. Jeyachandran

Shri J. Uthamanabbi

Shri B. Bavanandam

Shri S. Antony George Ratnam

Junior Clerks

Ms. Kamala Venkataraman

Ms. S. Sarada

Ms. C. Rajeshwari

Ms. S. Leelavathi — *Jr. Stenographer*

Supporting Staff

SSG - IV

Shri M. Ramadoss

Shri A. Francis — *Lab. Attendant*

SSG - III

Lab. Attendants

Shri P. Krishnan

Shri D. Motcham — *Daftry*

SSG - II

Watchmen

Shri S. Mani

Shri M. Alfred

Shri M. Thangavelu

Shri K. Thangaraja

Shri P. Muthumalai

Shri V. Samayamuthu

Shri B. Thangaraj — *Lascar*

Ms. S. Daisy — *Safaiwala*

Shri R. Uchimahali — *Lascar*

Shri Y. Balu — *Oilman*

SSG - I

Fieldmen

Shri Y. Satyawan Neelraj

Shri M. Muthuvel

Shri P. Kandan

Shri M. Sankaran

Shri G. S. Rayappan

Shri I. Ravindran

Shri K. John James — *Gardener*

Safaiwala

Shri P. Villiam

Shri K. Kadarkarai

Shri S. Alagesan — *Fieldman*

Shri I. Syed Sadiq — *Lab. Attendant*

Shri V. Muniasamy — *Lab. Attendant*

Watchmen

Shri N. Asokumar

Shri M. Shanmughavelu

Auxiliary Staff

Shri S. K. Guruswamy — *Motor Driver*

Kanyakumari Field Centre

Shri N. Retnasamy — T - 5

Shri I. P. Ebenezer — T - 4

Madras Research Centre

Technical Staff

T - 6

Field Officers

Shri A. Bastian Fernando

Shri P. K. Mahadevan Pillai

T - 5

Technical Officers

Shri S. Kandasamy

Shri M. Mohamed Sultan

Shri A. C. Sekhar

T - 4

Sr. Technical Assistants

Shri S. K. Balakumar

Shri P. Ramadoss

Shri K. S. Krishnan

T.II.3

Technical Assistants

Shri S. Palanichamy

Dr. R. Thangavelu

Dr. V. Selvaraj

Shri T. N. Sukumaran — *Bosun*

T.I.3

Technical Assistants

Shri I. Jayashankaran

Shri V. Rangacharylu

Shri H. Kader Batcha

Shri S. Subramani

Shri S. Seetharaman

Shri Hameed Batcha

Shri G. Natarajan — *Motor Driver*

T - 2

Jr. Technical Assistants

Shri M. Manimaran

Shri S. Chandrasekhar

Shri A. Ramakrishnan

Shri K. Shahul Hameed

Shri P. Thirumulu

Shri P. Poovannan

Shri G. Sreenivasan

Shri S. Mohan

Motor Drivers

Shri K. Ratna Kumar

Shri K. Pandi

Shri D. Padmanabhan — *Boat Driver*
Shri Voli Mohamed — *Boat Cook*
Deckhands
Shri K. Parasuraman
Shri C. Manipal
T - 1
Shri Ahmed Kamal Basha — *Field Assistant*

Ministerial Staff
Assistants
Shri R. Narayanan
Shri K. M. Karuppiah
Ms. S. Mangalam
Senior Clerks
Shri S. K. Murali
Shri S. Balasubramanian
Ms. M. Parvathy
Ms. G. Abitha
Junior Clerks
Ms. B. Lalitha
Ms. P. Thankaleelal
Ms. Rosy Joachim — *Stenographer*

Supporting Staff
SSG - III
Lab. Attendants
Shri G. Soundararajulu
Shri M. Vellayan
SSG - II
Shri R. Anandha Jyothi — *Watchman*
SSG - I
Messengers
Shri M. Ravindran
Shri S. Rajan
Watchmen
Shri A. Janakiraman
Shri G. Chakrapani
Shri T. Nagalingam
Shri S. Inbamani
Shri S. Yuvarajan — *Lab. Attendant*
Fieldmen
Shri V. Manoharan
Shri R. Sundar
Shri R. Vasu
Shri P. Selvaraj — *Safaiwala*
Ms. Aiyali Devi — *Peon*

Auxiliary Staff
Shri Joseph Xavier — *Deckhand*

Cuddalore Field Centre
Shri A. Srinivasan — T.I.3
T - 2
Shri M. Manivasagam
Shri T. Dhandapani
Shri M. Radhakrishnan

Pondicherry Field Centre
Shri L. Chidambaram — T.I.3

Mahabalipuram Field Centre
Shri S. Manivasagam — T - 4

Ongole Field Centre
Shri A. Hanumantha Rao — T.II.3
Shri T. Chandrasekara Rao — T.I.3

Nellore Field Centre
Shri G. C. Lakshmaiah — T - 5

Kovalam Field Centre
Shri S. Sankaralingam — T - 2
SSG - II
Shri D. Pakkiri — *Watchman*
SSG - I
Shri M. Anbu — *Messenger*
Shri M. P. Chandrasekar — *Watchman*

Kakinada Research Centre
Technical Staff
T.II.3
Technical Assistants
Shri P. Ramalingam
Shri K. Ramasomuyagulu
Shri K. Dhanaraju
T - 2
Shri K. Dharma Rao — *Motor Driver*
Shri Ch. Ellithathayya — *Jr. Technical Asst.*

T - 1
Field Assistants
Shri T. Nageswara Rao
Shri N. Burayya
Shri P. Venkata Ramana
Shri Vasamsetty Abbulu

Ministerial Staff
Shri S. Suryanarayana Murthy — *Sr. Clerk*
Shri E. Appa Rao — *Junior Clerk*

Supporting Staff
SSG - III
Shri K. Narasimhamurty — *Lab. Attendant*
SSG - II
Shri R. V. S. Subramanyan — *Watchman*
SSG - I
Shri S. Tatabhai — *Messenger*
Shri K. Satyanarayanan — *Watchman*

Machalipatnam Field Centre
Shri K. V. S. Seshagiri Rao — T - 4

Narsapur Field Centre
Shri P. Ananda Rao — T - 4

Visakhapatnam Research Centre
Technical Staff
T - 5
Technical Officers
Shri C. V. Seshagiri Rao
Shri M. V. Somaraju
T.II.3
Technical Assistants
Shri K. Chittibabu
Shri U. Alagamalai — *Bosun*
T - 2
Jr. Technical Assistants
Shri K. Narayana Rao
Shri J. B. Varma
Shri M. S. Sumithrudu
Shri S. Satya Rao
Shri M. Chandrasekhar
Shri M. Prasad Rao
Shri P. A. Reghu — *Oilman cum Deckhand*
Shri A. K. Unnikrishnan — *Boat Cook*

T - 1
Field Assistants
Shri S. Chandrasekhar
Shri P. Achayya
Shri P. Pashupathi Rao — *Motor Driver*
Deckhands
Shri S. Ganeshan
Shri P. M. Abdul Moheedu

Ministerial Staff
Shri R. Appa Rao — *Assistant*
Ms. Shanti Prasad — *Sr. Clerk*
Ms. B. Gowri — *Jr. Clerk*

Supporting Staff
SSG - II
Shri V. Mohana Rao — *Lab. Asst.*
Shri Rajan — *Peon*
Watchmen
Shri R. Kanakaraju
Shri V. Demudu
Shri P. Krishna Rao
Shri L. Appa Rao — *Messenger*
SSG - I
Shri R. Dalayya — *Safaiwala*

Auxiliary Staff
Shri S. Doraipandian — *Driver for Light Vehicle*

Contai Field Centre
Shri S. S. Dan — T - 8
Shri Sapan Kumar Ghosh — T.I.3
Shri Pulin Behari Dey — T - 2
Shri Bijoy Krishna Burman — T - 1
Shri Prasanta Kumar Das — SSG-I

Puri Field Centre
Shri P. V. Krishna Rao — T - 2
Shri Sukdev Bar — T - 2
Shri S. Hemasundara Rao — T - 1

Gopalpur Field Centre
Shri Satchidananda Naik — T - 1

Palasa Field Centre
Shri V. Achutha Rao — T - 2

Srikakulam Field Centre

Shri N. P. Chandra Kumar — T - 1

Minicoy Research Centre

Technical Staff

Shri Anasukoya — T - 1

Ministerial Staff

Ms. M. Safayabi — *Jr. Clerk*

Supporting Staff

SSG - IV

Shri D. Kojan Koya — *Fieldman*

SSG - III

Lab. Attendants

Shri C. Mohammed Koya

Shri K. Kunjukunju

SSG - II

Watchmen

Shri P. L. Koya

Shri O. Ismail

Shri N. Pookoya

Krishi Vigyan Kendra/ Trainers' Training Centre

Technical Staff

Technical Officers

Shri K. Asokakumaran Unnithan — T - 7

Dr. P. K. Martin Thompson — T - 7

Shri K. N. Rasachandra Kartha — T - 6

Shri A. N. Mohanan — T - 5

Shri P. Radhakrishnan — T - 5

Training Assistant

Ms. P. Sreelatha — T - 4

T.II.3

Shri N. B. Gopalakrishna Menon — *Bosun*

T.I.3

Shri K. K. Prabhakaran — *Boat Cook*

T - 2

Shri C. S. Xavier — *Motor Driver*

Shri P. J. Sebastian — *Motor Driver*

T - 1

Shri K. K. Bose — *Boat Driver*

Ministerial Staff

Superintendents

Shri S. R. Narayanan

Shri P. Aaithappa Naik

Shri C. Balamamundinathan — *Asst.*

Shri C. D. Manoharan — *Jr. Steno*

Shri N. K. Mohanan — *Jr. Clerk*

Supporting Staff

SSG - III

Fieldmen

Shri K. P. John

Shri N. K. Asokan

SSG - I

Watchmen

Shri P. K. Chellappan

Shri K. C. Rajappan

Shri K. G. Bhaskaran Nair — *Messenger*

Ms. Chinnamma Anjelo — *Safaiwala*

ADDRESS LIST OF RESEARCH/REGIONAL/FIELD CENTRES

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