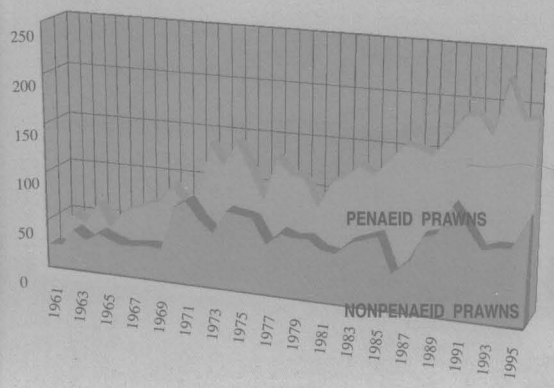
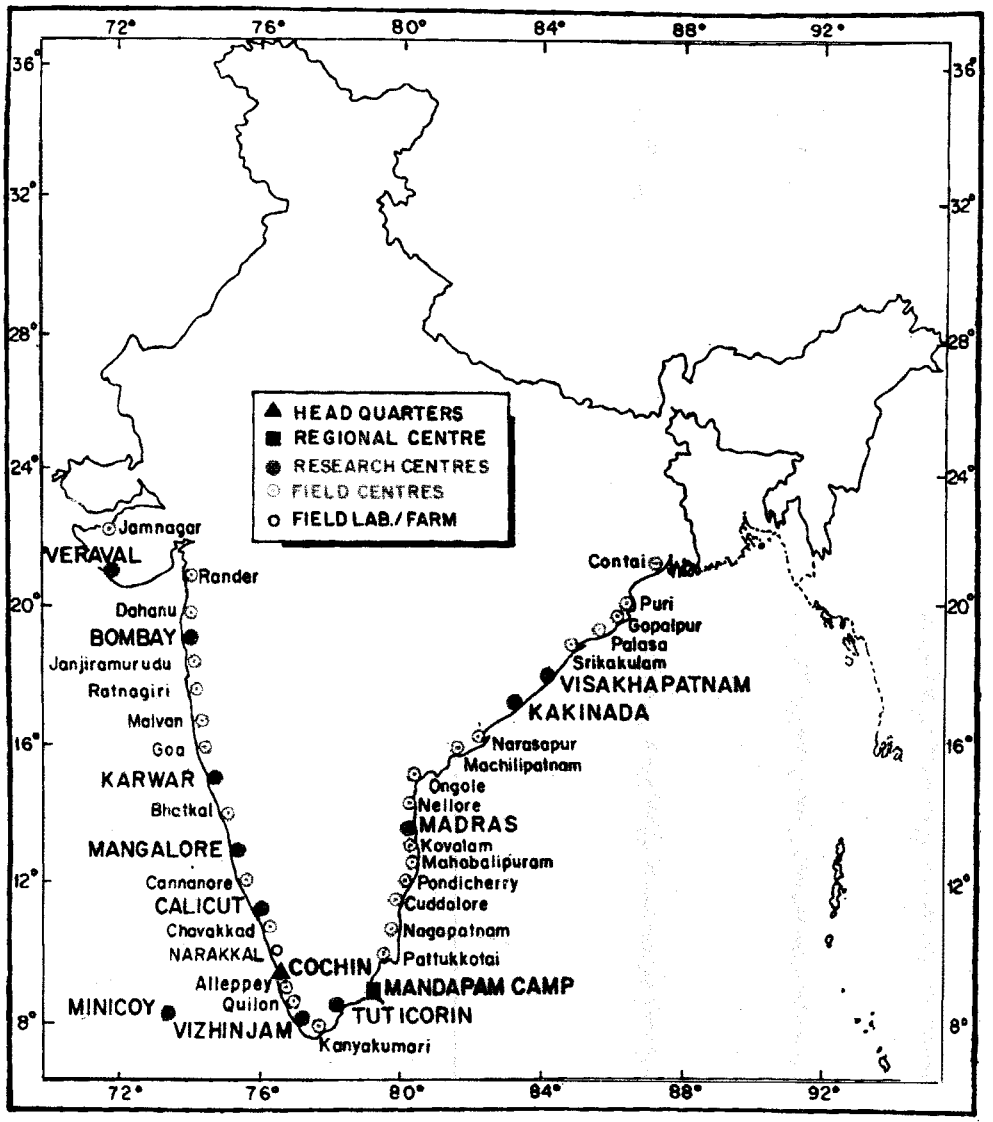


वार्षिक रिपोर्ट

ANNUAL REPORT

1996 - '97

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE



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FOREWORD

The Indian marine fisheries sector, is playing a significant role in supplying protein-rich seafood, employment generation and foreign exchange earning. With the significant advancements made through the successive five year plan periods since independence in the harvest and postharvest areas and in the domestic and export trade in marine products, the sector has grown to the status of a large industry. Export earnings from fish products (of which marine fishery products constitute the major component) account for 29% of the total agricultural exports from the country. Marine fish production from the capture sector reached 2.41 million tonnes (mt) during 1996. This production is in excess of the estimated potential yield of 2.2 mt from the inshore waters, indicating thereby the expansion of fishing beyond the outer limit (50 m isobath) of the inshore grounds. While there is scope for increasing production from the offshore grounds (>50 m isobath) through the introduction of additional effort for exploiting the estimated potential of 1.7 mt, there is urgent need to deploy appropriate fleets for offshore fishing. The CMFRI has been playing very vital roles over the years towards this objective through its R&D initiatives. These efforts were continued during the year 1996-97 through the various regular and sponsored research projects. All the required data on the exploited fish stocks, environmental characteristics and socioeconomics of fisherfolk have been collected systematically, analysed and used for various decision-making processes.

Recognising the need for supplementing marine fish production through coastal mariculture and seafarming, the Institute is fast strengthening its infrastructure for the development, upgradation and transfer of mariculture technologies. Additional infrastructure facilities including multipurpose hatcheries, growout systems, marine aquaria and tissue culture laboratories are being created for this purpose.

The Institute has successfully implemented various HRD programmes which comprise the regular M.F.Sc and Ph.D programmes and trainings offered through the Krishi Vigyan Kendra and Trainers' Training Centre. The Summer Institute on Recent Advances in Mariculture of Molluscs and a UGC sponsored training programme for college and university teachers on 'Industrial Fish and Fisheries' were also conducted.

During the year, the Institute implemented 83 research projects, the summaries of which are presented in this report. Attempts in mobilising external funds through sponsored projects have been very successful. Out of 83 projects proposed so far to various sponsoring agencies, 9 have been sanctioned and are in different stages of implementation while 17 projects for an outlay of Rs 930 lakhs have recently been cleared and approval being issued. With sustained support from the ICAR and the funds being generated through sponsorships, the Institute is rededicating itself to the R&D tasks of marine fisheries and mariculture in the country.

The budget grant of Rs 905 lakhs was fully utilised during the year. The Institute Perspective Plan Vision-2020 has been published.

My colleagues at the Headquarters and the various Research Centres and Field Centres have contributed significantly towards the fulfillment of the mandate of the Institute. I compliment them for their great sense of involvement, hardwork and support. I am thankful to Dr. R.S. Paroda, Director General, ICAR for the support he has been extending in implementing our tasks. Dr. P.V. Dehadrai, Deputy Director General (Fy) and Dr. R.A. Selvakumar, Assistant Director General (MF) have been of great support in sustaining the growth of the Institute. Dr. V. Sriramachandra Murty, Head, Demersal Fisheries Division and Dr. N.G.K. Pillai, Head, Pelagic Fisheries Division took considerable pain in consolidating this document.

Cochin
August, 1997

M. DEVARAJ
Director

ABOUT THE INSTITUTE

Established in 1947 under the Government of India and transfered to the Indian Council of Agricultural Research (ICAR) in 1967, the Central Marine Fisheries Research Institute (CMFRI) with its headquarters at Cochin, is one of the eight research organisations in the network of Central Fisheries Research Institutes under the ICAR devoted to Research, Education, Training and Transfer of Technologies in support of development of fisheries in India. The CMFRI is one of the largest marine fisheries research institutes in the world, comparable to the well-established laboratories in U.K., USA, Canada and Japan, capable of carrying out multidisciplinary research in marine capture and culture fisheries. The Institute has well trained R&D staff in areas of fisheries statistics, fisheries biology, stock assessment, physical and biological oceanography, mariculture, economics and extension.

The Mandate

— Assessment and monitoring of the status of the exploited and unexploited fish stocks in the Indian EEZ, the contiguous international waters (for the mesopelagics) and the Southern Ocean (for Antarctic krill and finfish) in relation to fishery independent and fishery dependent factors; evaluation of the technoeconomics and socioeconomics of marine fishing operations.

— Development of suitable technologies for seafarming of finfish, shellfish, seaweeds and other cultivable marine organisms; evaluation of the technoeconomics and socioeconomics of mariculture operations; upgradation of technologies through R&D in frontier areas in Biotechnology, Nutrition, Pathology and Endocrinology.

— Monitoring the health of the coastal ecosystems, particularly the endangered ecosystems in relation to artisanal fishing, mechanised fishing and marine pollution.

— Transfer of viable seafarming technologies through extension education, specialised trainings and consultancy services.

— Postgraduate education in marine fisheries and mariculture leading to M.F.Sc and Ph.D degrees; introduction of new subjects in frontier areas and establishment of another Deemed University in Fisheries.

To accomplish the above mandate, the Institute conducts researches on characteristics of exploited marine fish stocks; develops seafarming techniques; carries out exploratory surveys and assesses under- and unexploited resources and undertakes research in fishery environmental characteristics and sea-dynamics. Besides, the Institute collects marine fisheries statistics and makes estimation of species-wise landings and monitors the landings on a continual basis from all along the country's coastline. Studies are also conducted on economics of fishery enterprises and socio-economic conditions of fisherfolk.

The organisational set up

To be able to effectively carry out these tasks, the Institute has set up a Regional Centre at Mandapam Camp and Research Centres at Minicoy, Veraval, Bombay, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Madras, Kakinada and Visakhapatnam and 28 Field Centres. The entire activity is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory and field facilities in-

cluding computers and research vessels for carrying out research programmes and has been upgrading the same to meet the changing and additional requirements. The sanctioned staff strength of the Institute is: Scientists 189, Technical 445, Ministerial 172, Supporting 296 and Auxillary 39.

The multi-disciplinary researches in capture and culture fisheries are conducted under eight Divisions: Fisheries Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries, Fishery Environment Management, Physiology, Nutrition and Pathology and Socio-Economic Evaluation and Technology Transfer. Inter-divisional and Inter-institutional programmes with collaborating agencies are carried out for greater utilisation of expertise and facilities. Besides, the Institute also takes up short-term research projects on important and priority areas sponsored by outside agencies in the country and offers consultancy services to the industry. Under the Postgraduate Programme in Mariculture, the Institute organises M.F.Sc. and Ph.D. programmes under affiliation to the Central Institute of Fisheries Education - a Deemed University under the ICAR. The teaching programme is carried out by the Scientists of the Institute.

The Krishi Vigyan Kendra, established in 1976 and the Trainers' Training Centre, impart training in mariculture, agriculture, animal husbandry and other related subjects to fish farmers, agricultural farmers and farm women and to officials of State Governments, Banks, Societies and autonomous bodies interested in fisheries development respectively.

The Library and Documentation section provides reference facilities to research staff and students of the Institute as well as to visiting Scientists both within and outside the country. The results of researches carried out in the Institute are published in various scientific journals, bulletins and special publications and Marine Fisheries Information Service.

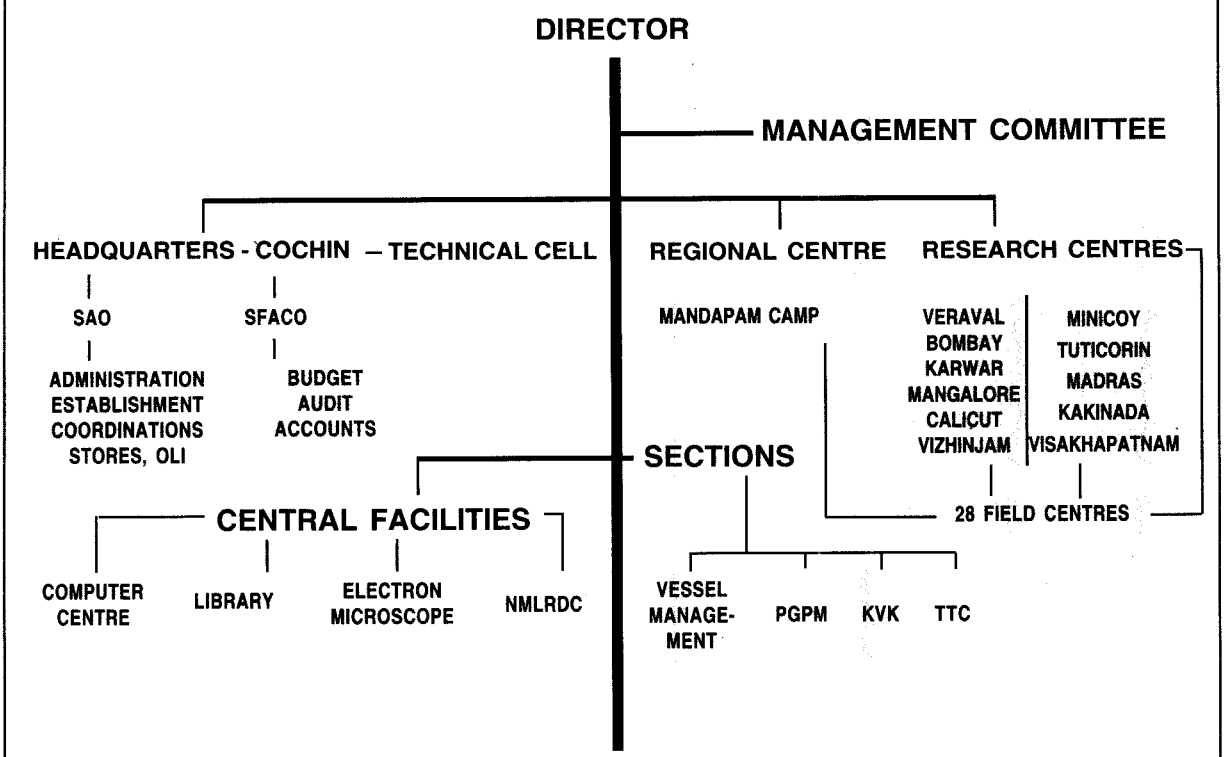
BUDGET 1996-97

(Rs in lakhs)

Budget Heads	Non Plan		Plan	
	Budget Estimates	Expenditure	Budget Estimates	Expenditure
Establishment Charges	695.00	695.00	2.50	2.50
O.T.A	1.20	1.20	—	—
T.A	8.80	8.80	8.00	8.00
Works	—	—	57.02	57.02
Other charges	25.00	44.62*	100.18	100.18
				(+)35.00
Other Items	—	—	7.30	7.30
Total	730.00	749.62	175.00	175.00
				(+) 35.00

* Due to short fall of Revenue Receipts

CMFRI - ORGANOGRAM

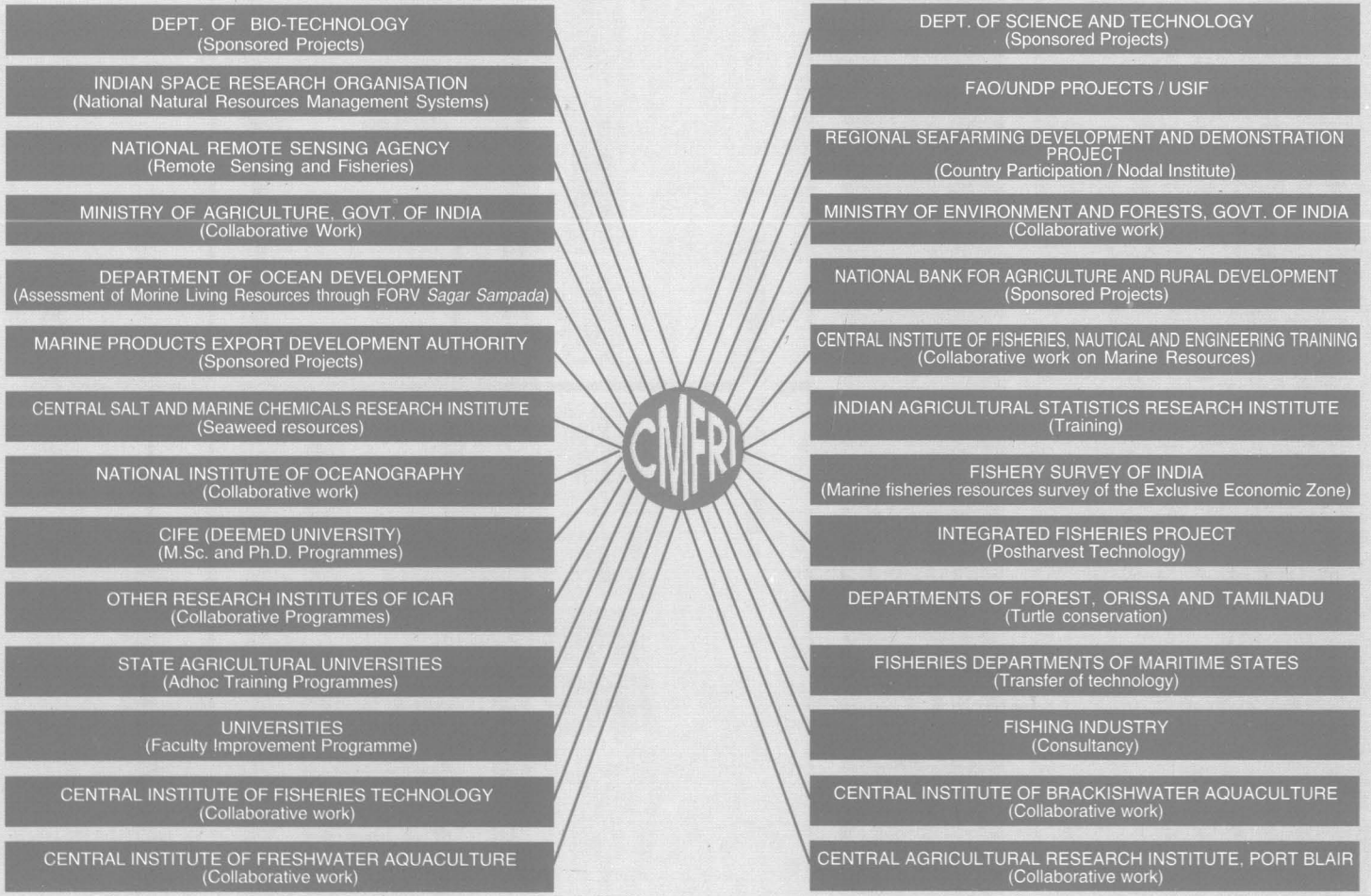


HEADS OF DIVISIONS

FISHERY RESOURCES ASSESS-MENT	PELA-GIC FISHER-IES	DEMER-SAL FISHERIES	CRUSTA-CEAN FISHER-IES	MOLLUS-CAN FISHERIES	FISHERY ENVIRON-MENT MANAGE-MENT	PHYSIOL-OGY NUTRITION PATHOL-OGY	SOCIO-ECO-NOMIC EVA-LUATION & TECHNOLOGY TRANSFER
Fisheries Statistics, Mathe-matical Modelling	Biology, Stock Assess-ment, Pelagic Finfish	Biology, Stock Assess-ment Demersal Finfish, Maricul-ture of Finfish	Biology, Stock Assess-ment Crusta-cean Shellfish, Maricul-ture of Crusta-ceans	Biology, Stock Assess-ment of Squids Cuttle fish, Molluscan Maricul-ture	Monitoring Environ-mental Character-istics, phyto and Zooplank-ton, Marine Pollution	Upgrada-tion of Maricul-ture Tech-nologies	Economics of Fishing Operations, Socioeco-nomic Studies in Marine Fisheries, Technology Transfer

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN (ICAR)

LINKAGES



CMFRI COMMITTEES

I. MANAGEMENT COMMITTEE

1. Dr. M. Devaraj — Chairman
   Director
   Central Marine Fisheries
   Research Institute
   Cochin-14

2. Dr. R.A. Selvakumar — Member
   ADG (Marine Fisheries)
   ICAR, Krishi Bhawan
   New Delhi-1

3. Shri Choudhari G.S. Dharasingh — -do-
   House No. VIII/2079,
   Palace Road
   Cochin-2

4. Engr. Nathulal Gurjar — -do-
   Krishnan Kunju, Lal Bagh,
   Nathdwara, Distt. Rajasmand
   Rajasthan

5. Dr. V.S.K. Chennubhotla — -do-
   Principal Scientist
   Visakhapatnam Research Centre
   of CMFRI, Visakhapatnam

6. Sr. Fin. & Accounts Officer, — -do-
   IIHR, Bangalore

7. Dr. P.P. Pillai — -do-
   Principal Scientist
   CMFRI, Cochin-14

8. Dr. R. Paul Raj — -do-
   Sr. Scientist
   Madras Research Centre of
   CMFRI, Madras

9. Dr. N. Kaliaperumal — -do-
   Sr. Scientist
   Mandapam Regional Centre of
   CMFRI, Mandapam Camp

10. Commissioner of Fisheries — -do-
    Govt. of Tamil Nadu
    Dept. of Fisheries
    Madras-600 006

11. Director of Fisheries — -do-
    Govt. of Kerala
    Vikas Bhavan, IVth Floor
    Trivandrum-695 003

12. Dr. D.M. Thampi — -do-
    Dean, Fisheries College,
    Panangad
    Cochin-682 506

13. Shri P.S. Sudersanan — Member Secretary
    Adm. Officer
    CMFRI, Cochin-14

II. RESEARCH ADVISORY COMMITTEE

1. Dr. N. Balakrishnan Nair — Chairman
   (Retd.) Chairman
   Dept. of Science & Technology
   Govt. of Kerala
   'SWATHI' Residency Road,
   Thycaud,
   Trivandrum-695 014

2. Dr. Arun Parulekar — Member
   Head,
   Biological Oceanography Division
   National Institute of Oceanography
   Dona Paula
   Goa-403 004

3. Prof. P. Natarajan — -do-
   Head of the Deptt. of Aquatic
   Biology & Fisheries
   University of Kerala
   Beach P.O., Trivandrum-695 007

4. Dr. D. Sudarsan — -do-
   Retd. Fishery Scientist,
   9-20-2, CBM Compound
   Visakhapatnam

5. Dr. P.S.B.R. James — -do-
   Director (Retd)
   CMFRI, Cochin-14

6. Dr. M. Devaraj
   Director — -do-
   CMFRI, Cochin

7. Dr. R. A. Selvakumar — -do-
   Asst. Director General (M.Fy.)
   ICAR, New Delhi

8. Shri Choudhary G.S. Dhara Singh — -do
   House No. VIII/2079
   Palace Road, Cochin-2

9.	Engr. Nathu Lal Gujar Krishan Kunju, Lal Bagh Nathdwara, Dist. Rajsamand Rajasthan	-do-
10.	Dr. K.A. Narasimham Principal Scientist CMFRI, Cochin-14	Member Secretary

III. STAFF RESEARCH COUNCIL

1.	Director CMFRI, Cochin-14	Chairman
2.	Joint Director/Incharge Research Coordination & Management Unit CMFRI, Cochin-14	Member
3.	Heads of the Divisions/ Sections CMFRI, Cochin-14	Members
4.	Principal Investigators of ongoing projects CMFRI, Cochin-14	Members
5.	Asst. Director General (M.Fy) ICAR, Krishi Bhavan New Delhi	Member
6.	Dr. N.R. Menon Director School of Marine Sciences Cochin University of Science & Technology Foreshore Road, Cochin-16	-do-
7.	Dr. K. Nagappan Nayar Retd. Principal Scientist No.5, Second Street Seetha Nagar Madras-34	-do-
8.	Dr. S.L. Shanbhogue Prof. & Head Dept. of Fishery Biology College of Fisheries P.B. No. 527 Mangalore-575002	-do-
9.	Dr. V.N. Pillai Principal Scientist CMFRI Cochin-14	Member Secretary

IV. RESEARCH CO-ORDINATION AND MANAGEMENT UNIT

1.	Dr. V.N. Pillai Head of Division CMFRI, Cochin-14	Chairman
2.	Dr. V. Sriramachandra Murty Head of Division CMFRI, Cochin-14	Member
3.	Dr. N.G.K. Pillai Head of Division CMFRI, Cochin-14	Member

V. DEPARTMENTAL RESEARCH COMMITTEE

1.	Dr. M. Devaraj Director CMFRI, Cochin-14	Chairman
2.	Dr. N.R. Menon Director, School of Marine Sciences, CUSAT, Cochin-16	Member
3.	Dr. M. Shahul Hameed Director, School of Industrial Fisheries CUSAT, Cochin-16	-do-
4.	Dr. P. Bensam Principal Scientist CMFRI, Cochin-14	-do-
5.	Dr. K.J. Mathew Sr. Scientist CMFRI, Cochin-14	-do-
6.	Dr. C. Suseelan Sr. Scientist CMFRI, Cochin-14	-do-
7.	Dr. (Mrs.) S. Sivakami Sr. Scientist CMFRI, Cochin-14	-do-
8.	Dr. M.K. George Sr. Scientist CMFRI, Cochin-14	-do-
9.	Dr. (Mrs.) V. Chandrika Sr. Scientist CMFRI, Cochin-14	-do-

10.	Dr. N. Gopinatha Menon Sr. Scientist CMFRI, Cochin-14	Member
11.	Dr. N. Gopalakrishna Pillai Head, PFD CMFRI, Cochin-14	-do-
12.	Dr. V. Kunjukrishna Pillai Sr. Scientist CMFRI, Cochin-14	-do-
13.	Dr. C.P. Gopinathan Sr. Scientist CMFRI, Cochin-14	-do-
14.	Dr. N. Sridhar Scientist (SS) CMFRI, Cochin-14	-do-
15.	Dr. K. Rengarajan Sr. Scientist CMFRI, Cochin-14	Convener

VI. JOINT COUNCIL

Office side

1.	Dr. M. Devaraj, Director	Chairman
2.	Shri P. Bapaiah Sr. Adm. Officer	Member
3.	Shri A.V. Joseph Sr. Finance & Accounts Officer	-do-
4.	Shri K. Balan Head, FRAD	-do-
5.	Shri P.R. Leopold Tech. Officer (T-8)	-do
6.	Shri P.A. Naik Asstt. Adm. Officer	Member Secretary

Staff side

1.	Dr. R. Thangavelu Sr. Technical Assistant (T-4)	Member
2.	Shri D. Soundararajan Technical Assistant (T-II-3)	-do-
3.	Shri M.P. Sivadasan Technical Assistant (T-I-3)	-do-
4.	Shri S. Hajanajeemudeen Sr. Technical Assistant	Member
5.	Shri S. Abdulla Assistant	-do-
6.	Shri K.J. Mathew Jr. Clerk	-do-
7.	Smt. E. Sasikala Hindi Translator	-do-
8.	Shri M. Krishnan Binder	-do-
9.	Shri A.P. Sebastian SS Gr. III	-do-
10.	Shri B. Zainuddin SS Gr. II	-do-
11.	Shri N.T. Velappan SS Gr. II	-do-
12.	Shri K. Sadanandan Sr. Clerk	Member Secretary

VII. GRIEVANCE COMMITTEE

1.	Dr. M. Devaraj Director	Chairman
2.	Dr. M. Peer Mohamed, Principal Scientist	Member
3.	Shri P. Bapaiah Sr. Adm. Officer	-do-
4.	Shri A.V. Joseph Sr. Finance & Accounts Officer	-do-
5.	Dr. A. Regunathan, Sr. Scientist	-do-
6.	Dr. K. Muniyandi Sr. Technical Assistant	-do-
7.	Shri Haji K.M. Abdulla Sr. Clerk	-do-
8.	Shri U. Rajendran SS Gr. I	-do-
9.	Shri P.A. Naik Asst. Adm. Officer	Member Secretary

DIVISIONS AND THEIR HEADS

1.	Fishery Resources Assessment Division	–	Shri K. Balan
2.	Pelagic Fisheries Division	–	Dr. P.P. Pillai (upto 1-11-96)
		–	Dr. N.G.K. Pillai (w.e.f. 2-11-96)
3.	Demersal Fisheries Division	–	Dr. P. Bensam (upto 1-11-96)
		–	Dr. V. Sriramachandra Murty (w.e.f. 2-11-96)
4.	Crustacean Fisheries Division	–	Dr. N.N. Pillai (upto 14-4-96)
		–	Dr. G. Sudhakara Rao (w.e.f. 15-4-96)
5.	Molluscan Fisheries Division	–	Dr. K.A. Narasimham (upto 3-11-96)
		–	Dr. K.K. Appukuttan (w.e.f. 4-11-96)
6.	Fishery Environment and Management Division	–	Dr. C.S.G. Pillai (upto 30-6-96)
		–	Dr. V.N. Pillai (w.e.f. 31-7-96)
7.	Physiology, Nutrition and Pathology Division	–	Dr. M. Peer Mohamed
8.	Socio-Economic Evaluation & Technology Transfer Division	–	Dr. R. Sathiadhas

REGIONAL/RESEARCH CENTRES AND THEIR OFFICERS-IN-CHARGE

Mandapam Regional Centre of CMFRI Marine Fisheries P.O. Mandapam Camp-623 520, Tamil Nadu Phone: 41443 & 41456	–	Dr. A. Regunathan Senior Scientist (upto 5-3-97)
	–	Dr. A.C.C. Victor Senior Scientist (w.e.f. 6-3-97)
Veraval Research Centre of CMFRI Bhidiya Plot, Near B.M.G. Fisheries Veraval-362 267, Gujarat Phone : 20065	–	Dr. K.K. Joshi Scientist (upto 31-3-97)
	–	Dr. B. Manoj Kumar Scientist (w.e.f. 1-5-97)
Bombay Research Centre of CMFRI 148, Army & Navy Building 2nd Floor, M.G. Road Bombay-400 001, Maharashtra Phone : 2822653, 2845260	–	Dr. Kuber Vidyasagar Senior Scientist
Karwar Research Centre of CMFRI Post Box No. 5 Karwar, North Kanara, Karnataka Phone : 26371 & 26165	–	Dr. V.S. Kakati Senior Scientist
Mangalore Research Centre of CMFRI Post Box No. 244, Bolar Mangalore-575 001 Dakshina Kanara, Karnataka Phone : 424152, 435807	–	Dr. C. Muthiah Senior Scientist
Calicut Research Centre of CMFRI West Hill P.O., Calicut-673 005, Kerala Phone : 50377, 50376	–	Dr. P.S. Kuriakose Principal Scientist
Vizhinjam Research Centre of CMFRI Vizhinjam P.O., Trivandrum-695 521, Kerala Phone : 481143, 480324	–	Dr. P.A. Thomas Senior Scientist
Tuticorin Research Centre of CMFRI 90, North Beach Road Tuticorin-628 001, Tamil Nadu Phone : 322274, 320274	–	Shri R. Marichamy Principal Scientist

Madras Research Centre of CMFRI 68/1, 4th Floor, Greams Road Madras-600 006, Tamil Nadu Phone : 8254252, 8253299	–	Dr. R. Paul Raj Senior Scientist (upto 8-9-96)
	–	Shri K. Dorairaj Principal Scientist (w.e.f. 9-9-96)
Kakinada Research Centre of CMFRI Door No. 8-14-18/2 Red Cross Street, Gandhi Nagar Kakinada-533 004, Andhra Pradesh Phone : 78039, 76231, 76082	–	Shri G. Subbaraju Principal Scientist
Visakhapatnam Research Centre of CMFRI Andhra University P.O. Visakhapatnam-530 003 Andhra Pradesh Phone : 543154, 543793, 63779	–	Dr.V.S.K.Chennubhotla Principal Scientist
Minicoy Research Centre of CMFRI Minicoy, U.T. of Lakshadweep Phone : 22228, 22263	–	Shri M. Sivadas Scientist (SS)
Field Lab of CMFRI Cochin Fisheries Harbour Thoppumpady Cochin-682 005, Kerala Phone : 230892	–	Mrs. Grace Mathew Senior Scientist

TRAINERS' TRAINING CENTRE

Trainers' Training Centre CMFRI Cochin - 682 014	–	Dr. V. Kunjukrishna Pillai Senior Scientist

KRISHI VIGYAN KENDRA

Krishi Vigyan Kendra of CMFRI Narakkal-682 505 Ernakulam Dist., Kerala Phone : 492482, 492450	–	Dr. D. Noble Sr. Scientist (upto 19-11-96) Shri P Said Koya (w.e.f. 20-11-96)

FIELD CENTRES

Alleppey Field Centre of CMFRI
Geetha Building, Kalarcode
Alleppey-688 005, Kerala

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1st Floor, Behind Ganesh Bhavan
Building, 27, Kidwai Road
Bhatkal (N.K.)-581 320

Chavakkad Field Centre of CMFRI
Edakkazhiyoor P.O.
Chavakkad P.O. 680 515
Trichur District, Kerala

Contai Field Centre of CMFRI
Thanapukurpar, P.O.
Contai 721 401
Midnapore District
West Bengal

Cuddalore Field Centre of CMFRI
Jawan's Bhavan
Lawrence Road
Cuddalore-607 002

Dahanu Field Centre of CMFRI
Kirtane Bungalow
Maangailwada
Dahanu, Thana District
Maharashtra

Goa Field Centre of CMFRI
Shri P.R. Phal House
1st Floor, B.B. Borkar Road
Alto-Porvorim-403 521
Bardez, Goa

Gopalpur Field Centre of CMFRI
Gopalpur-on-sea (P.O.)
Ganjam Dist.
Orissa

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Aerodrome Road
Jamnagar-361 006
Gujarat

Janjira Murud Field Centre of CMFRI
14/3, Bazar Peth Road, Ground Floor
Janjira Murud-402 401
Raigad District,
Maharashtra

Kannur Field Centre of CMFRI
Office of the Deputy Director of Fisheries
Moppila Bay Fisheries Complex
District Hospital Post
Kannur-670 017

Kanyakumari Field Centre of CMFRI
Kanyakumari-629 702
Tamil Nadu

Kovalam Field Laboratory of CMFRI
Kovalam-602 112
Chengulpet Dist
Tamil Nadu

Machilipatnam Field Centre of CMFRI
17/299, Sidimbi Agraharam
Lane, Machilipatnam-521 002
Andhra Pradesh

Mahabalipuram Field Centre of CMFRI,
Mahabalipuram-603 104
Tamil Nadu

Malwan Field Centre of CMFRI
2799/2, Dawoolwads,
Pawar Chal
Malwan-416 606
Maharashtra

Narasapur Field Centre of CMFRI
C/o Ratnam Enterprises
Darga Street, Narasapur
Andhra Pradesh.

Nagappatinam Field Centre of CMFRI
C/o Inspector of Fisheries
Salt Road, Nagapattinam-611 001
Thanjavur Dt., Tamil Nadu

Nellore Field Centre of CMFRI
Room No. 14, Municipal Building
New A.C. Bubba Reddy Statue
Weyyalakalava Street
Nellore-524 001, Andhra Pradesh

Ongole Field Centre of CMFRI
No. 49, A.P. Housing Colony
Manidipakam, Ongole-523 002
Prakasam District,
Andhra Pradesh

Palasa Field Centre of CMFRI
Devchand Nivas
K.T. Road (Near Ravi Electricals)
Palasa, Srikakulam District

Pattukottai Field Centre of CMFRI
Room No. 23,
Periaswamy Building
187/A, Big Bazar Street,
Pattukottai-614 601, Tanjore

Pondicherry Field Centre of CMFRI
Room No. 1, First Floor
V.K.G. Building
143, Chinnasubraya Street
Pondicherry-605 001

Puri Field Centre of CMFRI
Santikunja Lane
Near Hotel Sea 'n' Sand
Chakratirtha Road
Puri-752 002, Orissa

Quilon Field Centre of CMFRI
Municipal Stadium Buildings
Ward No. VII, Door No. 737
Quilon, Kerala

Rander Field Centre of CMFRI
II Floor, 'Devikripa', 3/213
Bandariward
Rander, Surat-395 005

Ratnagiri Field Centre of CMFRI
Building No. 3615, Lower Lane,
Ratnagiri-415 612
Maharashtra

Srikakulam Field Centre of CMFRI
Door No. 4-1-23/1
Opp. Govt. Employees
No.A-675, Srikakulam-532001
Andhra Pradesh

STAFF DEPUTED ABROAD

Dr. M. Devaraj, Director - to attend the Workshop on Oceanography (including Fisheries) held in Cairo, Egypt during the period from 22.6.96 to 27.6.96.

— to participate in the Workshop on Grouper Aquaculture at Kota Kinabalu, Sabah, Malaysia from 4.12.96 to 7.12.96.

Dr. M. Vijayakumaran Sr. Scientist - to attend the Fifth International Conference and Workshop on Lobster Biology and Management during the period from 9.2.97 to 14.2.97 in New Zealand.

Dr. N. Sridhar Scientist (SS) - On DBT Overseas Associateship for a period of six months at the Deptt. of Ecology Evolution and Organised Biology, Tulane Uni., Lousiana, U.S.A., from 10-2-'97 to 10-8-'97

EDUCATION PROGRAMME

Under the postgraduate education programme in Mariculture, a total of about 4400 manhours (22 manmonths) were devoted by the scientists of the Institute in teaching the M.F.Sc. and Ph.D. students. This includes about 3400 manhours devoted for the M.F.Sc. programme and 1000 manhours for the Ph.D. course work.

In the M.F.Sc. programme, the 13th batch (1993-96) comprising of 9 students, completed the course and all of them were declared passed, securing a maximum O.G.P.A. of 8.2/10. The 14th batch (1994-97) comprising 11 students, completed the second and third semesters. The 15th batch (1995-98) comprising 4 students belonging to the general science category completed their first semester of the Regular Course with four new additions from the B.F.Sc. stream admitted in 1996. The 16th batch (1996-99), comprising 5 students from the general science category was admitted to the Deficiency Course in September 1996 and their first semester was completed.

Under the Ph.D. programme, 3 candidates registered with the Cochin University of Science and Technology earlier, were awarded the doctoral degrees for their theses. Another 3 candidates completed their research work and submitted theses to the University for adjudication. Under the Deemed University (CIFE) regulation, the research work of the 12th Ph.D. batch (1994-97) has progressed well except for one student who discontinued the programme during the period under report. The 5 students of the 13th Ph.D. batch (1995-98) completed their course work and started research work. A fresh batch of 10 students (14th Ph.D. batch) was admitted during the reporting period and the first semester of the course work of this batch was successfully completed.

SUMMER INSTITUTE / SEMINAR / TRAINING

Summer Institute on Recent Advances in Mariculture of Molluscs

A Summer Institute on Recent Advances in Mariculture of Molluscs was held at Tuticorin Research Centre of the Institute from 20-5-96 to 8-6-96 by the Molluscan Fisheries Division. 24 participants representing various Fisheries Research Institutes and Universities attended the Summer Institute. They were appraised about the latest developments in the farming and breeding of the commercially important

molluscs like edible oysters, clams, mussels, scallops, abalones and about the pearl culture techniques developed in the Institute.

Training Programme for College Teachers in *Industrial Fish and Fisheries*

A training for college teachers of vocational course in the discipline 'Industrial Fish and Fisheries' sponsored by UGC was conducted at Headquarters from 1st to 31st July 1996. Teachers of ten colleges from 7 States participated in the training course. The participants were given training in the principles of aquaculture genetics and hatchery production of the seed of finfishes and shellfishes culture of finfishes and shellfishes, hatchery production of seed of pearl oyster, edible oyster and clams mariculture of edible oysters, clams and mussels; pearl oyster farming and pearl production; searanching of clams and pearl oysters; seaweed resources and culture and water quality management in aquaculture.

KRISHI VIGYAN KENDRA

Krishi Vigyan Kendra, Narakkal gives training for practising farmers, rural youths, school dropouts, village women and Extension workers of development departments. During the year 1996-97 the following training programmes were conducted.

No.	Subject	Duration in days	No. of courses conducted	Trainees		
				Male	Female	Total
A. FISHERIES						
1.	Prawn farming	15	2	-	61	61
2.	Prawn farming	5	7	29	126	155
3.	Edible oyster farming	2	1	40	1	41
4.	Mussel farming	2	2	32	15	47
B. AGRICULTURE						
1.	Coconut cultivation	5	1	1	18	19
2.	Coconut cultivation	3	3	3	47	50
3.	Coconut cultivation	2	2	1	39	40
4.	Vegetable cultivation	3	1	8	2	10
5.	Vegetable cultivation	2	2	-	59	59
6.	Mushroom cultivation	3	1	20	10	30
7.	Mushroom cultivation	2	3	26	53	79
8.	Mushroom cultivation	1	3	78	57	135
C. ANIMAL SCIENCE						
1.	Poultry production	2	2	2	34	36
2.	Goat farming	1	1	-	17	17
D. HOME SCIENCE						
1.	Fruit preservation	3	1	-	23	23
	TOTAL		32	240	562	802

Extension activities - Guidance given to:

a. a Harijan Society having 135 members with 2.14 ha water area divided into 5 ponds at Valappu, Vypeen island on group farming of prawn and fishes

b. farmers in Chellanam village on group farming of prawns

c. prawn/fish/crab/mushroom/coconut farmers who visit the Kendra

d. prawn/fish farmers by regular visits to the farms

Lab to Land Programme:

Monitoring of 100 families in Nayarambalam and Ezhikkara villages selected during 1994-95 was continued. The programme for the year 1996-97 was implemented for 52 families in Narakkal village by distributing critical inputs such as prawn seeds, chicks, vegetable seeds, coconut seedlings and fertilizer.

SC/ST Programme:

Monitoring of 56 families selected during 1994-95 was continued. A detailed bench mark survey was conducted to select the beneficiaries of the programme. 44 families were selected in Narakkal village. The programme could not be implemented during the period under report due to non availability of funds.

Programmes arranged/participated:

a. Participated in the 1 lakh employment scheme of Department of Agriculture at Kottuvally block office. Conducted seminar in prawn farming and poultlry farming.

b. Participated in the seminar jointly organised by KVK, Narakkal, Tapovanam, Puthuvype, FACT and Coconut Development Board, Ernakulam on Agriculture Production.

TRAINERS' TRAINING CENTRE

During the year April 1996 - March 1997, the Trainers' Training Centre of the Institute has organised 9 training courses of different durations, covering the following topics: Computer-based application of Statistics in Aquaculture, Pearl Oyster Surgery, Fish and Shellfish Disease Investigations, Live Feed Culture, Shrimp farming (for financing agencies), Hatchery Production of Marine Prawn Seeds, Seaweed Culture and Utilisation, Edible Oyster Culture and Post-harvest Technology in Fisheries. Altogether, 66 candidates from different maritime States including Kerala, Tamilnadu, Andhra Pradesh, Karnataka, Gujarat, Orissa, Maharashtra and the U.T. of Andaman and Nicobar were given training.

LIBRARY AND DOCUMENTATION SECTION

During the year under report 93 books and 1790 issues of journals were added to the library at headquarters. Essential books and periodicals were also acquired for the libraries at the Mandapam Regional Centre and all other Research Centres. Inter-library collaboration and inter-library loan of publications were continued. Reference facilities were provided to visiting scientists, scholars and students of various Universities, Institutions, and others from within and outside the country.

The library also stocks and distributes the Institute's publications. Sale of Indian Journal of Fisheries, CMFRI Bulletins and

Special Publications were also made during the period.

The following publications were issued:

1. Indian Journal of Fisheries Vol. 43 Nos. 1-3
2. CMFRI Special Publication No. 65
3. Marine Fisheries Information Service Nos. 140-145
4. CMFRI Newsletter Nos. 68-69, 70-71
5. CMFRI Annual Report 1995-96
6. Research Highlights 1995-96
7. Institute Brochure (Reprint)
8. Vision - 2020, CMFRI Perspective Plan

VESSEL MANAGEMENT CELL

The Institute has 8 vessels for carrying out the fishery resources surveys, studies on primary productivity, zooplankton, fish eggs and larvae, hydrography, marine pollution and launching of long lines and artificial reefs. The cell organised the repairs and maintenance of the vessels, planning and execution of research cruises and deployment of crew and co-ordinated with the research centres in carrying out the activities, besides monitoring the performance of the vessels, *Cadalmin-IX* at Cochin is used extensively for collection of sea water for various research projects of the Institute.

Cadalmin-V at Visakhapatnam was decommissioned and disposed off during October '96. *R.V. Skipjack* continued to be in laid up condition and a high level meeting of ICAR officials with those of GRSE was conducted at Cochin to settle the outstanding dispute. The matter is now referred to the Indian Council of Arbitration.

The Cell arranged manpower requirements and stores purchase for six cruises of FORV *Sagar Sampada* during 1996-97. Technical Officers of the Cell attended the cruises as Fishing Masters. *Cadalmin-IX* at Cochin made 115 daily sea trips during the period under report. The vessels at Research Centres were out in sea for 51 days at Tuticorin, 48 days at Mandapam and 27 days at Madras during the period 1996-97.

PROVIDING CONSULTANCIES AND R&D SUPPORT

MOUs SIGNED DURING 1996-97 / TO BE SIGNED

Sl. No.	Name of the Entrepreneur	Location & activity	Amount(Rs)
1.	M/s N.C.C. Bluewater Products Ltd.	Chandanada(A.P.) Pearl Culture	84,000
2.	M/s Balaji Bio-Tech Ltd., Nellore	Thupilipalem Pearl Culture	1,66,250
3.	M/s Aqua Prime International (India) Ltd.	Nellore Pearl Culture	2,01,350

Sl. No.	Name of the Entrepreneur	Location & activity	Amount(Rs)
4.	M/s Gem Holiday Resorts Ltd.	Madras Pearl Culture	4,30,750
5.	M/s Sterling Shrimpex (P) Ltd.	Chirala (A.P.) Pearl Culture	
6.	M/s Kalinga Aquatics Ltd.	Bhubaneswar Crab Farming	
7.	M/s Pink Gold British Exports Ltd.	Raigarh (Maharashtra) Crab Farming	1,94,000
8.	M/s Mangalore Refineries & Petrochemicals	Mangalore Pollution Monitoring	3,60,000
9.	M/s Kudremukh Iron Ore Co. Ltd. (KIOCL)	Mangalore Pollution Monitoring	3,80,000
10.	M/s Master Pearls Ltd.	Hyderabad Pearl Culture	6,71,250

THE OFFICIAL LANGUAGE IMPLEMENTATION PROGRAMME

Hindi Correspondence: 162 letters were received in Hindi of which 136 were replied in Hindi; for 27 letters reply was not necessary. 1198 documents coming under section 3(3) of the Official Languages Act such as general orders, rules, notifications, tender notices, administrative and other reports were issued in bilingual form.

Against the 50% target for the Hindi general correspondence to Region 'A', 'B' and 'C', the achievement was 39.85%. Against the 82% target to Region 'C' the achievement was 34%.

Hindi Committees: Regular quarterly meetings of the Official Language Implementation Committee at headquarters and Research centres were conducted and progress made in Hindi Implementation was reviewed. Two meetings of the Cochin Town Official Language Implementation Committee were attended.

Extension activities: Hindi Fortnight was celebrated at Headquarters from 16-9-96 to b27-9-96 with various programmes in Hindi. Hindi day/week was celebrated at the Regional/Research centres also. The Institute and the centres have participated in the TOLIC programmes of concerned places and won prizes.

At the Veraval Research Centre of CMFRI, Functional Hindi course for one month has been organised.

Training: 3 staff of CMFRI passed the various courses under Hindi.

Inspection: The Second Sub-Committee of the Parliament Committee on Official Language inspected the Hindi activities of Minicoy Research Centre of CMFRI on 18-1-1997 and recorded satisfaction.

Publications: The Institute's Annual Report, Newsletter and the "Marine Fisheries Information Service, T&E Series" were released in Hindi and English.

Education programme: M.F.Sc. students incorporated the abstract of their theses in Hindi.

Library: 12 Hindi books were added to the Hindi library. Hindi newspaper and popular periodicals are procured and displayed.

Award received: The Institute won the Rajbhasha Rolling Trophy from Cochin TOLIC for the excellent Hindi implementation.

AWARDS

The Rafi Ahmed Kidwai Award for the triennium 1993-95 is given jointly to **Dr. R. Sathiadhas**, Sr. Scientist and Head, Socio-Economic Evaluation and Technology Transfer Division, **Shri K.K.P. Panicker**, Emeritus Scientist for their outstanding research contribution in the field of Social Sciences particularly Fishery Economics, Research and Extension.

Dr. Krishna Srinath, Senior Scientist, Socio-Economic Evaluation and Technology Transfer Division was given the Outstanding Extension Worker Award of ICAR for the triennium 1993-95 for the contributions in the field of Fisheries Extension and services to the fishing communities. She has also been honoured as the Most Favoured women Scientist Award by the Kerala State Women's Development Corporation on the occasion of the International Women's Day Celebrations, 1996.

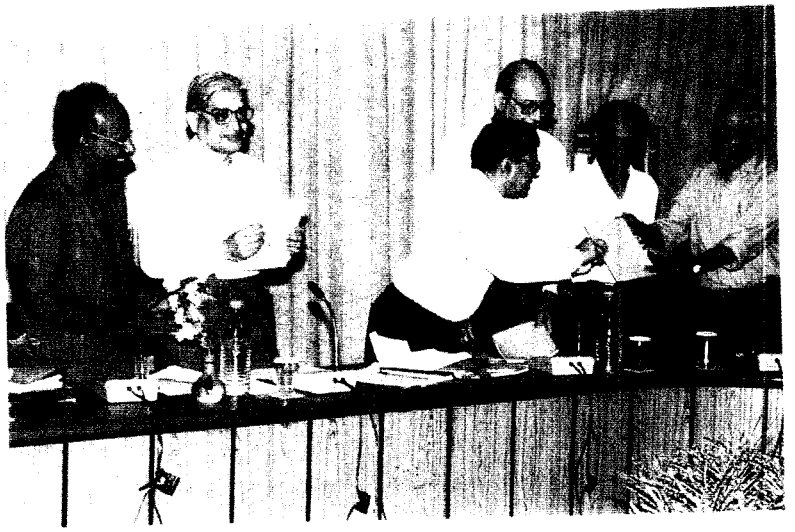
Dr. (Mrs.) Krishna Srinath receiving the Outstanding Extension Worker Award from the Hon'ble Minister for Agriculture Shri Chaturanan Misra

Dr. R. Sathiadhas Sr. Scientest and Shri K.K.P. Panicker, Emeritus Scientist receiving the Rafi Ahmed Kidwai Award from the Hon'ble Minister for Agriculture Shri Chaturanan Misra

Meeting of the Parliamentary Committee on Official Language at Minicoy Research Centre

Shri T. K. Ramakrishnan,
Hon'ble Minister for Fisheries,
Kerala, naugurating the
Golden Jubilee
Celebrations of CMFRI.

Shri T. K. Ramakrishnan,
Hon'ble Minister for fisheries,
Kerala, releasing
the Vision - 2020,
CMFRI Perspective Plan;
Dr. P.V. Dehadrai, DDG (FY)
ICAR and Dr. M. Devaraj
Director are also seen



Dr. P.V. Dehadrai DDG (FY),
ICAR releasing the first issue
of *Indian Journal of fisheries*
after its return to the Institute
at the conference of Directors
of Fisheries Research Institutes
of ICAR.

RESEARCH ACCOMPLISHMENTS

I. Fishery Resources Assessment Division

Assessment of Exploited Marine Fishery Resources (FSS/FRA/1.1)

K.Balan, K.N.Kurup, K.S.Scariah, M.Srinath and K.Vijayalekshmi

Marine Fish Production in India During 1996

The marine fish production in India during 1996 was provisionally estimated at 2.41 million tonnes(mt) which is 1,56,000t (6.9%) higher than the estimated production of 2.26 mt during 1995.

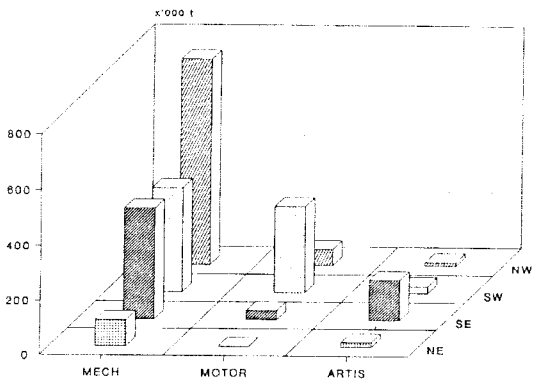
The pelagic groups accounted for 51.7% and demersal finfishes, molluscs and crustaceans 48.3% of the total estimated landings. The mechanized and motorized units together contributed about 91.3% to the total and the traditional units the rest.

The resources which contributed significantly to the production are oil sardine, perches, ribbonfishes, mackerel, penaeid prawns and nonpenaeid prawns. Elasmobranchs, lesser sardines, whitebaits, carangids, pomfrets and seerfishes registered decrease.

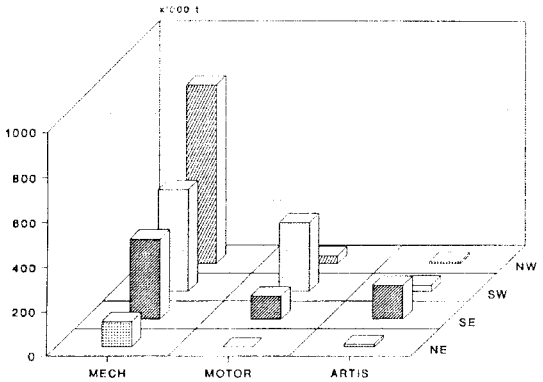
Regionwise marine fish production (in tonnes) in Inaia during 1996.

Region	Estimated landings	% in the all India total
1. Northeast (West Bengal & Orissa)	1,28,901	5.3
2. Southeast (Andhra Pradesh, Tamil Nadu & Pondicherry)	6,18,539	25.6
3. Southwest (Kerala, Karnataka & Goa)	7,92,095	32.8
4. Northwest (Maharashtra & Gujarat)	8,40,310	34.9
5. Lakshadweep & Andamans	33,804*	1.4

* Provisional estimate



Regionwise marine fish landings in different sectors during 1995



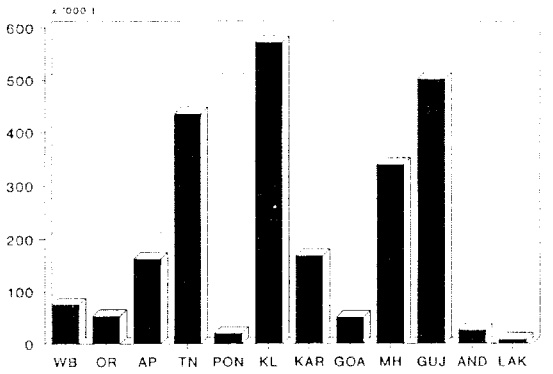
Regionwise marine fish landings in different sectors during 1996

Regionwise Landings

Northeast region

Northeast region contributed 1.29 lakh tonnes which formed 5.3 % of fish production of the country; an increase of 12,000 t compared to the estimate of 1995 was observed. The principal components in the landings were *Hilsa* shad, anchovies, Bombayduck, croakers, ribbonfishes, pomfrets, penaeid prawns and non-penaeid prawns.

Hilsa shad which is an important fishery of this region, registered an increase of 6,000 t with the estimated production of 24,000 t. The landings of croakers also showed an increase of 3,700 t, the estimate being 20,000 t. Another important fishery of the region, the Bombayduck did not show much difference from the landing of 1995 with the estimated production of 12,000 t during 1996. Seerfish landing was 3,200 t which showed an increase of 1600 t. However, pomfret landing registered a decrease of about 2600 t, the estimate being 5,400 t. Penaeid prawn landing was 7,400 t during 1996 which showed a reduction of 1,300 t. The non-penaeid prawn landings did not show much variation.



Marine fish landings along the coasts of maritime states of India in 1996

Southeast region

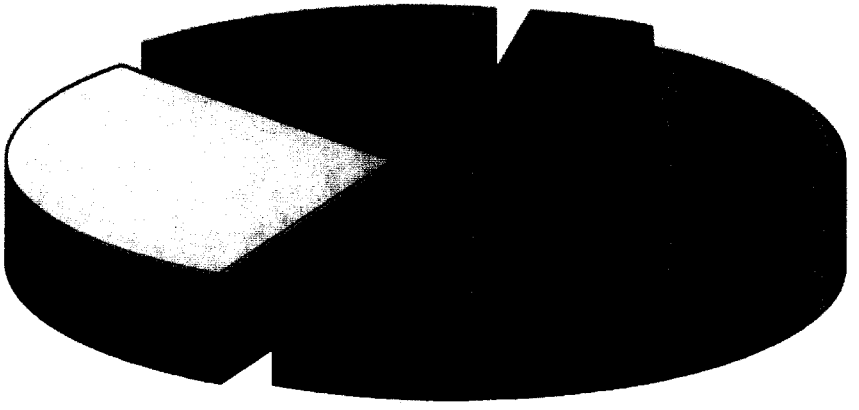
The marine fish landings in 1996 along the southeast region was 6.29 lakh tonnes, which registered an increase of 34,600t (5.9%). Among the major groups, oil sardine fishery is characterized by its gradual increase in the production. An estimated 70,000 t was landed in 1996 which showed an increase of 33,000 t. Lesser sardine catch also improved by 19,000 t, the estimate being 80,000 t. Perch fishery was of the order of 44,000 t, which did not record any appreciable change. The croakers and silverbelly landings were 21,000 t and 50,000 t in 1996 which showed reduction of 4,000 t each. The mackerel landings was 28,000 t in 1996 with a dcline of 12,000 t, compared to the estimate of 1995. However, seerfish landing was of the order of 10,000 t which did not show any variation. Penaeid prawn landing was 45,000 t during the year which registered a reduction of 700 t. The cephalopod landing was about 19,000t which showed an increase of 2,600t in 1995. The *Stolephorus* landings registered an increase of 5,000 t in 1996, the stimate being 24,000 t.

Southwest region

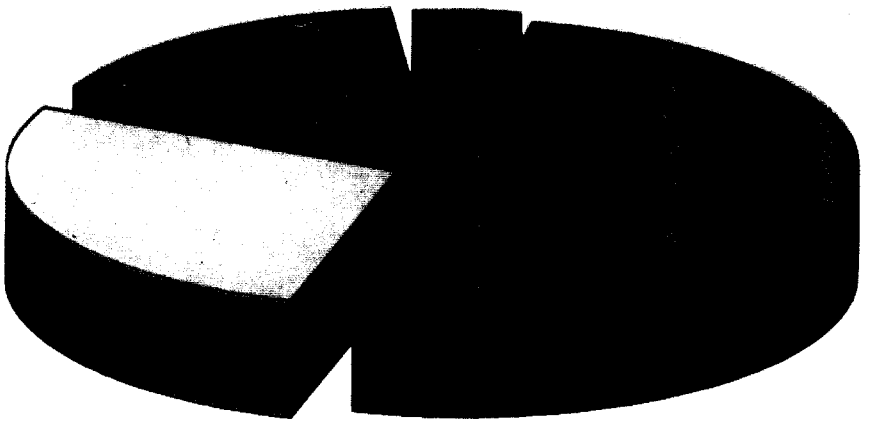
The southwest region contributed 7.92 lakh tonnes which formed 32.8% of the total marine fish production in the country in 1996 with an increase of 80,000 t (11.2%), over the production of 1995.

From an estimated production of 18,000 t, in 1995 the oil sardine fishery rose to 39,000 t in 1996, with a substantial increase of 21,000 t. However, the landings of lesser sardines registered a decline of 41,000 t. The estimate of lesser sardines was only 14,000 t in 1996. *Stolephorus* fishery, another important fishery of the region, also declined by 14,000 t; the estimate in

1995



1996



Composition of marine fish landings in India

Crustacean shellfish

Molluscan shellfish

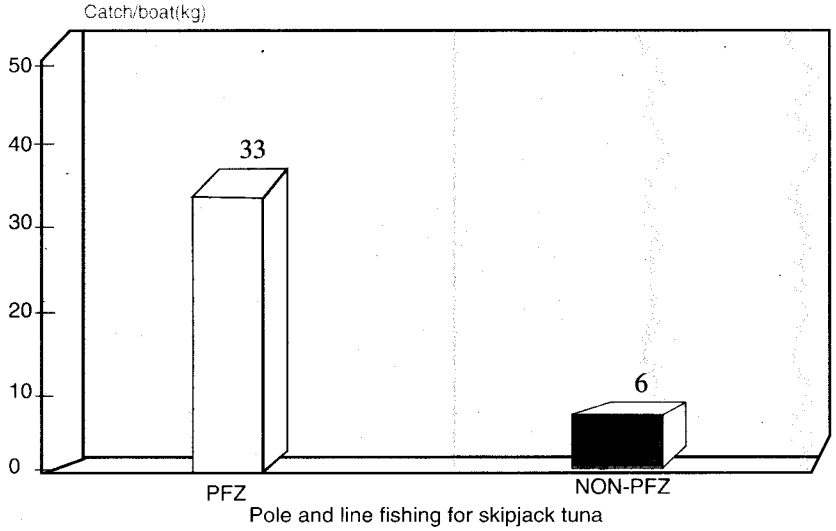
Demersal finfish

Pelagic finfish

PFZ VALIDATION

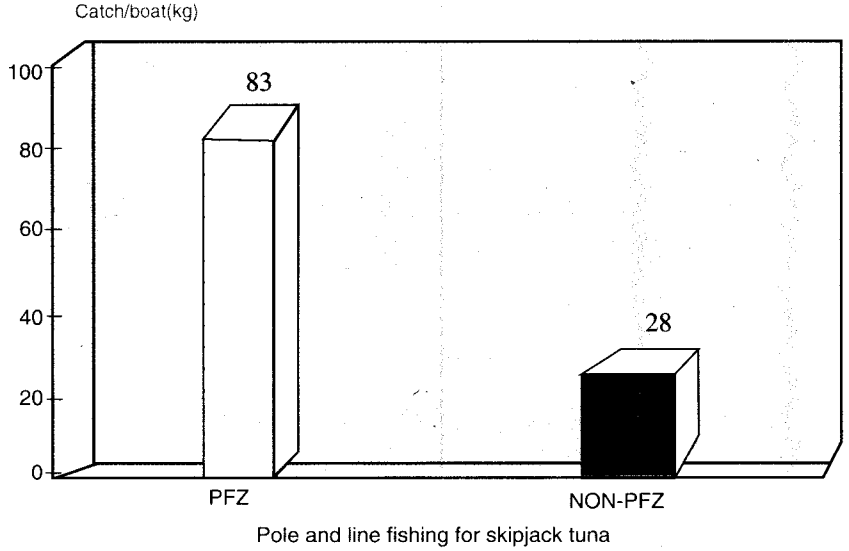
MINICOY ISLAND

First week of March '97



Pole and line fishing for skipjack tuna

Thirdweek of March '97



Pole and line fishing for skipjack tuna

1996 was 34,000 t. Perch landing was 86,000 t during the year, which showed an increase of 28,000 t; the threadfin breams are mainly responsible for this spurt with an increase of 26,000 t in their landings. Croaker landing was 23,000 t and that of ribbonfishes 27,000 t, with increase of 8,000 t and 20,000 t respectively. However, carangid fishery declined by 41,000 t, the fall was due to decline in scad fishery.The estimate of carangids was 87,000 t in this region. A substantial increase of 99,000 t in the landings of mackerel was observed in the southwest coast with an estimate of 2,04,000 t. The other major fishery, penaeid prawns, also indicated an increase of 3,700 t in this region with an estimate of 5,65,000 t in 1996. However, the cephalopod landing was 41,000 t which showed a decline of about 12,000 t in 1996.

Northwest region

The landings in this region contributed 8.41 lakh tonnes in 1996 with an increase of 28,000 t (3.5%) when compared to the estimate of 1995. The major groups which contributed to the increased production include Bombayduck, perches, ribbonfishes, carangids, mackerel, penaeid prawns and non-penaeid prawns. Croakers and seer fishes registered decreased landings.

Bombayduck fishery was 79,000 t and perches 34,000 t during 1996 with an increase of 5,000 t and 3,000 t respectively. A substantial increase of 32,000 t in the landings of ribbonfishes was noticed during the year, with an estimate of 82,000 t. Mackerel landings also registered increase by 12,000 t with an estimate of 41,000 t. Penaeid prawn landing was 81,000 t and non-penaeid prawns 96,000 t with increase of 6,000 t and 28,000 t.respectively. Carangid landing was 22,000 t in 1996 which showed an increase of 7,500 t. However, croakers and seerfishes registered decline in production by 18,000 t and 8,700 t respectively. The annual production of croakers and seerfishes was 98,000 t and 15,000 t respectively.

Pelagic Finfishes

Oil sardine: The oil sardine fishery suffered a severe setback in 1994, was slowly recovering. An increase of about 54,000 t was recorded during 1996, the production during 1996 being 1,10,000 t. The landings accounted for 4.6% of the total production and 8.8% of the pelagic fish landings. Both southeast and southwest coasts registered increased landings of 33,000 t and 21,000 t respectively.

Estimated landings (t) of pelagic finfishes in India during 1995 and 1996.

Name	1995	1996
CLUPEOIDS		
Wolf herring	13874	14341
Oil sardine	56633	110346
Other sardines	127905	106924
Hilsa shad	19518	25648
Other shads	13452	7981
Coilia	33545	30986
Setipinna	1771	2316
Stolephorus	69496	61392
Thrissina	0	146
Thryssa	36839	37944
Other clupeoids	45486	60126
BOMBAYDUCK	88106	91657
HALF BEAKS & FULL BEAKS	5747	3783
FLYING FISHES	4090	997
RIBBON FISHES	74043	126905

Name	1995	1996
CARANGIDS		
Horse Mackerel	21021	17652
Scads	103063	66790
Leather-jackets	5966	5176
Other carangids	66818	57760
MACKERELS		
Indian mackerel	176749	275677
Other mackerels	81	17
SEERFISHES		
S. commerson	28615	24613
S. guttatus	17205	12662
S. lineolatus	87	96
Acanthocybium spp.	5	23
TUNNIES		
E. affinis	15447	14778
Auxis spp.	4867	11119
K. pelamis	796	1225
T. tonggol	5787	4263
Other tunnies	10892	9535
BILL FISHES	1388	3889
BARRACUDAS	14679	14476
MULLETS	6475	6198
UNICORN COD	139	297
MISCELLANEOUS	42823	40104
Total	1113408	1247842

Mackerel: Mackerel landings accounted for 11.4% of the total production and 22.1% of the pelagic fish catch. A substantial increase of 99,000 t was recorded in the landings during 1996, the estimate being 2,76,000 t. Increased landing was recorded along the west coast and, the southwest coast alone contributed an increase of 99,000 t. The northwest region, especially Maharashtra coast also recorded an increase of 12,000 t. However, a reduction of 12,000 t of mackerel landing was observed in the southeast region resulting the overall increase of 99,000 t.

Whitebait: This resource accounted for 2.5% of the total marine fish production of the country and 49% of the pelagic fish production. The estimated landing of 61,000 t in 1996 registered a decline of about 8,000 t in 1996 over the previous year.

Bombayduck: The Bombay duck landing showed a slight increase of about 4000t over 1995. An estimated 92,000 t of Bombayduck was landed during 1996 which accounted for 3.8% of the total marine fish production and 7.3% of the pelagic fish landing of the country.

Carangids: An estimate of 1,47,000 t of carangids was recorded during 1996, which showed a decline of 49,000 t when compared to 1995. This group formed 6.1% of the total marine fish landings of the country and accounted for 11.8% of the pelagic group in 1996.

Ribbonfishes: The landings of ribbonfishes accounted for 5.3% of the marine fish production of the country and 10.2% of the pelagic fish catch. The landings of ribbonfishes showed an improvement, over 1995 with an estimated production of 1,27,000 t during 1996. An increase of 53,000 t was recorded during 1996. The increase was primarily from northwest coast, particularly at the Veraval Fisheries Harbour.

Tunnies: The estimate of tunnies was 41,000 t which showed an increase of 3,000 t during 1996. Tuna landings accounted for 1.7% of the marine fish production and 3.3% of the pelagic fish catch of the country.

SHELLFISHES

Cephalopods: A decline of about 10,000 t was recorded in the cephalopod catch. The estimated landing during 1996 was 107,000t. The cephalopods accounted for 4.4% of the total marine fish production of the country and 9.2% of the demersal component.

Penaeid prawns: The penaeid prawns landing was 188,000 t in 1996 with an increase of 9,000 t over 1995. The fishery improved along the southwest coast. The landings accounted for 7.8% of the total marine fish production of the country and 16.3% of the demersal catch.

Nonpenaeid pranws: The landing of this resource crossed one lakh mark during 1996. The estimate was 104,000 t which accounted for 4.3% of the total marine fish production of the country and 9.0% of the demersal catch. A substantial increase of 30,000 t was recorded in this year. The northwest region alone accounted for an increase of about 28,000 t and the rest by southwest coast.

Estimated landings (t) of shellfishes in India during 1995 and 1996

Name	1995	1996
CRUSTACEANS		
Penaeid prawns	179143	188060
Non-penaeid prawns	73999	104462
Lobsters	1923	2631
Crabs	30610	29049
Stomatopods	66330	72342
MOLLUSCS		
Cephalopods	116764	107071
Total	468769	503615

DEMERSAL FINFISHES

Catfishes: Catfish landing in the country was estimated at 36,000t during 1996, which accounted for 1.5% of the total marine fish production and 3.1% of the demersal catch. The landing in 1996 registered a decrease of 2,400 t over 1995.

Elasmobranchs: This group accounted for 2.4% of the total marine fish production of the country and 5.0% of the demersal catch during 1996. The estimate was 59,000 t which showed a decline of 11,000 t compared to 1995.

Perches: The landings of this group, particularly threadfin breams, improved during 1996 by 30,000 t. The estimated production of 168,000t is 7.0% of the total marine fish production of the country and 14.6% of the demersal catch.

Croakers: The landings of croakers accounted for 6.7% of the total marine fish production and 14.0% of the demersal catch. The estimate of 161,000 t registered a reduction of about 10,000 t during 1996.

Pomfrets: The estimate of pomfrets was 36,000 t during 1996 which showed a reduction of 9,000 t. Pomfrets accounted for 1.5% of the total marine fish production and 3.1% of the demersal catch.

Estimated landings (t) of demersal finfish in India during 1995 and 1996

Name	1995	1996
ELASMOBRANCHS		
Sharks	45960	34750
Skates	2327	2132
Rays	20987	21752
EELS	5904	7030
CATFISHES	38493	36090

Name	1995	1996
LIZARD FISHES	33820	30055
PERCHES		
Rock cods	12448	14688
Snappers	3652	4258
Pig-face breams	10141	12104
Threadfin breams	69497	90705
Other perches	42593	46139
GOATFISHES	9601	10407
THREADFINS	10913	8832
CROAKERS	171665	161080
SILVERBELLIES	64752	62003
BIG-JAWED JUMPER	7152	6523
POMFRETS		
Black pomfret	19941	12433
Silver pomfret	24034	22834
Chinese pomfret	540	515
FLAT FISHES		
Halibut	3000	3516
Flounders	244	99
Soles	34937	37746
MISCELLANEOUS	44054	37501
Total	6,76,655	6,63,192

LANDINGS BY MECHANIZED, MOTORIZED AND ARTISANAL UNITS

The landings of 17.5 lakh t by the mechanized units accounted for about 72.6 % of the total marine fish landings of the country during 1996 followed by the motorized (18.7%) and artisanal units (8.7%). Trawlnet, purseseine, gillnet and dolnet were used by the mechanized units, ringseine and gillnet by motorized sector and gillnet, shoreseine, boatseine and several others by the the artisanal sector.

Percentage contribution of different regions to the landings by each category of units during 1995 and 1996

	1995			1996		
	Mech.	Motor.	Arti.	Mech.	Motor.	Arti.
Northeast	6.03	0.39	8.47	6.68	0.04	6.51
Southeast	24.90	8.33	72.79	20.85	23.39	74.21
Southwest	23.25	76.78	12.25	26.37	68.51	14.21
Northwest	45.82	14.50	6.49	46.10	8.06	5.07

Mech. - Mechanized, Motor. - Motorized, Arti - Artisanal

Percentage contribution of different categories of units to the production from each region during 1995 and 1996

	1995			1996		
	Mech.	Motor.	Arti.	Mech.	Motor.	Arti.
Northeast	83.87	1.35	14.78	89.37	0.15	10.48
Southeast	68.94	5.78	25.28	58.09	17.01	24.90
Southwest	52.80	43.71	3.49	57.37	38.91	3.72
Northwest	91.15	7.23	1.62	94.44	4.31	1.25

In the mechanized sector, northwest region accounted for maximum (46.1%) production followed by southeast coast.

In the motorized sector, southwest coast contributed the maximum (69.03%) and minimum along the northeast coast. The motorization is steadily growing in all the regions.

The mechanized units accounted for maximum (94%) landing in the northwest coast; the yield from artisanal units was only marginal. In the southeast region, the operation of motorized craft has been slowly increasing over the years; 17% of the total catch in this region was from these units. In the southwest region the higher contribu-

tion was by mechanized units followed by motorized units and the share of artisanal units in landings from this region was negligible because most of the artisanal units were fitted with outboard engines. In the northeast region, mechanized units contributed about 89% of the total catch.

An increase of CPUE of the mechanized units occured in 1996 along the southwest coast probably because of decline in effort of the long voyage fishing at Sakthikulangara and Cochin along Kerala coast. The increase in the operation of pair trawling units resulted in increased CPUE in the southeast region. In the northwest region, the greater CPUE from the mechanized sector was due to the multiday fishing by a large number of units along the Gujarat coast.

Effort (1000 units operation), catch (t) and CPUE (kg) of each category of units along different regions in 1995 and 1996.

Region		1995			1996		
		Effort	Catch	CPUE	Effort	Catch	CPUE
Northeast	I	369	97513	264	455	115197	253
	II	51	1577	31	4	187	50
	III	291	17179	59	320	13517	42
Southeast	I	2036	402570	198	1239	359331	290
	II	481	33743	70	1693	105190	62
	III	3832	147640	39	3289	154018	47
Southwest	I	816	375871	461	766	454406	593
	II	1474	311186	211	1682	308189	183
	III	1089	24851	23	985	29500	30
Northwest	I	1032	740980	718	1066	794560	745
	II	498	58749	118	381	36250	95
	III	197	13169	67	99	10499	106

(I : Mechanized, II : Motorized, III : Artisanal)

Evaluation of Change in the Pattern of Catch and Composition of Marine Fishery Resources in India (FSS/FRA/1.19)

K.S. Scariah, K.N.Kurup, K. Balan, M.Srinath and K. Vijayalekshmi

Under this project, application of Markov's chain was attempted on the landings of dominant groups in Kerala.

The preparation of reports on marine fisheries apprisal in respect of Karnataka, Andhra Pradesh, Goa and Gujarat is in progress.

Management Information System in Marine Fisheries (FSS/FRA/ST.1)

K.N. Kurup, K. Balan, K.S. Scariah, M.Srinath and K. Vijayalekshmi

The marine fishery data collected during April '96 to March '97 were computerized. The data were processed and backup information stored on magnetic tapes.

A new user-friendly package for data analysis and retrieval 'INBASE' has been developed.

The various endusers were provided with necessary data on marine fish landings.

A training programme on Computer-based Statistical Application in Aquaculture was arranged for three weeks for the personnel engaged in research/ teaching.

STOCK ASSESSMENT TECHNIQUES IN MARINE FISHERIES RESEARCH AND MANAGEMENT (FSS/FRA/1.3)

M. Srinath and K.N. Kurup

During this year, time series analysis using ARIMA methodology was continued using the quarterly data of total landings in the maritime states of India, of the period 1985-'95. The appropriate ARIMA models were identified using the'acf' and'pacf'plots. The validity and adequacy of the models were tested using the acf of the residuals. The forecast of the total landings during 1996 based on quarterly production data is 23.26 lakh tonnes, excluding Island territories. The forecasts of the landings are given below.

Forecasts for 1996

State	Qr-I	Qr-II	Qr-III	Qr-IV	Total
WestBengal	19.045	0.697	18.366	40.338	78.446
Orissa	16.65	3.377	4.455	26.466	50.948
Andhra Pradesh	53.625	26.367	31.597	46.785	158.374
Tamilnadu	99.404	100.787	121.963	98.554	420.708
Pondicherry	1.932	3.031	4.160	1.600	10.723
Kerala	99.418	116.102	225.038	165.049	605.607
Karnataka	41.863	17.774	27.982	67.608	155.227
Goa	3.001	2.349	2.736	5.497	13.583
Maharashtra	94.742	62.082	43.077	129.238	329.139
Gujarat	163.734	99.000	30.785	209.830	503.349
Total	593.414	431.566	510.159	790.965	2326.104

(Note : The figures are in thousand tonnes)

Using the data on total annual landings from 1961 to 1995, the forecast was made as 23.71 lakh tonnes including the island territories.

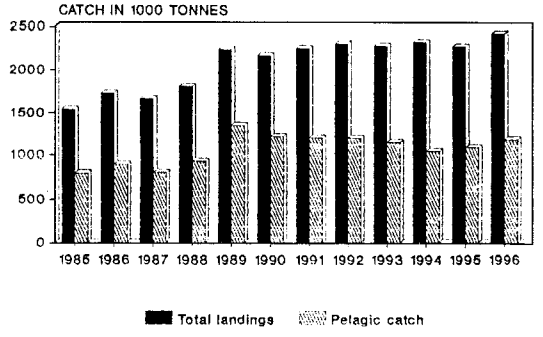
The estimate of all India landings from the sample survey during 1996 was about 24.10 lakh tonnes which deviated from the predicted value by about 2% which is within the statistically acceptable levels.

The comparative performance of some of the time series methods was also assessed using the total quarterly landings in Kerala of the period 1975 to 1995. The methods used were:

1. A modified version of the time varying regression model (TVS) where dummy variables for seasonal cycles are also included in the equation.
2. Intervention analysis
3. Exponential smoothing - Winter's multiplicative seasonal model.
4. ARIMA
5. Spectral analysis

Among these, the Winter's model and ARIMA seasonal multiplicative model were found to fit the data much better than the other methods. The forecasts for the total landings in Kerala for 1996 and 1997 were 550 and 556 thousand tonnes by Winter's model whereas the ARIMA yielded forecasts of 581 and 607 thousand tonnes respectively.

II. Pelagic Fisheries Division



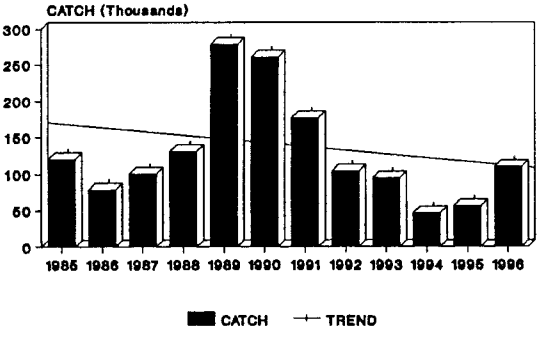
All India total and Pelagic fish landings (t)

During 1996-'97 the Pelagic Fisheries Division undertook seven research projects, of which six were on resources characteristics and stock assessment of major resources and one on fishery forecasting in the Malabar upwelling zone. The resources covered are: sardines; anchovies; seerfishes; tunas, tuna-livebaits billfishes; mackerel; Bombay duck and ribbonfishes. The pelagic finfish landing during the last 12 years varied from 0.78 million t (mt) in 1985 to 1.35 mt in 1989; in 1996 it was 1.18 mt forming 49% of total fish production. A stagnation in the catch at around 1.2 mt could be observed for the last seven years. Nearly 65% of the pelagic finfish production in 1996 was obtained from the west coast while 33% from the east coast and the rest from the island territories. The maximum contribution was from Kerala (27.6%) followed by Tamil Nadu (18.1%), Gujarat (16.2%), Maharashtra (10%) and the rest from other maritime states.

Fishery and Resource Characteristics of Sardines (*Sardinella* Spp.) (PF/RE/1.1)

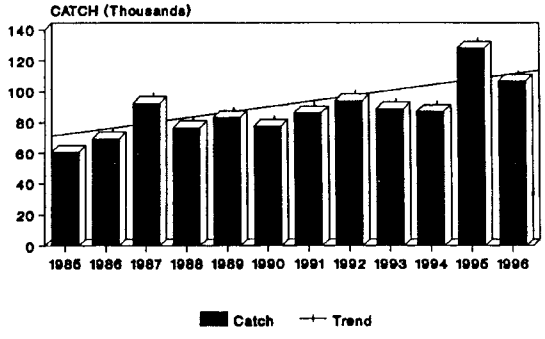
N.G.K.Pillai, Prathibha Rohit, K.P. Said Koya, R.Thiagarajan, and G. Syda Rao

The oil sardine production during the last 12 years varied from 0.47 lakh t in 1994 to 2.79 lakh t in 1989 with the present production at 1.1 lakh t. The catch, after the peak in 1989, showed a gradual reduction till 1994 and increased slowly subsequently. Kerala, which was the major contributor till 1993, was slowly relegated and in 1996 Tamil Nadu became the major contributor (40%) followed by Kerala (27.7%). Contrary to oil sardine, lesser sardine production showed a steadily progressing trend and the catch ranged from 0.6 lakh t in 1985 to 1.3 lakh t in 1995 with the present catch at 1.1 lakh t. The major contributor in 1996 was Tamil Nadu (56.6%) followed by Andhra Pradesh (14.7%).



All India landings (t) of oil sardine

The fishery and resource characteristics of *Sardinella* spp. exploited by different gears were monitored at Karwar, Mangalore,



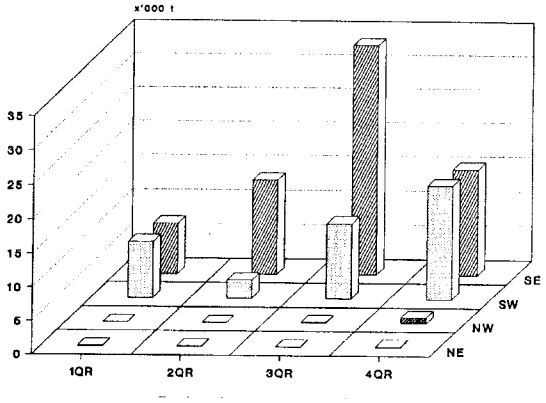
All India landings (t) of lesser sardines

Calicut and Cochin along the west coast and Tuticorin, Mandapam, Madras and Visakhapatnam along the east coast. During 1996, there was a significant increase in the sardine production compared to the previous year; an estimated 2.17 lakh t were landed against 1.85 lakh t in 1995 which constituted 7.6% of the total marine fish production. There was a remarkable increase of about 96% in the catch of oil sardine compared to 1995. The improvement in the fishery was noticed along the southwest region, particularly along the Kerala coast. Contrary to this, the lesser sardine catch recorded a decline of 16.4% compared to that of 1996.

Major gears employed for the exploitation of sardines were purseseine, ringseine, trawl net gillnet and artisanal gears. Purseseines contributed 97.7% of the total sardine catch at Mangalore and 79.6% at Cochin whereas ringseine was the dominant gear at Calicut which contributed 94.3% of the total catch. At Tuticorin and Visakhapatnam, sardine gillnet was the dominant gear, which contributed 78.5% and 85.3% respectively. The peak fishing season was August to December along the west coast and June to September along the east coast.

Among the sardines, *S. longiceps* was the dominant species at Karwar (87%) and it formed 78.4% at Mangalore followed by *S. gibbosa* (10.2%), *S. fimbriata* (6.9%), *S. brachysoma* (2.2%) and the rest by other species. In the sardine catch at Calicut, 92.6% and Cochin 94.5% was composed of *S. longiceps*. At Tuticorin *S. gibbosa* dominated the catch (38.5%) followed by *S. albella* (23.5%), *S. sirm* (17.7%), *S. dayi* (11.8%), *S. longiceps* (7.2%) and *S. clupeoides* (1.13%). *S. fimbriata* was the dominant species (59.7%) at Visakhapatnam and the rest was formed by *S. longiceps* (31.2%) and *S. gibbosa* (9.1%).

The length range of *S. longiceps* in purseseine at Karwar, Mangalore and Cochin was 80-205 mm with fishes of 125 to 175 mm length dominating the fishery. The recruitment size at the latter two centres was 50-100 mm. In ringseine at Calicut and Cochin the size range was 50-225 mm; 90-120 mm size groups dominated. In gillnet, the size range of *S. longiceps* was 110 to 205 mm with 135 to 150 mm and 180 to 190 mm



Regionwise, quarterly landings of oil sardine in 1996

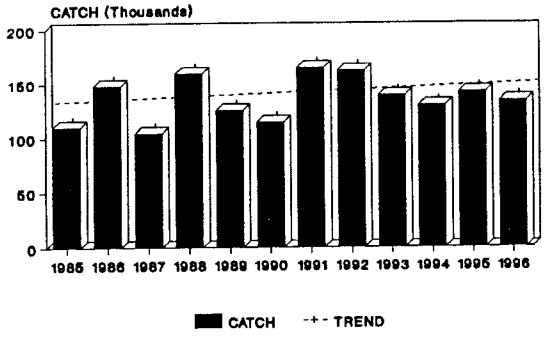
size groups supporting the fishery at Visakhapatnam. The size of *S. gibbosa* in purseseine at Mangalore ranged from 135 to 180 mm whereas in gillnet at Tuticorin it was 105 to 165 mm with 135 to 145 mm groups supporting the fishery. *S. fimbriata* had a size range of 40 to 175 mm in gill net at Visakhapatnam with 60 to 90 mm group dominating.

All stages of maturity were observed in *S. longiceps*. At Karwar, indeterminates and pre-adults dominated, while at Mangalore the gravid and partially spent ones dominated during August-November and the young ones during November-March. At Calicut, juveniles dominated during April-June and the developing and mature ones during other months. At Tuticorin, developing and gravid specimens of *S. gibbosa* were predominant during June-October. Spent and spent recovered specimens of *S. longiceps* constituted the fishery during January-March at Visakhapatnam.

Fishery and Resource Characteristics of Anchovies (PF/RE/1.2)

R. Thiagarajan, M. Zaffar Khan, Prathibha Rohit and P.N.Radhakrishnan Nair

During the period 1985 to 1996, the maximum catch of 1.65 lakh t of anchovies was recorded in 1991 and the minimum of 1.05 lakh t in 1987. The production during 1996 was 1.34 lakh t. This shows that the catch is almost stabilized between 1 and 1.6 lakh t. In 1996 the major contributor was Kerala (26.7%) followed by Gujarat (20.2%) and Tamil Nadu (18.7%).



All India landings (t) of whitebait

There was a decrease in the catch of anchovies in 1996; an estimated of 1.34 lakh t was landed against 1.42 lakh t during the last year. At Cochin Fisheries Harbour, 127.8 t of whitebaits were landed this year as against 1307 t in the last year, of which 72.8% was contributed by ringseine and the rest by trawl net. The C/E was 1.3 kg in trawl net and 52.4 kg in ringseine.

At Mangalore and Malpe fishing harbours too, the fishery failed and the catch was only 3265 t as against 7907 t last year. Mangalore Fisheries Harbour accounted for 83% of the catch. Gearwise, 52.1% was contributed by purseseine followed by trawl net (47.7%) and indigenous gears (0.16%). The fishing season at Mangalore and Malpe was slightly different. At Mangalore, the whitebaits were landed in both purseseine and trawl net in almost all the months of operation, whereas at Malpe, continuous landing was recorded in trawl net and, in purseseine it occurred only in November and December. The C/E in purseseine was 100.79 kg at Mangalore and 12.42 kg at Malpe, whereas in trawl net it was 26.2 kg and 18.4 kg respectively.

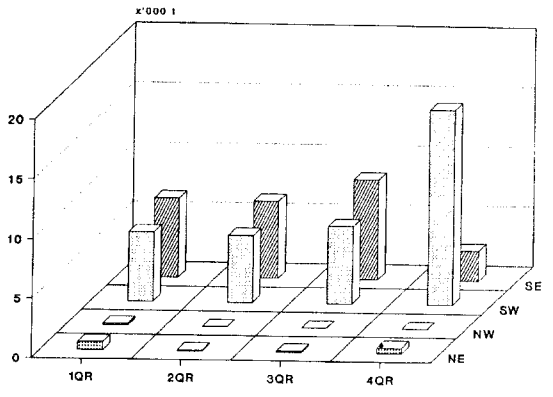
At Cochin, *Stolephorus bataviensis* dominated forming 44.3% followed

by *S. devisi* (40.2%), *S. indicus* (15.3%) and *S. commersoni* (0.2%) in trawl net whereas in ringseine, *S. devisi* formed the dominant one (55.6%) followed by *S. macrops* (22.2%), *S. bataviensis* (21.6%) and *S. indicus* (0.6%). At Mangalore-Malpe, *S. devisi* dominated in both purseseine and trawl net followed by *S. bataviensis* and *S. macrops*.

The overall size of *S. bataviensis* from ringseine ranged from 55 to 100 mm with 70 - 100 mm dominating and in trawl net, it ranged from 55-110 mm with 65-85 mm forming the fishery. The length range of *S. devisi* from trawl net was 55-90 mm with 80 mm size dominating and in ringseine, it was 65-95 mm with 90 mm size supporting the fishery. *S. macrops* ranged from 60 to 85 mm with a mode at 70 mm in ringseine. The M:F ratio in adult *S. devisi* was 1:0.7. In *S. bataviensis* it was 1:0.7 in trawl net and 1:1.3 in ringseine. In *S. macrops* from ringseine, the ratio was 1:1.

At Mangalore and Malpe, the length range of *S. devisi* was 50-100 mm in trawl net and 65-95 mm in purseseine with 65 to 95 mm supporting the fishery. The size range of *S. bataviensis* was 60-105 mm with 70 to 90 mm size dominating the fishery from trawl net and 80-105 mm with the mode at 100 mm from purseseine. Pre-adults and adults of both *S. devisi* and *S. bataviensis* occurred in the purseseine whereas in the trawls, only adults of *S. bataviensis* were found.

At Vizhinjam, the anchovy fishery was better (304.5 t) this year than in the previous year (176.5 t). Boat seine and the *Netholi*



Regionwise, quarterly landings of whitebait in 1996

valai contributed 57% and 42% respectively and the rest was by shoreseine. *S. devisi* dominated forming 39.8% followed by *S. bataviensis* (27.1%), *E. punctifer* (25.7%) and the rest by *S. andhraensis* and *S. indicus*. The length of *S. devisi* ranged from 35 to 95 mm in boat seine with modal size at 40 mm and 70-90 mm and 85 mm respectively in *Netholi valai*.

The shrimp trawlers at Pamban and Rameswaram contributed 102.3 t of anchovies of which *Stolephorus commersoni* constituted 87.9% at Pamban and 70.4% at Rameswaram and the rest by mostly *S. waitei*.

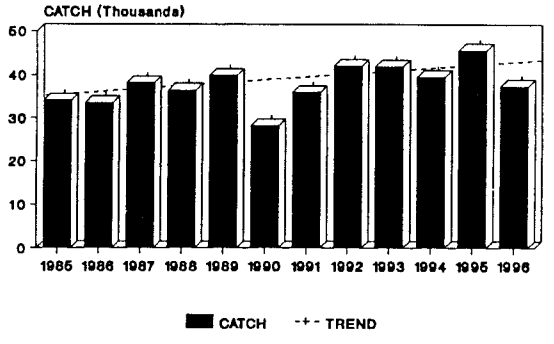
At Bombay, Sasoon dock, *Coilia dussumieri* contributed 88.5t with a catch rate of 14.7 kg forming 6.5% of the *dol* net catch. The size range was 50-190 mm with a modal size of 150 mm. The present fishing is found to be below optimum level.

Fishery and Resource Characteristics of Seerfishes (PF/RE/2.1)

C. Muthiah, B. Manoj kumar, Alexander Kurian, K.P. Said Koya, N.G.K. Pillai, H. Mohammed Kasim, and R. Thiagarajan

In the seerfish landings, during 1985-96, the maximum catch was 0.46 lakh t in 1995 and the minimum was 0.28 lakh t in 1990. The annual average catch was around

0.4 lakh t. Statewise, Gujarat recorded the maximum share (22%) in 1996 followed by Maharashtra (17.8%), Andhra Pradesh (15.7%) and Kerala (12.9%).



All India landings (t) of seerfishes

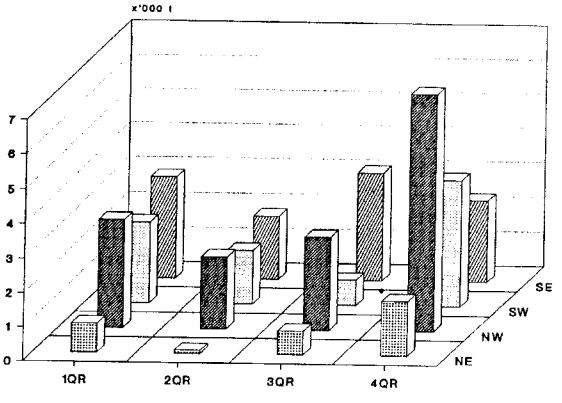
Studies were carried out at five centres on the west coast (Veraval, Bombay, Mangalore, Calicut and Cochin) and four centres on the east coast (Tuticorin, Mandapam, Madras and Visakhapatnam).

There was a decrease in the catch in 1996 compared to the previous year and the estimated landings were 37,402 t and 45,853 t respectively. The seerfish fishery during the year showed improvement at Visakhapatnam (21.05%), Calicut (123.5%), Cochin (17.7%) and Veraval (57.3%), whereas it recorded a decline at Madras (46.2%), Bombay (11.7%), Tuticorin (14.0%), and Mangalore (12%). Along the west coast the catch was highest at Veraval (2170 t) and lowest at Bombay (84 t). Along the east coast it was highest at Tuticorin (624 t) and lowest at Visakhapatnam (142 t).

Seerfishes were fished by drift gillnet and bottom trawl along both the coasts of India but along the east coast, in addition to these gears, hooks and lines were also employed. Drift gillnet was the principal gear contributing 66.4% of the total catch followed by bottom trawl (26.0%), hooks and line (7.7%) indigenous gear (1.1%) and purse seine (0.3%). The catch rate varied from 6.4 kg at Visakhapatnam to 59.9 kg at Madras in drift gillnet; from 0.31 kg at Cochin to 9.8 kg at Mangalore in bottom trawl and from 2.73 kg at Visakhapatnam to 40.23 kg at Madras by hook and line.

The king seer, *Scomberomorus commerson* and the spotted seer *S. guttatus* were the dominant species contributing 61.6% and 38.0% to the total seerfish catch respectively. The king seer dominated the catch at all the centres, except the northern centres (Visakhapatnam, Bombay and Veraval) on both the coast where spotted seer was the major species.

The king seer fishery was supported mainly by a wider size range in drift gillnet (16-132 cm) and hook and line (40-140 cm); and by smaller size groups in bottom trawl (16-86 cm). The spotted seer fishery was sustained by 14-68 cm size fish in both gillnet and bottom trawl. Young king seer below 34 cm in size was caught in appreciable quantity in the small meshed gillnet, *podivalai* (52.7%) at Tuticorin and in trawl net (58.6%) at Mangalore-Malpe. Almost all king seer caught by trawl at Mangalore-Malpe, Cochin



Regionwise, quarterly landings of seerfishes in 1996

and Tuticorin and in *podivalai* at Tuticorin were below the minimum size at first maturity (67 cm).

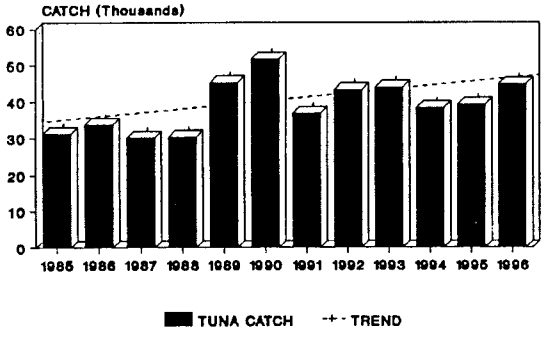
Stock assessment revealed that the seerfish resource is marginally overexploited along the coast of West Bengal and Kerala, exploited around MSY level in Orissa and Karnataka and underexploited in Andhra Pradesh, Tamil Nadu, Pondicherry, Goa, Maharashtra and Gujarat.

Fishery and Resource Characteristics of Tunas, Tuna Live-baits and Billfishes (PF/RE/2.2)

P.P. Pillai, B. Manoj kumar, M. Zaffar Khan, C. Muthiah, K.P. Said Koya, N.G.K. Pillai, H. Mohammed Kasim, M. Sivadas and A.K.V. Nasser

The catch of tunas during 1985 to 1996 ranged from 0.3 lakh t in 1985 to 0.52 lakh t in 1990. The present catch of 0.45 lakh t is slightly more than the previous year's catch. Kerala accounted for the maximum share (40.6%) in 1996 followed by Gujarat (18.8%) and Lakshadweep (15%) and the rest by other states.

Studies on the fishery and resource characteristics of tunas, tuna live-baits and billfishes were continued at Veraval, Bombay, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Madras and Minicoy.



All India landings (t) of tunas

During the year 1996-97 tuna catch declined at major centres such as Mangalore, Calicut, Cochin, Vizhinjam and Minicoy at the rate of 23% to 154% when compared to the previous year. Although the effort increased at most of the centres (12% to 56%), the C/E declined at the rate of 8% to 21%. At Tuticorin also, the catch and C/E declined by 26% and 14% respectively but the effort increased by 12%.

Though there was a significant increase in the catch at Bombay and Veraval, other centres recorded a notable decrease. The catch and percentage of increase/decrease were as follows: Veraval 2487.5 t (+ 70.4%); Bombay 260.1 t (+50.3%); Mangalore 313.7 t (-51.9%); Calicut 40.2 t (-61.3%); Cochin 903.6 t (-79.2%); Tuticorin 314.6 t (-37.5%); and Minicoy 606.6 t (-61.2%). The catch per effort in gillnet varied from 14.6 kg at Calicut to 130.1 kg at Bombay. In pole and line it was 284.2 kg at Minicoy and 340.0 kg at Agatti. One of the important developments at Minicoy during the year was the exploitation of yellowfin tuna by hand lines operated in the night, not only during monsoon period but also in December.

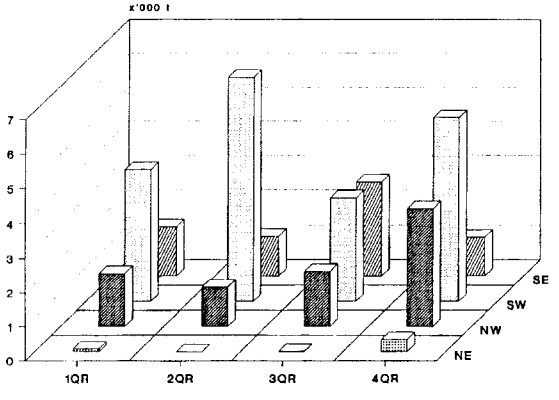
Among tunas, *E. affinis* constituted the major species (46.7%) at all the centres along

the mainland of India. *T. tonggol* contributed 16.3%, *A. thazard* 14.4%, *T. albacares* 10.7%, *A. rochei* 10.4% and *S. orientalis* 2.0% of the overall tuna catch.

Istiophorus platypterus (60.8%), *Makaira indica* (30.1%) and *Xiphias gladius* (9.1%) contributed the billfish catch at different centres along the mainland of India. At Minicoy, in pole and line fishery 87.9% was comprised by *K. pelamis* followed by *T. albacares* (11.6%). In the hand lines operated at Minicoy, *T. albacares* constituted 99.1%. At Agatti *K. pelamis* constituted 98% of the total tunas caught.

The bait fish catch at Minicoy was 5.6 t with a C/E of 3.4 kg, and at Agatti it was 53.6 t with a C/E of 14.4 kg. Clupeids were the major group at both the centres (65%).

The size range of *E. affinis* in the fishery was 27-74 cm, with fishery supporting group in the 30-56 cm size range; that of *A. thazard* 22-50 cm with modes in the 34-42 cm size groups; that of *T. tonggol* 30-94 cm with modes in the 40-88 cm size groups; that of *T. albacares* 28-176 cm with modes at 42-108 cm size group; that of *K. pelamis* 28-70 cm, with modes at 48-50 cm size group and that of *S. orientalis* 34-52 cm with modes in the 44-46 cm size group.



Regionwise, quarterly landings of tunas in 1996

Biological studies were carried out at Minicoy on *K. pelamis*. Bait fishes were dominant in the stomachs in most of the months. The maturity condition revealed the presence of only mature fishes in the sizes above 50 cm in all the months. Among these, partially spent ones dominated.

Experimental rearing of *Archamia fucata,* a tuna livebait, was conducted at Minicoy. This species, kept alive for nearly 12 months, had grown to a size of 50-60 mm from the initial size of 30-40 mm. The gonad was found to be in the immature stage even after attaining 50-60 mm size.

At Tuticorin, the stock assessment studies conducted on *E. affinis* and *A. thazard* revealed that the exploitation rate (U) is 0.71 and 0.58 respectively in *paruvalai.* The stock of *E. affinis* was estimated as 207.8 t and of *A. thazard* 110.9 t in the fishing ground of *paruvalai.*

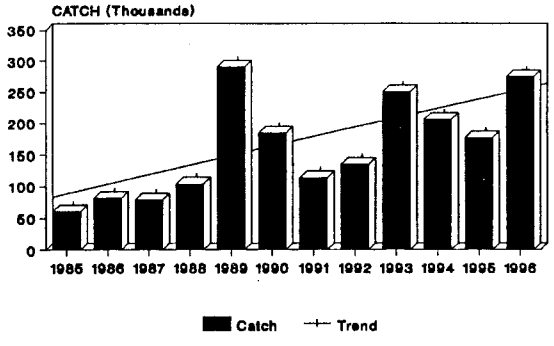
At Mangalore, the exploitation ratios of *E. affinis, T. tonggol* and *A. thazard* were 0.05, 0.48 and 0.26 respectively. All the three species were underexploited during the year as compared to slightly higher exploitation level in the last year (E-0.61) for *E. affinis*; 0.6 for *T. tonggol* and 0.54 for *A. thazard.*

The stock assessment studies on *E. affinis* at Bombay gave the following values: $L\alpha = 83.0$ cm, $K = 0.72$, $Z = 3.84$ and $F/Z = 0.79$ which indicate that the present level of fishing is very close to the optimum level.

Fishery and Resource Characteristics of Mackerel (PF/RE/2.3)

H. Mohammed Kasim, Prathibha Rohit, K.P. Said Koya, P.P. Pillai, P.N.Radhakrishnan Nair, R. Thiagarajan, E.M. Abdussamad and G. Syda Rao

During the period 1985 to 1996, the mackerel production was maximum (2.9 lakh t) in 1984 and minimum (0.6 lakh t) in 1985. The current production of 2.76 lakh t landed in 1996 is the second highest recorded during the last 12 years. Kerala was the major contributor (47.1%) in 1996 followed by Karnataka (19.4%) and Maharashtra (13.9%).

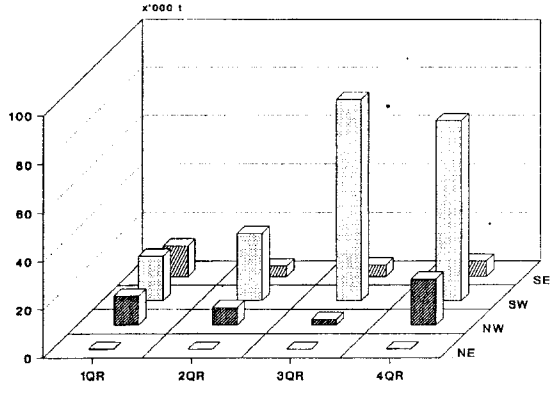


All India landings (t) of mackerel

The fishery and resource characteristics of mackerel exploited by different gears were monitored at Karwar, Mangalore, Calicut and Cochin along the west coast and at Tuticorin, Mandapam, Kakinada, and Visakhapatnam along the east coast. There has been a significant increase in the mackerel production during 1996 when compared to 1995. An estimated total of 2.77 lakh t of mackerel was landed in 1996 against 1.77 lakh t in 1995. Mackerel constituted 9.02 % of the total marine fish production in 1996.

Along the west coast, the increase in the mackerel catch compared to the previous year, varied from 135.8% at Cochin to 220% at Mangalore. Among the different gears operated, the purse seine/ring seine landed major share of mackerel in all the centres and the contribution varied 60.6% in ringseine at Calicut to 84.6% in purse seine at Mangalore. The trawlnet landed 10.1 to 33.8% of mackerel. *Chalavala*, gillnets and other indigenous gears landed the rest of the catch. The size range varied from 60-270 mm in ringseine, 120-279 mm in purseseine, 130-279 mm in trawlnet and 175-254 mm in drift gillnet. The indeterminates and preadults were dominant in ringseine landings. At Calicut, more than 90% of the ringseine catch was comprised of juveniles of the size less than 140 mm landed during the monsoon season, especially in August. This phenomenon is caused by increased ringseine operations during the monsoon period.

The M:F ratio in ring seine at Calicut was 1:1, but the males were dominant in



Regionwise, quarterly landings of mackerel in 1996

trawl catch at Cochin. Maturation commenced by October/November and by February/March all were in fully matured condition. Oozing gonads were common in March-June period.

The drift gillnets, trawlnets and boatseines exploited mackerel effectively along the east coast. The increase in the mackerel catch varied from 28% at Visakhapatnam to 66.5% at Kakinada. The drift gillnets landed more mackerel at Visakhapatnam (71%) and Tuticorin (69%). The size range varied from 63 to 157 mm in boat seines, 130-289 mm in drift gillnets and 60-269mm in trawlnets. The recruitment of juveniles to the fishery was observed in April and this shows that mackerel might have spawned during January-March along the east coast. The exploitation rate by drift gillnet and trawl net at Tuticorin was 0.82 and 0.73 respectively and this suggests that mackerel is overfished by these two gears along the Tuticorin coast. The total annual stock is assessed at 626 t at Tuticorin. The females were dominant. The indeterminates were landed more by boat seines and *chalavalai*.

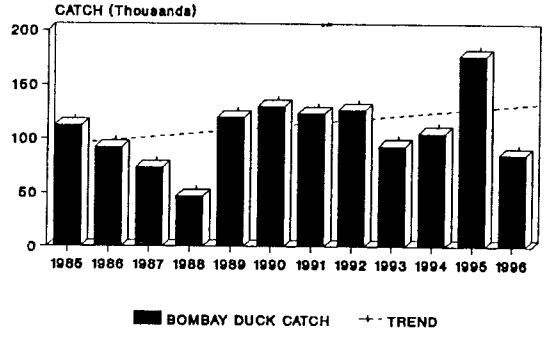
In a nutshell the mackerel fishery was better along the Indian coasts due to better abundance and higher effort input of most of the gears operated. As in the previous years the fishery along the west coast was better than the east coast. Overfishing of mackerel is reported by trawl and drift gillnet off Tuticorin. Recruitment of juveniles to the fishery was observed in April along the east coast and in September along the west coast.

Fishery and Resource Characteristics of Bombay Duck (PF/RE/3)

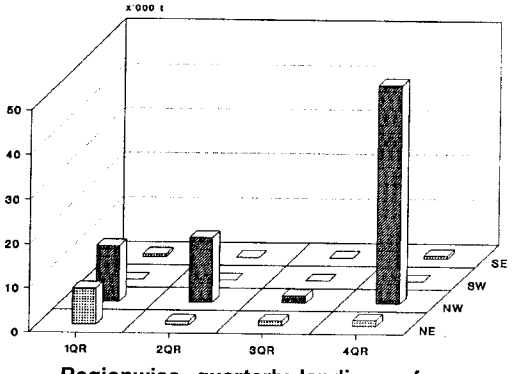
Alexander Kurian and B. Manoj Kumar

There was wide annual fluctuation in Bombay duck landing as the minimum catch was 0.47 lakh t in 1988 and the maximum 1.77 lakh t in 1995. In 1996 the catch came down to 0.89 lakh t. About 73% was landed in Gujarat followed by Maharashtra (11.9%).

Investigations on the fishery and resource characteristics of Bombay duck were conducted out at Sasoon dock,Bombay and Jaffrabad, Rajpara and Nawabunder along the Sourashtra coast. The estimated landing in 1996 was 85,766 t against 92,687 t in 1995. Northwest region contributed 72,610 t (84.9%) to the total Bombay duck landings. Gujarat alone contributed 62,446 t forming 72.8% of the total production. Along the Sourashtra coast, Rajpara contributed to



All India landings (t) of Bombay duck



Regionwise, quarterly landings of Bombay duck in 1996

38.1% followed by Jaffrabad (36.7%) and Nawabunder (25.2%). The average catch per dolnet haul in the above three centres together was 55.57 kg against 63.69 kg observed in the previous year. The catch per haul decreased at all the centres except at Nawabunder.

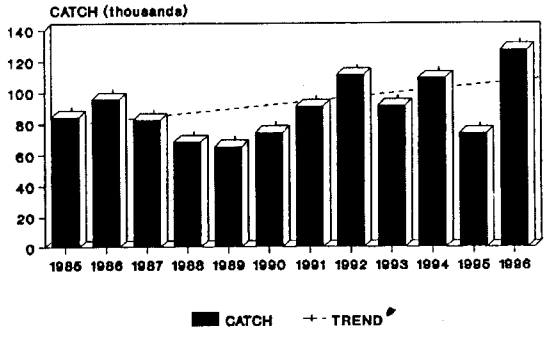
The Bombay duck fishery in Maharashtra witnessed a decline in effort as well as total catch (10,164 t), but there was a marginal increase in catch rate when compared to 1995-96. The effort in terms of units got reduced to 8738 in 1996-97 from 10727 in 1995-96. However the catch rate for 1996-97 increased to 310 kg from 306 kg observed in the previous year.

The length range in the catch was 30 to 314 mm along Gujarat and Maharashtra. Recruitment (at 30 mm) occurred during February to June. The Bombay duck fishery at Nawabunder was supported by wider size groups (30-209 mm) with 195-204 mm size dominating the fishery, whereas 210-224 size groups supported the fishery at Rajpara. About 28.3% of the fishes at Nawabunder and 31.7% at Rajpara were with empty stomachs in the observed samples. The gut of the sampled fish mainly contained non-penaeid prawns, fishes and juveniles of Bombay duck. The sex ratio showed female domination at Nawabunder and Rajpara. Two spawning periods, one during pre-monsoon and another during winter were noticed along the Gujarat coast.

Fishery and Resource Characteristics of Ribbonfishes (PF/RE/4)

P.N.Radhakrishnan Nair, K.K. Joshi, M. Zaffar Khan, C. Muthiah, and E.M. Abdussamad

During the period 1985 to 1996 the minimum catch of ribbon fishes (0.65 lakh t) was recorded in 1990 and the maximum in 1996 (1.27 lakh t). In this period, the ribbonfish production crossed 1.25 lakh t only in 1996. This was mainly due to target fishing on this resource which has got an export market in the north east Asian countries, especially in China. Gujarat contributed 43.3% of the total ribbonfish landings followed by Maharashtra 21.6% Kerala 17.2% and the rest by other states.



All India landings (t) of ribbonfishes

Investigations were carried out at Veraval, Bombay, Karwar, Mangalore, Cochin and Vizhinjam along the west coast and Madras, Kakinada and Visakhapatnam along the east coast. Trawl net was the major gear in all the centres except at Vizhinjam, where this was landed in the traditional gears.

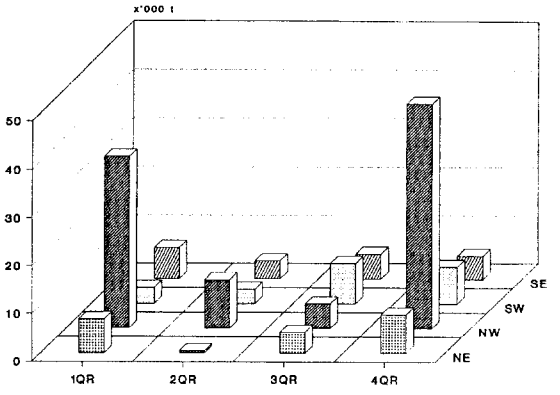
Ribbonfish emerged as one of the important pelagic finfish resources along the Indian coasts during 1996-97. An estimated 1,27,467 t of ribbonfishes were landed against 73,743 t in 1995-96.

The landings by trawl increased in all the centres except at Kakinada and Visakhapatnam where the trawl fishery had the impact of cyclone. The annual catch and its percentage increase at different centres were as follows: Veraval 14131 t (124%), Bombay 7956 t (381.4%), Karwar 191.2 t

(141%), Mangalore 2788 t (141%), Cochin 1795.3 t (2393.5%) and Madras 1382 t (52.5%). The catch and its percentage decrease at Kakinada and Visakhapatnam were 1956 t (60%) and 76 t (62.5%) respectively. At Vizhinjam, a total of 5663.2 t of ribbonfish was landed by all the gears together, which is the highest since 1993.

In all the centres except at Kakinada, the fishery was constituted by *Trichiurus lepturus* alone. At Kakinada, *T. lepturus* formed 90% catch of ribbonfish followed by *Eupleurogrammus muticus* (3.8%), *Lepturacanthus gangeticus* (2.5%), *T. russelli* (1.9%), *L. savala* (1.7%), *E. glossodon* (0.2%).

The size of *T. lepturus* varied from 12 to 118 cm with the mode at 66 cm in trawl and 32 to 118 cm with the mode at 36 and 112 cm in gillnet at Veraval; 30 to 120 cm with the mode at 65 cm at Bombay; 32-106 cm at Mangalore-Malpe with the modes at 38 and 100 cm; 34 to 122 cm with multimodes at Cochin; 22 to 74 cm with multimodes at Kakinada and 19-99 cm at Visakhapatnam. The recruitment size in trawl was the smallest (8 cm) at Kakinada. It was 16, 20, 30, 32 and 40 cm at Visakhapatnam, Veraval, Mangalore, Cochin and Bombay respectively. The food and feeding studies showed the dominance of crustaceans and cephalopods at Kakinada and crustaceans (*Acetes sp*) and fishes at Visakhapatnam. Females were dominant at Veraval (55%), Bombay (57%),



Regionwise, quarterly landings of ribbonfishes in 1996

Mangalore (59%) and Kakinada (53%). At Visakhapatnam, the males dominated in trawl net (59%) and females in boat seine. At Cochin, males were more (58%). Spawning season was generally from November to May or June.

The stock assessment studies conducted at Bombay showed that the estimated total mortality (Z) was 3.825 with F/Z = 0.848. The growth parameters estimated at Mangalore-Malpe were L α = 123 cm and K = 0.45 per year. From the estimated exploitation ratio (E= 0.32) it is inferred that during the current year, *T. lepturus* was exploited below the optimum level as compared to the situations of optimum exploitation in 1995-96 and slightly at higher optimum level in 1994-95.

Fishery Forecasting Based on Multispecies Resource Interaction in Space and Time in the Malabar Upwelling Zone (CMFRI/IDP/FF/1)

P.P. Pillai, M. Devaraj, P.N.Radhakrishnan Nair, V.N. Pillai, K.G.Girijavallabhan, K. Balan, M. Srinath, P. Bensam, N.G. Menon, S. Sivakami, N.N. Pillai, K.N. Rajan, K.A. Narasimham and Lakshmi Latha

The objective of the project was to develop a multispecies yield prediction model for commercially important fisheries.

Historical data on the monthly landings of major pelagic finfish resources was the prerequisite for the development of pre-

diction models. To begin with, the data on mackerel and sardines since 1978 were gathered, compiled and passed on to the statisticians for computer processing and developing yield prediction models. The data on oil sardine landings along the Kerala coast, since 1961, was processed and correlated statistically with the effect of sunspot activity, total rainfall and mean sea level pressure.

The following results were obtained in the analysis using ARIMA models:

— There was a general declining trend in the oil sardine landings

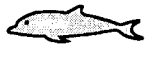
— The general declining trend may be attributed to the increase in fishing effort since 1960 s

— The smoothed data showed periodicity of about 10 to 11 years

— Although the years of higher sunspot activity, in general, coincided with higher oil sardine landings, there seemed to be "leads" in the landings with respect to the sunspot activity. This meant that higher sunspot activity at present might lead to higher oil sardine landings in 4 to 6 years hence.

— Significant cross correlations of oil sardine landings with total rainfall were found. Higher the amount of rainfall during the late phase of the monsoon (July-September)seemed to yield higher landings whereas higher amount of rainfall during the early phase of the monsoon (April-June) was found to result in lower landings.

— A decadal periodic trend in the oil sardine and that of the mean sea level pressure could be observed.



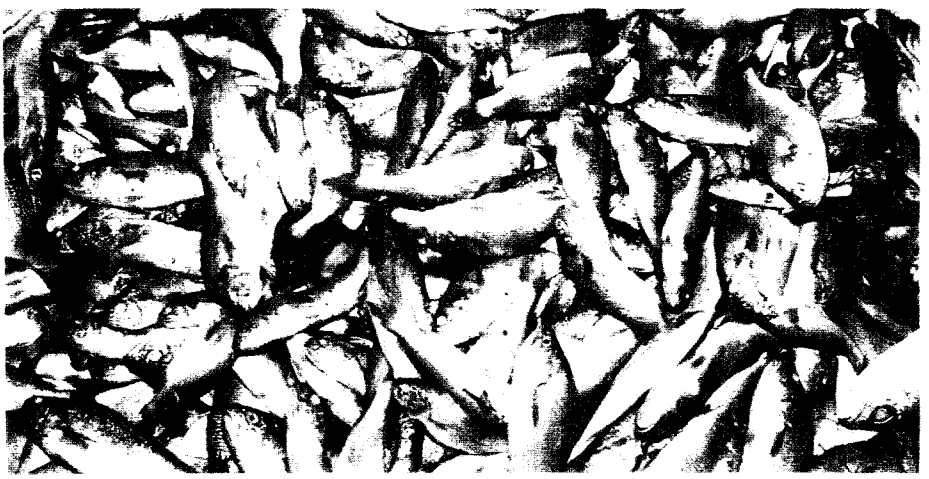
The Oil Sardine — a fishery that started improving again along the southwest coast

The Indian mackerel — the most dominant single species pelagic fishery along the Indian coast

Little tunny — The most abundant coastal tuna

A part of a day's catch of threadfin breams (Nemipteridae) at Neendakara during southwest monsoon period

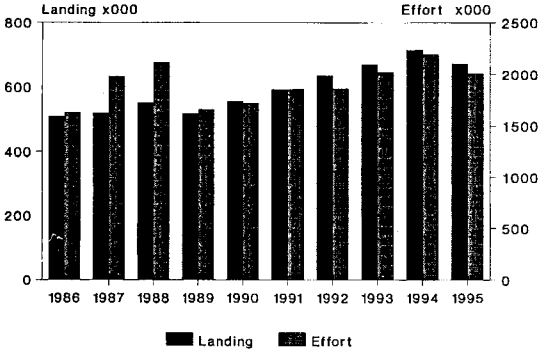
Catfish (Tachysuridae) at Cochin Fisheries Harbour



Croakers (Sciaenidae) at Fisheries Harbour, Cochin

III. DEMERSAL FISHERIES DIVISION

In the estimated marine fish potential yield of 3.9 million tonnes(mt) in the Indian EEZ, the demersal finfish resources constitute about 25%. The estimated potential yield of these resources is about 0.56 mt in 0-50m depth zone and 0.41 mt in depths beyond 50 m. The fishing was confined to 0-50 m zone until a few years back but in recent years it is extended upto 120m depth in certain regions and, for economic reasons the trawlers are conducting stayover fishing for periods of 2-7 days continuously. During the past one decade, the annual estimated demersal finfish landings increased from about 0.49 mt in 1988 to about 0.71 mt in 1995 with an annual average of 0.59 mt,with bulk of the catch coming from trawlers. The maximum yield in 1995(0.71 mt) is more by 0.15 mt than the potential yield in 0-50 m depth zone and 0.26 mt less than the total potential yield in the country's EEZ. If the shrimp bycatch discards are also accounted, the present catch of demersal finfish is likely to be close to the estimated potential yield in the country's EEZ. The situation therefore, warrants close monitoring of exploitation and implementation of regulatory measures emanating from research, based on a sound database on exploited stocks to ensure economically sustainable yields. In recognition of this, the demersal fisheries division strengthened its research efforts on exploited stocks and data were collected from several centres along the coast and stock assessment carried out on several species stocks. Noting the imperative need to develop viable technologies for breeding and culture of marine finfish, the division initiated multidisciplinary research in this area during the year.



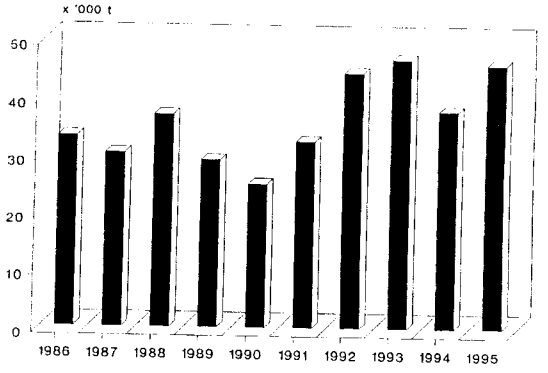
Estimated trawling effort (units) and demersal finfish landing (t) in India

The division implemented 13 research projects: eight on exploited stocks, one on finfish mariculture, one on fish eggs and larvae, one on benthic fauna in the trawling grounds and two sponsored projects. The details are presented in this report.

MONITORING THE RESOURCE CHARACTERISTICS OF ELASMOBRANCHS (DF/RE/1)

P. Devadoss, S.G.Raje, Grace Mathew, R. Marichamy and V. Gandhi

Work in the project was continued at Bombay, Madras, Mandapam and Tuticorin. Data were collected from Trawlers, drift gill net, bottom set gillnet and deepsea trawl. Trawlers landed this resource from all the centres, drift gill net from Madras and Tuticorin, bottom set net and deepsea trawls only at Tuticorin. The estimated catch from all these four centres was 6,163 t, of which trawlers contributed 5910 t (96%). Rays contributed to 63% of the elasmobranchs, followed by sharks (32%) and guitar fishes(5%).



Landings of sharks in India

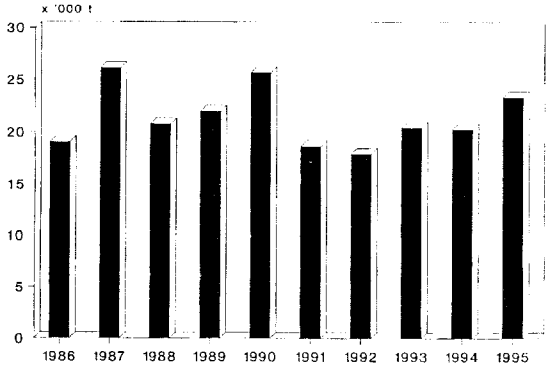
The catch at Tuticorin (2190 t) and Bombay (2084 t) accounted for 69% of the total of the four centres. October to March is the period of maximum catch at Bombay, July to September at Tuticorin (both trawl and drift gill net), October to June at Mandapam and January to March and July to September at Madras.

At Tuticorin, Rays were the dominant group (84%) in the trawl, and sharks (79%) in the drift gill net. *Rhizoprinodon acutus* was the dominant species.

In the Mandapam region the trawlers landed an estimated 1020 t from trawlers at Rameswaram and Pamban. There was an increase of 268 t compared with previous year. *Dasyatis* spp formed 78% at Rameswaram, and *Rhinoptera javanica* and *Aetobatus narinari* accounted for 70% of the elasmobranchs at Pamban. The sizes of *D. uarnak* ranged between 40-220 cm and *D. sephen* 50-150 cm.

The estimated total at Madras was 867 t with trawlers contributing 88% of the production. There was reduction in effort over the years : 54859 boatdays during 1994-95, 49,046 during 1995-96 to 32365 during the period under report. The catch per effort however, remained more or less unchanged. Elasmobranchs formed 3% of the trawl catch and 15% of the drift gillnet catch. February - April was the period of peak landings. Rays were the major component in the trawlers contributing to 89% of elasmobranchs. The size of *D. jenkinsii* ranged from 16 cm to 142 cm with the bulk of the catch in the length range of 45-89 cm.

Elasmobranchs were landed only by trawlers at Bombay. The catch (2084 t) showed a decline of 36% over previous year. This group formed around 3% in the total landings. Sharks were dominant forming 71% of elasmobranchs followed by rays with 20% and the rest guitar fishes . *Scoliodon laticaudus*, *Dasyatis zugei* and *Rhynchobatus djeddensis* were the dominant species among sharks, rays and guitar fishes respectively. The size range of *S.laticaudus* males was 180-560 mm with the mean at 393 mm and that of females 160-640 mm with the mean at 396 mm. The male:female ratio was 1:1.5 and pregnant female were recorded during April and December to March.



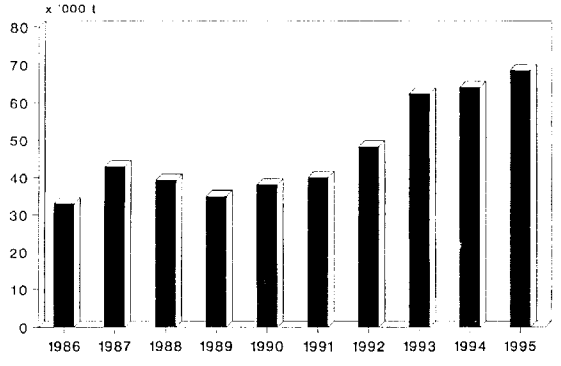
Landings of skates and rays in India

Monitoring the Resource Characteristics of Groupers, Snappers and Pigface Breams (DF/RE/2)

Grace Mathew, P. Nammalwar, S.K. Chakraborty
K.K. Philippose and P. Livingston

Investigations were carried out at Bombay, Cochin, Vizhinjam, Tuticorin and Madras.

At Bombay, (New Ferry wharf), the shrimp trawlers land these fishes from off



Perch landing in India

Bombay and Kutch region. The estimated total catch during the year was 734 t registering 30% increase over that of the previous year. January-March was the period of peak landings. *Epinephelus diacanthus* was the most dominant species ranging in length from 10 cm to 52 cm.

At Cochin also, the perch fishery registered an improvement over the previous year. The catch was estimated at 848t during the year while in the previous year it was only 346t. This was mainly due to the increase in catch by the hooks and lines. The landings from trawlers were high during August-September and December-January months. *Epinephelus diacanthus* was landed throughout the year by trawlers. In the hooks and lines, catch, the dominant species was *Pristipomoides typus* followed by *E. chlorostigma*, *E.diacanthus*, *E.albomarginatus* and others. The length range of *E.diacanthus* from the trawlers was 10 cm to 37 cm, with 10 and 15 cm being dominant. In the hooks and lines, length range in the catch was 23 cm to 50 cm with mode at 35 cm. *P. typus* from the hooks and lines ranged in size from 30 to 71 cm with the mode at 45 cm. *E. diacanthus* from trawl catch was in immature stage.

At Vizhinjam, these fishes were landed principally by the hooks and lines operated by motorised units; the estimated catch was 740 t with CPUE of 9.0 kg. Highest catches as well as catch rates were recorded during May-July period and also January-February. *Epinephelus* spp, *Pristipomoides* spp, *Lethrinus nebulosus*, *L.lentjan* were the most dominant species. Length frequency data showed that *L. lentjan* was in the range of 180 mm to 730 mm with dominant modes at 550 mm and 610 mm ; *L.nebulosus* in 140 mm to 440 mm with modes at 370 and 390 mm.

At Tuticorin, the estimated total landing during April-December was 3579 t. Trawl was the principal gear for the resource followed by gillnets and hooks and lines . The average CPUE was 85 kg. The average annual CPUE from trawlers, drift nets and hooks and lines were 102 kg, 15 kg and 75 kg respectively. *Lethrinus nebulosus*, *Epinephelus undulosus*, *L. miniata*, *E. tauvina*, *Lutjanus rivulatus*, *E. malabaricus*, *L.waigaiensis* were the most dominant species in the order of their abundance. In *L. nebulosus* the length range was 100-660 mm with modes at 170 mm and 350 mm.

Epinephelus undulosus was in the length range of 330 - 580 mm with mode at 435 mm.

At Madras only 85 t were landed. Groupers constituted 55%, snappers 9% and Pigface breams 36%. Hooks and lines by mechanised craft were used principally. *Epinephelus tauvina* and *E. diacanthus* were the dominant species of groupers. *E. tauvina* ranged from 250 to 949 mm in length with major mode at 530 mm. Fishes in advanced stages of maturation occurred during July-September. The dominant food items were fish, small prawns and crabs.

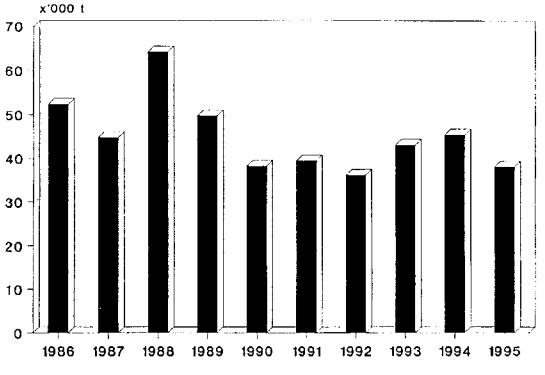
Monitoring the Resource Characteristics of Catfishes (DF/RE/3)

N.G. Menon, S.G.Raje and P. Nammalwar

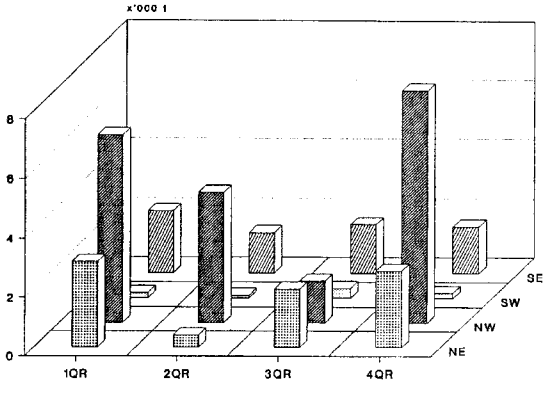
A total of 1382 t of marine catfish were landed at New Ferry Wharf (Mumbai) by trawlers; compared to previous year there was a decline of 21%. The maximum catch of 208 t was obtained in November with a CPUE of 50.7 kg. The average CPUE during the year was 47 kg. *Tachysurus dussumieri* was dominant forming 40.3% of catfish catch followed by *O. militaris* (25.7 %), *T. sona* (9.9 %), *T. caelatus* (9.8 %) and others. The size range of *O. militaris* in trawlers was 120-450 mm with mean at 267 mm. *T. caelatus* ranged from 170 to 460 mm in length with the mean at 313 mm. The male : female ratio of *T. caelatus* was 1:1.4. The rates of mortality and exploitation of two species are estimated as:

Species	Z	M	F	F/Z	F/Z(1-e^{-Z})
O.militaris	4.3239	1.10	3.2239	0.7456	0.7357
T.caelatus	1.5160	1.10	0.4160	0.2744	0.2141

The estimated catfish catch was 19 t at Cochin, with drift gill netters contributing 76.5% and purse seiners 23.5%. Maximum catch was obtained during July-November. The drift net catch consisted chiefly of *Tachysurus thalassinus* (14-54 cm) and a few mature females of *T. serratus* (85-110



Catfish landing in India



Regionwise, quarterly landings of catfishes in 1996

cm) in the month of June. The entire catfish landing by purseseine was in October , consisting of *T. serratus* only; the catch was taken from two shoals on two consecutive days. Ripe females and egg carrying male brooders were caught . An estimated 280 kg of eggs/embryos of *T. serratus* was also landed on these 2 days.

The estimated catch at Madras by hooks & lines was 35.3 t. The monthly catch rate ranged from 1.8kg (July) to 11 kg (September) catfish formed 8.3 % of the total catch by hooks and lines. *T. dussumieri* was the dominant species in this gear. The size ranged from 250 to 899 mm.

At Visakhapatnam 15 t of catfish was landed by trawlers which formed 0.7 % in the total landing. The catch consisted of *Tachysurus thalassinus* (50 %) and *T. tenuispinis* (50%) and their sizes ranged from 100 to 119mm and 280 to 299 mm respectively. The reappearance of *T. tenuispinis* is worth recording in the context of its declining trend in landings elsewhere. The entire catch of *T.thalassinus* consisted of fishes smaller than the size at first maturity.

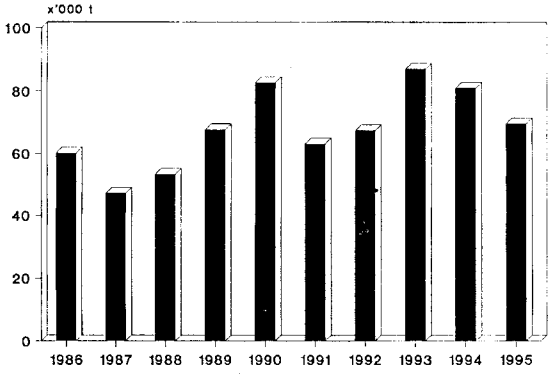
Development of Management Strategies for Sustainable Fishery of Threadfin Breams and Silver Bellies (DF/RE/4)

E.Vivekanandan, P.P. Manojkumar, S.K.Chakraborty, P.U.Zacharia K.V.S. Nair, V.S. Rengaswamy, A.Raju and K.M.S.A. Hamsa

This project was conducted at 9 research centres and data were collected from major fisheries harbours. Both the resources were exploited almost exclusively by trawlers.

Threadfin Breams

An estimated 3770 t (CPUE: 3.8 kg/h) of threadfin breams were landed by the trawlers at Veraval. The catch increased by 125 % compared to 1995-96. The landings were high during January-March, 97. *Nemipterus japonicus* formed 69.8% and *N. mesoprion* 25.8% of the catch. The length range of *N. japonicus* was 90 -299 mm with the bulk of the catch in the length range of 170-249 mm.



Landings of threadfin breams in India

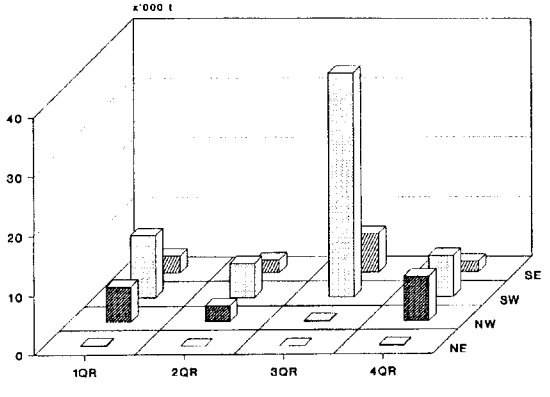
At Bombay (New Ferry Wharf) the estimated landing was 1389t (CPUE : 47.3 kg/boat) which formed 2.2% of the total trawl landings. The catch decreased by 42% over that of previous year. The length range of *N. japonicus* was 80-309 mm and the annual mean length was 128 mm. In *N. mesoprion* the length range in the catch was 60-277mm with the mean at 152mm. In this species most of the fish were in maturing stage with a few mature adults occurring in September, November, December and March. The mortality rates and MSY were estimated as:

Species	Z	M	F	MSY
N. japonicus	2.88	1.5	1.33	315 t
N. mesoprion	3.44	1.57	1.87	1551 t

The trawlers at Mangalore and Malpe landed an estimated 6387 t (CPH: 4.1 kg) of threadfinbreams. The catch was higher by 48% when compared to previous year. *N. japonicus* and *N. mesoprion* constituted the fishery forming about 50% of the nemipterid landings. The length range *N. japonicus* was 90-300 mm with the mean at 166mm. On the basis of the data on *N.japonicus* for the last 8 years, the MSY of *N.japonicus* from off Karnataka was estimated as 3410 t against the present catch of 3397 t.

An estimated 645 t were landed (CPUE: 18.6 kg/unit) by trawlers at Cochin Fisheries Harbour. The catch declined by 7% over previous year. The length range of *N. mesoprion* was 110-199 mm and modal length was 135 mm. Females in stage III of gonadal development dominated the fishery.

At Tuticorin the trawlers landed an estimated 1426 t (CPUE: 38.5 kg/unit) of threadfin breams, which formed 4.6% of the total trawl landing. *N. delagoae* (77.2%) and *N. japonicus* (22.5%) dominated the landings. The length range of *N. delagoae* was 130-280 mm and the modal length was 215 mm.



Regionwise, quarterly landings of threadfin breams in 1996

In the Mandapam region 153 t of nemipterids were estimated to have been landed. At Pamban, *N. tolu* and *N. japonicus* formed 77.2% and 22.5% of the landings, respectively. The length range of *N.tolu* at Pamban was 120-239 mm and the modal length was 185mm.

An estimated 3194 t (CPH: 4.1 kg) were landed by trawlers at Madras forming 11.7% of the total trawl landings. The catch declined by 34% compared to 1995-96. *N. mesoprion* (28.7%), *N.delagoae* (27.5%), *N. japonicus* (26.9%) and *N. tolu* (17.0) contributed to the fishery. The length range of *N. japonicus* was 90-259 mm and the annual mean length was 140 mm. Females in early stages of gonadal development dominated the fishery. The following population parameters were estimated;

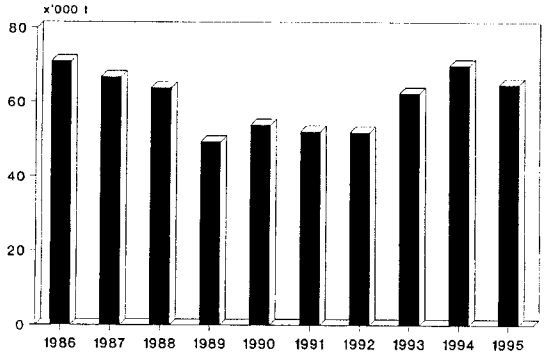
Species	Z	F	M	Current Yield	MSY
N.japonicus	5.085	3.610	1.475	851 t	1075 t
N.mesoprion	5.796	3.721	2.075	908 t	1410 t

At Kakinada an estimated 431 t (CPH: 4.1 kg) were landed by trawlers forming 1.6% of the total trawl landings. *N. japonicus* (81.9%) and *N. tolu* (10.9%) formed the major components of the catch. The length range of *N. japonicus* was 30-289 mm and the modal length was 135 mm. Females in early stages of gonadal development dominated the fishery.

The trawlers at Visakhapatnam landed an estimated 161 t of threadfin breams (CPH: 1.3 kg) forming 7.6% of the total trawl landings. The catch declined by 25% . *N. mesoprion* and *N. japonicus* formed 70% of the nemipterid landings. The length range of *N. japonicus* was 110 -249 mm and the annual mean length was 171 mm.

SILVERBELLIES

An estimated 474 t (CPH: 0.4 kg) of silverbellies were landed at Veraval and Mangrol landing centres. The catch declined by 28% compared to 1995-96. In the Mangalore region, the silverbelly landings were estimated at 380 t (CPH: 0.3 kg). *Leiognathus bindus* and *Secutor insidiator* dominated the fishery in both the centres. The length range of *L. bindus* was 60-119 mm and the modal length was 87 mm. At Tuticorin the trawlers landed an estimated 3895 t (CPH: 105.1 kg/unit) which is 54% higher than that of last year. *L.dussumieri* (32.4%),*G. minuta* (25.5%) and *L. bindus* (10.6%) were dominant. In the Mandapam region, the silverbelly catch was estimated at 18,639 t (CPUE: 210 kg/unit). The catch declined marginally (7%) compared to last year. At Rameswaram, *L. brevirostris* (50.6%) and *L. jonesi* (40.6%) were dominant and at Pamban, *L. dussumieri* (55.6%). The length range of *L. jonesi* was 40-134 mm and the modal length was 82 mm. The length range of *L. dussumieri* was 50-149mm and the modal length was 92 mm. Females in early stages gonadal development dominated the fishery in both the species.

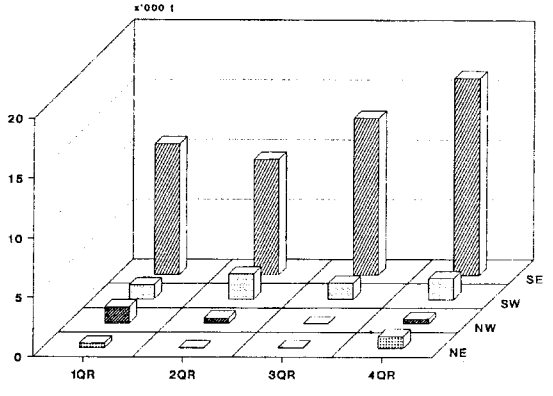


Landings of silverbellies in India

An estimated 3301 t (CPH: 4.3 kg) were landed by trawlers at Madras forming 12.5% of the total trawl landings. The catch and CPH have declined by 40% and 43%, respectively. *L. bindus* (35.7%) and *S. insidiator* (21.3%) were dominant. The length range of *L. bindus* was 30-124 mm and the annual mean length was 87 mm. The population parameters were: Z=5.101; F=3.129; M= 1.972; current Yield: 1045 t; MSY=1285 t.

At Kakinada the trawlers landed an estimated 758 t of silver bellies (CPH: 1.0 kg) forming 2.9% of the total trawl landings. *L. bindus* (31.0%) and *L. splendens* (24.3%) dominated the landings. The length range of *L. bindus* was 15-114 mm. In *S.insidiator* the length range was 30 -109 mm. Females in stages III and IV of gonadal development dominated the fishery of both the species.

At Visakhapatnam, an estimated 176 t (CPH:1.4 kg) were landed forming 8.3% of the total trawl landings. *L.bindus* (41.7%) and *Gazza minuta* (14.1%) dominated the fishery. The length range of *L.bindus* was 35-119 mm and *S.insidiator* 60-114 mm.



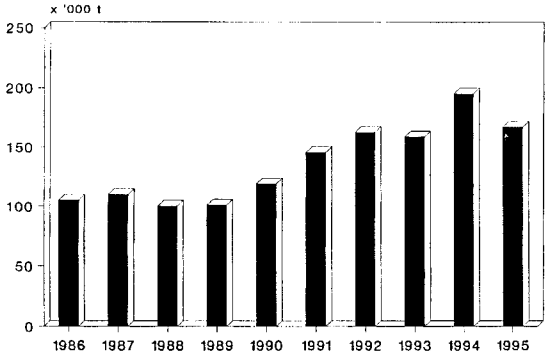
Regionwise, quarterly landings of silverbellies in 1996

Development of Management Strategies for Judicious Exploitation of Sciaenids (DF/RE/5)

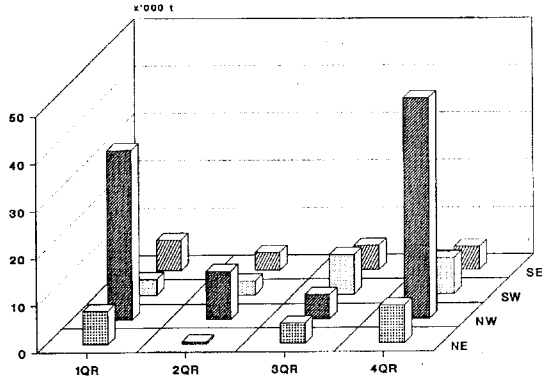
S.K. Chakraborty, P.P. Manojkumar, M. Feroze Khan, S. Sivakami, V.S.Rengaswamy, P.Devadoss, and K.M.S.A. Hamsa

Data were collected from 8 centres along the Indian coast. A total of 23,174 t of sciaenids were landed at these centres, of which the trawlers at Veraval accounted for 53% followed by the trawlers at New Ferry Wharf (22.8%), Madras (6.6%), Kakinada (5.3%), Tuticorin (3.5%), 'Dol' net at Veraval (2.6%), gillnet at Veraval (1.6%), and trawlers at Calicut, Karwar, Tadri, Cochin and Visakhapatnam together 4.2%. When compared to the previous year, the sciaenid catch by trawlers during the period under report registered 52% increase along with 26% increase in effort at Veraval. At all other centres, the landings by trawlers declined considerably: 2.4 % at Kakinada, 44.6% at Visakhapatnam, 55.1% at Madras, 33.6% at Cochin, 18.0% at Calicut 45.2% at Karwar and 32.4% at New Ferry Wharf. At all these centres, the estimated effort also registered decline ranging from 1.6% at Calicut to 45% at Visakhapatnam. Only at Kakinada, the effort increased by 3.4% over the previous year. At Veraval, the sciaenid landings by 'dol' net and gill net registered declines of 37.7% and 15.1% respectively though there was increase in effort to the tune of 2.6% and 12.7% respectively.

The number of species of sciaenids landed and dominant species at each centre are shown below which clearly show the differences at different centres.



Landings of sciaenids in India



Regionwise, quarterly landings of sciaenids in 1996

Total number of species of sciaenids landed by different gears at different centres along with dominant species

Centre	Gear	Total number of species	Dominant species with their % in parentheses in Sciaenids
Veraval	Trawl	16	*Otolithus cuvieri* (55.7), *Johnieops glaucus* (14.3) *Otolithus biauritus* (6.4)
	Gillnet	15	*P. diacanthus* (43.1), *Otolithus* spp. (30.5)
Mumbai	Trawl	12	*Otolithus cuvieri* (23.5), *J.macrorhynus* (21.2), *J. vogleri* (19.6)
Karwar	Trawl	3	*O. cuvieri* (45), *J.coitor* (43), *O. ruber* (12)
	Gillnet	3	*O. cuvieri* (52), *J.coitor* (40), *O. ruber* (8)
Tadri	Trawl	3	*O. cuvieri* (51), *J.coitor* (40), *O. ruber* (9)
Majli	Gill net	3	*J.coitor* (53), *O. cuvieri* (45), *O. ruber* (2)
Calicut	Trawl	7	*J. sina* (52), *J. belengeri* (23), *O. ruber* (17)
Cochin	Trawl	2	*J sina* (64),*O. ruber* (36)
Tuticorin	Trawl	4	*J. maculatus* (63),*O. ruber* (35)
	Drift gill	4	*O. ruber* (69), *J. maculatus* (29) net
Madras	Trawl	15	*O. ruber* (32)*J.sina* (17) *N.maculata* (11), *J. dussumieri* (11), *K. axillaris* (9)
Kakinada	Trawl	18	*J. macrorhynus* (16),*O. ruber* (10) *J. dussumieri* (11), *J. vogleri* (9), *P.macrophthalmus* (9)
Visakhapatnam	Trawl	10	*P.macrophthalmus* (18), *J. amblycephalus* (18) *O. ruber* (14), *N. maculata* (12) *J. dussumieri* (10), *J. carutta* (10)

The details of the length range and dominant lengths of different species in the fishery at different centres are furnished below:

Centre	Species	Length range mm	Dominant Length range mm	Gear
Veraval	*O.cuvieri*	60-320	130-240	Trawl
	"	100-240	130-200	Dol net
	J.glaucus	70-230	120-190	Trawl
	P. diacanthus	260-1160	320-360	
			760-1100	Trawl
	"	660-1240	820-1060	Dol net
	O.biauritus	230-1530	340-590	Trawl
Mumbai	*J.macrorhynus*	100-295	150-240	Trawl
	J. vogleri	100-295	160-245	Trawl
	O. cuvieri	75-368	150-190	Trawl
	J. sina	100-216	130-175	Trawl
Karwar	*O. cuvieri*	60-224	90-140	Trawl
	"	75-215	95-135	Gill net
	J. coitor	60-229	90-135	Trawl
Calicut	*J. sina*	70-144	75-100	Trawl
Cochin	*J. sina*	70-180	120-149	Trawl
	O. ruber	100-270	140-190	Trawl
Tuticorin	*O. ruber*	190-460	210-260	Trawl
	"	190-350	260-300	Drift-Gill net
	J.maculatus	130-220	140-200	Trawl
Madras	*O. ruber*	110-309	120-180	Trawl
	K. axillaris	100-169	110-140	Trawl
Kakinada	*A. nibe*	105-235	155-200	Trawl
	N. maculata	55-295	125-185	Trawl
Visakhapatnam	*J. carutta*	110-230	140-180	Trawl

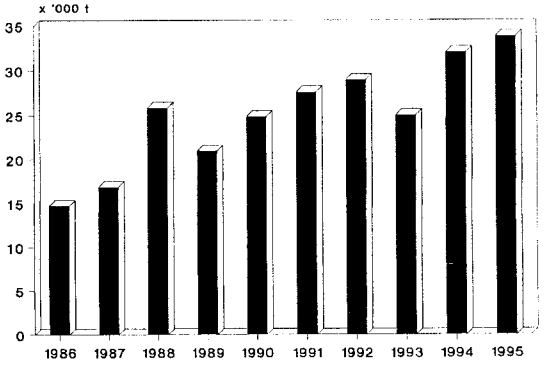
In *J. sina* at New Ferry Wharf, mature fish were recorded in October and February - March. At Visakhapatnam, mature and ripe females of *J.carutta* in the length range of 175-220 mm occurred in trawl catch.

Resources Characteristics and Biology of Lizard Fishes, Polynemids, Pomfrets, and Bull's Eye (DF/RE/6)

S.Sivakami, M. Feroze Khan, E.Vivekanandan, S.G.Raje and P.P.Manojkumar

Lizard Fish

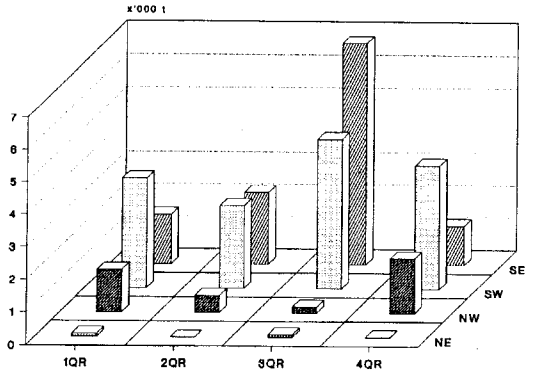
Lizard fish landings declined by 17.2 % at Mangrol, 44.5% at Bombay 75% at Calicut, 36.9% at Cochin and 21.0% at Visakhapatnam when compared to previous year. However the landings at Veraval and Madras increased by 63% and 16% respectively. October and January were the months of peak landings at Veraval and December to February at Mangrol. At other centres, the months of peak landings were, May at Mumbai and Visakhapatnam, April-June at Puthiappa, August at Beypore and Cochin and April at Madras. *Saurida tumbil* was the dominant species at Veraval, Mangrol, Bombay and at Calicut, *S. undosquamis* at Cochin, Visakhapatnam and Madras. The important biological data are furnished below.



Lizardfish landing in India

Data on biology of lizard fishes from different centres during 1996-97

Centres	Dominant species	Length range (mm)	Dominant maturity stages	Sex ratio M : F
Mangrol	*S.tumbil*	180-450	-	-
Bombay	*S.tumbil*	100-440	V,VI,VII Oct-Nov	1 : 1.7
Calicut				
Puthiappa	*S. undosquamis*	70-400	V-VI Jan	1: 0.7
Beypore	*S. tumbil*	100-329	I-V, II dominant	
Cochin	*S.undosquamis*	100-300	V-VI Oct-Jan	1: 1
	S. tumbil	240-450	-	1: 1.13
Madras	*S. undosquamis*	80-269	V-VI Oct-Nov	
Visakhapatnam	*S. undosquamis*	115-305	I-II (65%) III-IV (35%)	1:0.9



Regionwise quarterly landings of lizardfishes in 1996

Polynemids

Polynemids were landed mainly at Veraval (in trawl and gillnet), Mangrol (in trawl), Dhamlej (gillnet) and Bombay (trawl). At Veraval, the landings increased by 78% in trawl and decreased by 5% in gillnet, over previous year. At Mangrol also, there was a decline of 43% in trawl catch though there was about 7% increase in effort. At Dhamlej, the gillnets landed 126 t (C/E:4.9 Kg). At Veraval, the landing by trawl was at peak in January (C/E : 21.26 Kg), and by gill net during October (C/E: 9.2 Kg) and December (C/E: 8 Kg). At Mangrol, the highest C/E of 5.2 kg was obtained in May by trawl. At Dhamlej, the peak months were October (C/E: 11.26 kg) and December (C/E: 8 Kg). Major species were *Eleutheronema tetradactylum, Polynemus indicus and P. sextarius*.

At New Ferry Wharf the estimated catch was 310 t (C/E: 10.6 kg) and at Sassoon Dock 42 t (C/E: 2.8 kg).

In the Veraval region, the length range of *P. indicus* was 300-640 mm with modes at 385, 525, 625 mm in the trawlers; at 330, 450, 490, 550 and 590 mm in gill nets.

Pomfrets

At Veraval, the estimated catch showed an increase of 180% with an increase of 26% in effort. At Bombay the catch at New Ferry Wharf was estimated at 591 t and 343 t at Sassoon Dock. At Versova, the catch in 'dol' net was only 8 t. At Puthiappa and Beypore, the estimated catch was 77 t and 89 t respectively. The catch was only 7t at Cochin, 228 t at Madras and 48 t at Visakhapatnam. *Pampus argenteus* was the dominant species at all centres followed by *Formio niger* at Visakhapatnam, Madras and Bombay and *F. niger* followed by *P.argenteus* at Calicut.

Bull's Eye

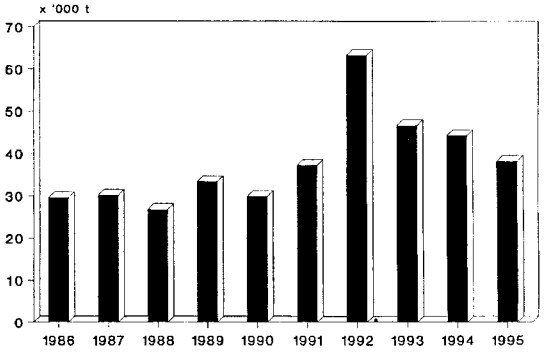
At Veraval, the estimated catch was 522t (C/E: 5.8 kg) by trawl which showed a three-fold increase when compared to that of 1995-96. At Puthiappa the estimated catch was 733 t (C/E: 20.5 kg) and 818 t (C/E: 25.9 kg) at Beypore. At New Ferry Wharf, it was 97 t (C/E: 3.3 kg) and 141 t (C/E: 9 kg) at Sassoon Docks. The estimated landing was 290 t (C/E: 10.5 kg) at Cochin and 72 t (C/E: 0.1 kg) at Madras. *Priacanthus hamrur* was the major species at all the centres (Veraval, Bombay, Calicut, Cochin, Madras). At Calicut-Beypore the length range of this species was 160-279 mm with modes at 170, 210, 240 and 260 mm. At Cochin, the size range was 150-320 mm with dominant mode at 175 mm; fish with ripe ovaries were observed during August, November and January-March.

Biology and Fishery of Flatfishes, Goatfishes and White Fish (DF/RE/7)

P.Bensam, P.U. Zacharia, M.Feroze Khan, A.Raju, P. Devadoss, S. Krishna Pillai and K.M.S.A. Hamsa

Flatfishes

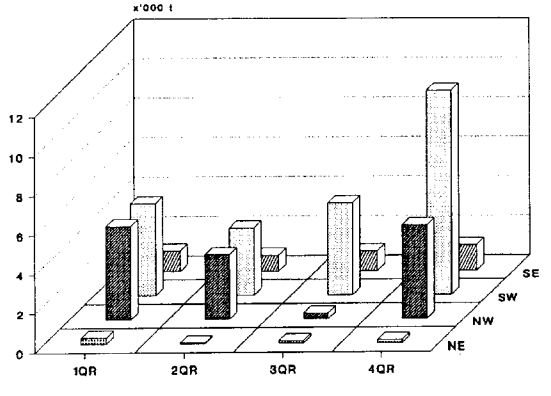
Bottom trawlers have harvested this resource predominantly. At Mangalore the production has registered a 16% increase over the previous year whereas at the nearby Malpe there was a remarkable increase from 143 t to 1,878 t. At Calicut, the catch and the catch rate showed declines,with the peak production during December-January. At Cochin the annual production was about 190 t only, with the peak during October. At all these centres *Cynoglossus macrostomus* was the dominant species, accounting for over 90% of the flatfish catch. At these centres the length of this species ranged from 5 to 17 cm, with the dominant mode around 12 - 13 cm. At Mangalore the major spawning season appeared to be during November-January. At



Landings of flatfishes in India

Calicut and Cochin the fishes were mostly immature during all the months of observation.

At Vizhinjam *C. bilineatus* was the dominant species,(133t) in disco net catch. In Rameswaram-Pamban area, 246 t were landed with *C. macrolepidotus* forming 50% of flatfish catch, followed by *C. bilineatus* (26%). The former species ranged from 9 to 42 cm, with dominant modes at 21 and 26 cm. More than 70% of the females were in stages II - IV of maturity.



Regionwise, quarterly landings of flatfishes in 1996

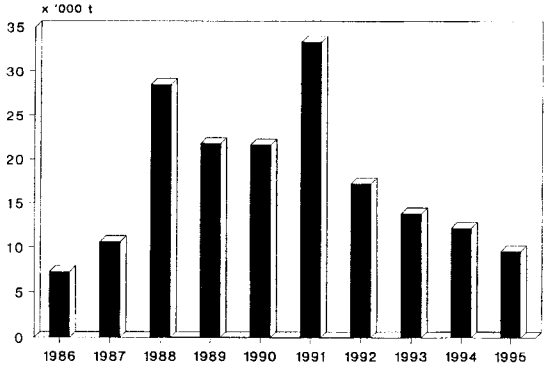
Whitefish

At Mangalore the production declined by 190% over the previous year and there was a marginal increase at Malpe. At Cochin, the total annual production was only 8 t, with the peak of 5 t in April; at Vizhinjam

and Mandapam the estimated catches were to 6 t and 19 t respectively. At Mangalore the length range was 8 - 20 cm, with the mode at 15 cm. Immature fishes formed about 35% and the major spawning season was November to March, as judged from the occurrence of partly spent specimens.

GOAT FISHES

There was no landing of this resource at Mangalore and 19 t were landed at Malpe composed entirely of *Upeneus vittatus*. At Puthipappa in Calicut only 3t was caught and at Beypore about 17 t mainly composed of *U. vittatus* and *U. Sulphureus,* were landed. At Cochin also the landings were meagre: only about 1t of *U. Bensasi* during the whole year. In the Rameswaram-Pamban area, about 410 t were landed by trawlers and shoreseines, with peak production in October. *U. sundaicus* was dominant followed by *U. vittatus* in trawl nets, while in the shoreseines *U. tragula* was the major species followed by *U. sundaicus;* the last mentioned species ranged from 7 to 20 cm, with the dominant mode at 12 cm. The sex ratio was M1:F3 and maturity stages ranged from II to IV. In Madras the production was 1,106 t, with *U. moluccensis* being the dominant species followed by *U. bensasi*. The former ranged in length from 8 to 19 cm, with the mode at 15 cm and the latter from 8 to 15 cm with the mode at 13 cm. Gravid females of *U. sulphureus* were recorded during most months at Madras.



Goatfish landing in India

AQUARICULTURE OF MARINE ORNAMENTAL FISH (DF/RE/8)

V. Sriramachandra Murty, R. Thiagarajan, I. Jagadish, Ranimary George, K.K. Philippose, S. Jasmine and A.K.V. Nasser

This Project was undertaken mainly to understand the species of ornamental fishes occurring in different regions and their relative abundance, and to maintain these fish in the aquaria. The work was carried out from Mandapam, Vizhinjam and Minicoy.

Vizhinjam: Collections were made using a cage of 5' x 2' x 2' size with live mussel as bait in the Vizhinjam Harbour. The cages were operated round the year except during the monsoon months of June-September. A total of 11,859 specimens comprising 10,215 specimens of 68 species belonging to 17 families of ornamental fishes and 1,644 specimens of 25 species belong to 9 families of other fishes. The details of important ornamental fishes collected are given below:

Sl. No.	Family	Number of species	Number of specimens	% in total	Dominant species and their % in the collection of the family
1.	Chaetodontidae	7	2,531	24.7	*Chaetodon collaris* (85%)
2.	Pomacanthidae	2	34	0.3	*Centropyge bispinosus* (74%)
3.	Pomacentridae	13	3,509	34.3	*Abudefduf spp,* (80%)
4.	Acanthuridae	8	799	7.8	*Acanthurus nigricauda* (18.4%) *A.phillppinus* (16.3%) *Ctenochaetus striatus* (43.6%)
5.	Zanclidae	1	17	0.2	*Zanclus canescens*
6.	Platacidae	2	123	1.2	*Platax orbicularis* (79%)
7.	Scorpaenidae	2	7	0.1	*Pterois. volitans*
8.	Scaridae	1	126	1.2	*Scarus ghobban*
9.	Labridae	10	355	3.5	*Thassoma lunare* (54.6%) *Bodianus pulchellus* (16.3%)
10.	Monacanthidae	1	196	1.9	*Pervagor melanocephalus*
11.	Ostraciidae	2	49	0.5	*Ostracion tuberculatus* (87.8%)
12.	Diodontidae	1	4	–	*Diodon hystrix*
13.	Balistidae	3	45	0.4	*Balistapus undulatus* (44.4%) *Odonus niger* (42.2%)
14.	Siganidae	2	825	8.1	*Siganus javus* (62.4%) *S. canaliculatus* (37.6%)
15.	Apogonidae	6	1159	11.3	*Apogon taeniatus* (56.3%)
16.	Mullidae	3	197	1.9	*Parupeneus indicus* (53.8%) *P. macronema* (45.7%)
17.	Holocentridae	4	239	2.3	*Sargocentron rubrum* (72.8%)
All 17 families		68	10,215		

About 40 species of important aquarium fishes were maintained in aquaria. Different feeds (imported marine flakes, pellets, cooked mussels and locally made feed) were tried and it was found that majority of the aquarium fishes could sustain on cooked mussel meat.

Mandapam: The landings of perch traps at Kilakari showed that *Callyodon* spp, *Siganus* spp, *Chaetodon* spp, *Abudefduf* spp, *Holocentrus* sp, *Acanthurus* spp and balistids occur in the catches, of which parrort fish were more abundant.

12 glass aquaria of the size 8'x2'x2' were installed at the regional centre. Ornamental fishes were collected from the Gulf of Mannar and Palk Bay from the fishermen as well as by using the traps fabricated at

Vizhinjam. The fishes were transported in plastic bins and released in aquaria. Water was changed every day and fishes were given chopped sardines. Periodically, the fishes were treated with malachitegreen, acriflavin and methylene blue. The important species in the collections are: *Chaetodon collaris*, *C.octofasciatus*, *Heniochus acuminatus*, *Abudefduf septemfasciatus*, *Siganus oramin*, *S. javus*, *Sargocentron rubrum*, *Diodon hystrix*, *Tetrodon hispidus*, *Syngnathus biaculeatus* and *Hippocampus kuda*.

In October, one specimen (202 mm) of *Syngnathus biaculeatus* (male, brooding) was collected and maintained in 100 litre fibreglass tank. After an hour of keeping in the tank, 109 juvenile pipe fishes measuring 21-23 mm were released by this fish. These juveniles were placed in 100 litre tank and fed with rotifer (*Brachionus plicatilis*). Provision for clinging also was made. They survived only for a week.

Minicoy: Preliminary trials were made in maintaining aquarium fishes collected from the lagoon. *Chaetodon auriga* (11.6 cm), *C. collare* (12.0cm), *C. kleini* (4.3 cm) *C. citrinellus* (8.2 cm), *Dascyllus aruanus* (4.3 cm), *D. reticulatus* (3.9 cm), *Acanthurus leucosternon* (7.7cm) and *A.lineatus* (7.0 cm) were maintained in plastic basins with sea water and aeration. These fishes survived for periods ranging from 8 to 12 days. *D. aruanus* of the lengths 4.5 -6.0 cm were in ripe stage. The fishes particularly *C. kleini* and pomacentrids accepted minced fish as food. Work on breeding is being taken up.

Investigations on the Impact of Coastal Bottom Trawling on Demersal Fishes and Macro-Benthos (DF/TR/1)

N.G. Menon, P.U.Zacharia, E.Vivekanandan and I.Jagadish

At Mangalore the fin fishes formed 59.8 % , crustaceans and cephalopods together 14 % and the nonedible biota 26.2 % of the 4,008 t landed by single-day trawlers. *Squilla* formed 99.7 % of the nonedible biota. An estimated 283 t of young fishes consisting of flatfish, whitefish, sciaenids and clupeids were caught. The nonedible biota formed 46.7 % of 4860 t of trawl catch at Malpe.

Of the 23,062 t landed at Mangalore by the multiday trawlers the benthic biota formed 11.3%. Young fishes were caught in large quantities during October- February. The estimated catch of nonedible biota was 2,591 t. Stomatopods were the dominant group forming 77.1 %. At Malpe, the nonedible benthic biota formed 5.4 % of 14,827 t landed by multiday trawlers.

At Cochin, finfishes formed 56.1 % , prawns and other crustaceans 26.8 %, cephalopods 15.6% and the nonedible biota 1.5% of the trawl landings. *Squilla* and nonedible crabs formed 30 % each of nonedible component. The estimated juvenile finfish landing was 125 t.

At Kollam, the total trawl catch was 97,463 t. Finfishes formed 64.5 % , Prawns and other crustaceans 13.4 % , cephalopods 12.7 % and macrobenthos 9.4 % of the total catch. The benthic biota consisted of gastropods & bivalves (22.9 % of non-edible component), *Squilla* (0.2 %), nonedible crabs (13.1%), echinoderms and non edible ground fishes (63.8 %). Sea pens, sponges, seaanemons, seaweeds and egg mass of cephalopods also occurred occasionally. Juveniles and subadults of finfishes occurred throughout the period consisting of threadfin breams, lizard fishes, carangids, silverbellies, flatfishes, *Thryssa* and sciaenids (50-120 mm).

In the trawl landing from Gulf of Mannar (Pamban), the finfishes formed 94.5%, the target groups 2.1% and the nonedible catch 4.0% whereas the finfish catch was 73.8% the target group 13.8% and the nonedible bycatch 12.4% from Palk Bay (Rameswaram).

At Madras the discarded bycatch in trawlers formed 2100 t, consisting mainly of *Thryssa*, sciaenids, carangids and crabs.

At Kakinada, finfishes contributed 62.5 %, prawns, lobsters and edible crabs 32.5 %, cephalopods 3.4 % and the nonedible benthic organisms 1.6 % of the total trawl catch. A total of 146 t of juvenile finfishes were landed, of which sciaenids formed 38.7 %, flatfishes 22.3 %, perches 11.2 % , threadfin breams 11.9 %, goatfishes 7.7 % and lizard fishes 8.2 %. Juvenile fishes were observed throughout the year with peaks in different months or different species. The landing of benthic biota was about 415 t, and non edible crabs formed 60.3 % followed by stomatopods 36%, molluscan shells 3.3%, and echinoderms, sea cucumbers and sponges 0.4%.

At Karwar, finfishes formed 43.7% , crustaceans and cephalopods 17.9% and the nonedible benthic biota 38.4 % of total trawl catch. *Squilla* was the major component of nonedible organisms landed, forming 89.6 %, followed by nonedible crabs 7 % and other organisms 3.4 %. At Tadri, finfish formed 33.3 % , the target group 26.9% and the nonedible biota 39.8 % of 3600 t landed by trawlers. *Squilla* formed 91 % of nonedible biota.

Experiments on Culture, Induced Breeding of Groupers and Seabass (DF/CUL/3)

R. Marichamy, K.V. S. Nair, Grace Mathew, P. Livingston V.S. Rengaswamy, D.C.V. Easterson A. Raju, A.Regunathan. D. Kandaswami and I. Jagadish

During the year under report, experiments on marine finfish culture with particular emphasis on groupers, was initiated at three centres. After developing the required minimum infrastructure facilities, experiments were initiated mainly in regard to collection of seed and its transport, development and maintenance of broodstock, breeding and grow out. The results obtained at different centre are reported below.

A. Tuticorin

Culture

- Seed of *Epinephelus tauvina* were collected from mini shoreseine and dragnet operating at Vellapatti near Tharuvaikulam.
- Seed were transported to Karapad field laboratory and maintained in 1000 L, FRP tanks.
- Trash fish was provided as food from the second day of stocking in FRP tanks
- During June-July, 450 grouper seed were stocked in 0.3 ha pond in the fish farm at Karapad
- The stocking size range was 110-205 mm (13-120 g) with the average of 130 mm/28 g.
- Juveniles of *Tilapia* were also released into the pond in the ratio of 1 grouper: 10 *Tilapia* to serve as forage.
- During November 96, another 360 groupers were released into the same pond thus making the total of 810 at the rate of 2700/ha.
- By the end of March '97 the fish were in an average length of 281 mm/372 g.

Live fish transport

During March '97, 140 groupers of the length range 120-140 mm were transported to Cochin: 8-10 specimens were placed in double -jacketed polythene bags of 10 l capacity, filled with filtered seawater and Oxygen. Before filling oxygen, ice cubes packed in small polythene bags were placed in the transportation bag. Groupers of 530-850 mm (2-12 kg) were collected during May 1996 from floating cage belonging to "Scanet aqua exporters" at Vanthivu. These fish were transported in 500 l syntex tanks to Karapad laboratory by boat and then to Mandapam by road with 100% survival.

B. MANDAPAM

— 73 specimens of *E. tauvina* of the length range 280-940 mm (0.2-13.8 kg) were maintained in two outdoor cement tanks

— Trash fish, at the rate of 10% body weight of *E.tauvina*, was provided as food.

— Some of the stocked specimens developed infection of *Vibrio*; they were treated with Acriflavin and Chloramphenicol but some of them died; the remaining fish were given prophylactic treatment and maintained in healthy condition. These specimens were only in immature or early maturing stages.

— During July-September, hormone (ovaprim) injections were given to a set of four specimens of the 51-53.5 cm length range (2-2.5 kg) at the rate of 0.5 ml/kg body weight. After 6 days, they released a few eggs of the diameter range 0.9 - 1.2 mm.

— In another set of similar specimens, 3 injections of the same dose were given at weekly intervals. After first injection on the fifth day, though a few eggs were released the fishes died.

C. COCHIN

During the first quarter, infrastructure for culture and hatchery of groupers was developed. Seeds of *E. tauvina* of 120-242 mm were transported from Tuticorin and stocked in four separate tanks according to their size. Though 50% of the fish died due to frequent power failure and inadequate aeration, this problem was overcome by establishing filtration and circulation systems. The monthly average growth was observed to be 130 g in three tanks and 160 g in one tank.

During the period under report, juveniles of groupers were maintained in 1000 l FRP tanks. The fishes were fed with *Tilapia* once a day. In November and December, the feeding rate as well as frequency were increased. In November 1996, the feed mainly consisted of *Tilapia* and small quantities of compounded feed. Fishes with body weight of 500 g were given Cod liver oil (150 mg) capsules twice a week; these fish showed higher growth rate.

GUIDE TO THE EGGS AND LARVAE OF THE INDIAN MARINE FINFISHES (CMFRI/IDP/EL/2)

P. Bensam, K.J. Mathew, N. G. Menon, P.N.R. Nair, Grace Mathew and T.S. Naomi

This project was initiated during the year under report. The Scientists and technical personnel involved in this project had discussions on the modalities of the various aspects of the work and formulated procedures for classification of various developmental stages and descriptions of salient features. Compilations of the various publications were under progress during the above period as per the agreed norms and guidelines. Over 250 reference pertaining to eggs and larvae of marine

fishes were collected. Data and information on developmental stages of different fish species were compiled from published work of the period 1951-65. Writeups were prepared for some species belonging to the genera *Pseudosciaena, Mugil, Sphyraena, Acanthocybium, Anodontostoma, Albula* and *Nematolosa*.

Survey and Assessment of Ornamental Fish Resources of Lakshadweep (CMFRI/SPO/1)

M. Devaraj and V. Sriramachandra Murty

During the year, the survey was conducted at Agathi, Kavarathi and Minicoy with greater coverage at Minicoy. A total of 3300 specimens representing 16 families and 89 species were collected using gillnets of different mesh sizes and encircling nets. At Kavarathi, parrot fish and wrasses were most abundant in April; at Agathi, parrot fish, wrasses, goatfish, surgeonfish, squirrelfish and butterflyfish were most abundant in May. At Minicoy, a total of 89 species of aquarium fish belonging 14 families were collected during November 96 - January 97 of which wrasses, parrotfish, damselfish, surgeonfish, squirrelfish, goatfish, butterfly fish and triggerfish were most abundant together forming 98% of the fishes collected. Among the species collected, *Acanthurus triostegus, A. leucosternon, Ctenochaetus strigosus, A. nigricauda* and *A. matoides* in the surgeonfish, *Callyodon taeniurus, C. bataviensis, C.ghobban* and *Leptoscarus vaigiensis* in parrotfish, *Rhineacanthus aculeatus* in the triggerfish, *Chaetodon collaris* (Minicoy), *C. auriga* and *Heniochus acuminatus* in the butterflyfish, *Holocentrus lacteoguttatus, H. violaceous, Myripristis murdjan, M. adustus* and *H. sammara* in the squirrelfish, *Halichores centriquadrus, H. scapularis, H. marginatus, Thalassoma hardwickii, Stethojulis axillaris* and *S. albovittata* in wrasses, *Mulloidichthys samoensis, Parupeneus macronemus, P. barberinus* and *P. indicus* in goatfish, *Centropyge multispinis* in the angel fish, *Chromis caeruleus, Dascyllus aruanus, Abudefduf lacrymatus, A. biocellatus, A.sexfasciatus* and *A. septemfasciatus*, in damselfish, *Siganus stellatus* and *S. rostratus* in rabbit fish, *Zanclus canescens* in moorish idol, *Parapercis hexophthalmawa* in sandsmelt, and *Synodus variegatus* the lizardfish were most common. With the collections made during the year, the total number of ornamental fish specimens collected is about 16000 represented by 164 species belonging to 22 families. Data on length, weight, sex, maturity and food were collected on major species.

The data collected over a period of three years from 9 islands show that the above mentioned forty species along with a few others are consistantly abundant throughout and suggest scope for exploitation for aquarium purpose. A rough estimate (on the basis of area of operation and the number of fish caught) of potential yield of 10 groups was made; this consists of 38% of wrasses, 32.7% of damselfish, 8.4% of goatfish, 7.4% of parrotfish, 4.8% of surgeonfish, 4.9% of squirrelfish, 2.1% of butterflyfish, 0.8% of triggerfish, 0.5% of pufferfish and 0.4% of moorish idol. The data are being analysed further, taking into account the biological characteristics, to enable arriving at refined and reliable estimates. It is however observed that the most sought after fish, such as moorish idol and butterfly fish, are less abundant. Hence it is essential to formulate exploitation strategy incorporating quotas for each species or species group. Further,

since the lagoons are shallow and are abundant in corals, exploitation of ornamental fish would lead to overexploitation and environmental degradation if proper care is not taken in the very beginning. It is therefore necessary that exploitation is carried out by nondestructive methods such as that using traps and through diving using hand nets, besides formulating effective mechanisms of monitoring exploitation specieswise and fixing quotas specieswise taking into account the relative abundance of each species in the area.

During the year, transport of live fish was undertaken by Ship (1 - 2 days) from Minicoy to Cochin in open containers (40 ltr. capacity) by changing water 2-3 times on the way and providing aeration. The following species were transported with almost no mortality and released in FRP tanks at Cochin: *Chaetodon auriga*, *C. lunula*, *Dascyllus aruanus*, *Gomphosus caeruleus*, *Halichoeres marginatus*, *H. centriquadrus*, *Ctenochaetus strigosus*, *Rhineacanthus aculeatus*, *Centropyge multispinis* and *Parapercis hexophthalma*.

Studies on Mangrove Ecosystem of Gulf of Mannar Islands and Their Impact on Larval Recruitment of Economically Useful Fishes and Prawns (CMFRI/SPO/10)

P. Nammalwar, R. Thiagarajan and A. Raju

During the period April '96 to March, 1997, survey was conducted in the mangroves of the Gulf of Mannar islands such as Rameswaram (Chinnapalam), Poomarichan and Hare. While sampling was done only once in Poomarichan (16-05-96), sampling was done at Rameswaram and Hare islands, monthly.

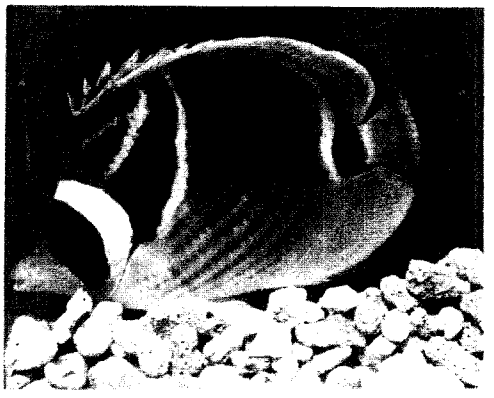
Simultaneous sampling was done in the mangrove and marine habitats. Within the mangrove area at Chinnapalam, two different zones with abundance of *Rhizophora mucronata* and *Avicennia marina* and with differing fish seed abundance were located. Hence samples for all the parameters were taken in these two zones only, at Chinnapalam.

For fish seed survey, a nylon drag net with 2 mm mesh size and mouth diameter of 4 m was used. In each habitat, a total of five hauls, each with a duration of five minutes were made and the fish seeds collected were preserved in 10% formalin.

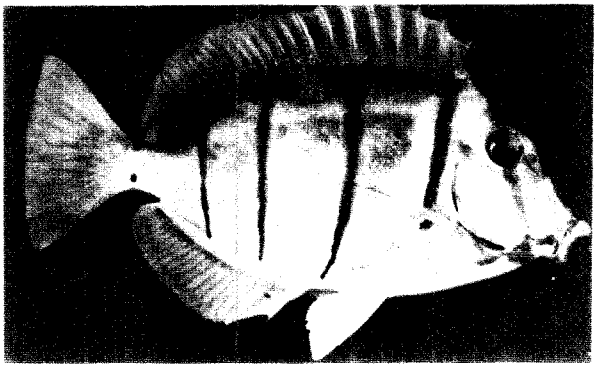
Data on the atmospheric temperature and surface water temperature were collected. Water samples were also analysed for different hydrographical parameters. A set of water samples in white and dark bottles were incubated for primary productivity study. Fish seeds were identified in the laboratory and the total length of each measured.

Comparison Between Marine and Mangrove Habitats

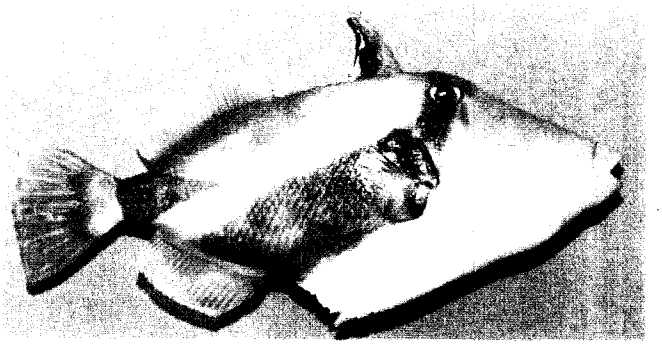
During the period April to December '96, the surface water salinity of mangrove habitat ranged from 12.28 ppt to 38.39 ppt. (both the extremes in *Avicennia* zone of Chinnapalam) whereas in the marine habitat it ranged from 21.36 ppt (Chinnapalam) to 35.50 ppt (Hare island). The dissolved oxygen values of the mangrove habitat ranged from 1.38 ml/l (*Rhizophora* zone of Chinnapalam) to 8.0 ml/1 (mangrove habitat of Hare island) and from 3.56 ml/l (Chinnapalam) to 6.22 ml/l (Hare island) in marine habitat. The pH values of the mangrove habitat ranged from 7.96 (both the



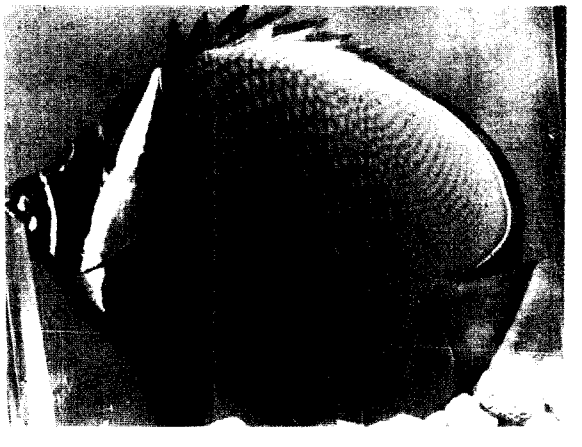
Halfmoon butterfly fish
(*Chaetodon lunula*)



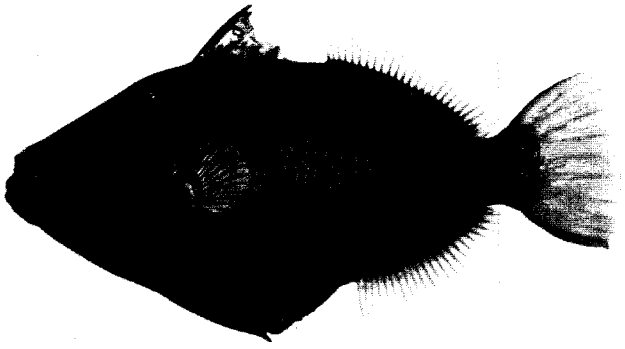
Convict surgeon
(*Acanthurus triostegus*)



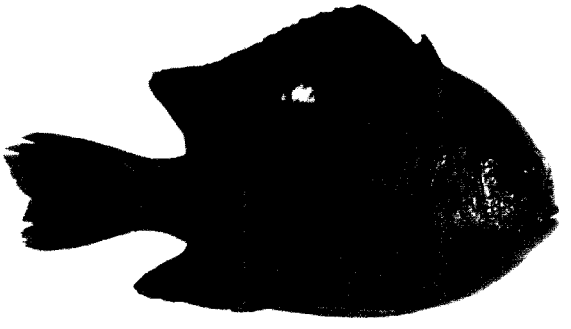
Patchy trigger fish
(*Rhineacanthus rectangulus*)



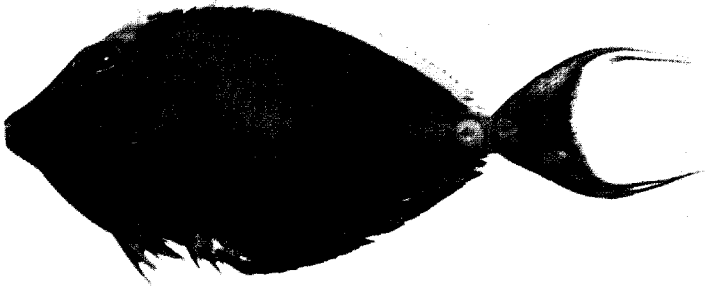
Butterfly fish
(*Chaetodon collaris*)



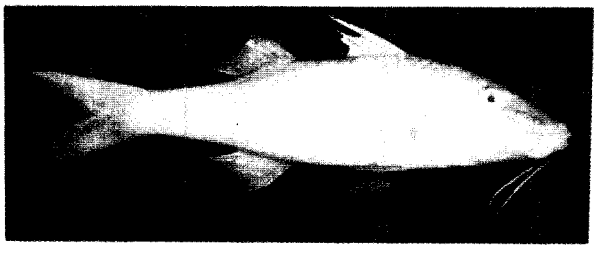
Orangestriped
trigger fish
(*Balistapus undulatus*)



Domino (*Dascyllus*
trimaculatus)



Orange-spine unicorn
(*Naso litturatus*)



Yellow goatfish
(*Parupeneus luteus*)

extremes in *Rhizophora* zone of Chinnapalam) to 8.80 whereas in marine habitat it ranged from 8.01 to 8.38 (both the extremes in Chinnapalam). Net primary productivity ranged from 24.01 mg C/m^3/h in *Avicennia* zone of Chinnapalam to 97.64 mg C/ m^3/h mangrove habitat of Hare island; in marine habitat it ranged from 11.57 mg C/ m^3/h to 56.50 mg C/m^3/h.

SEED ABUNDANCE

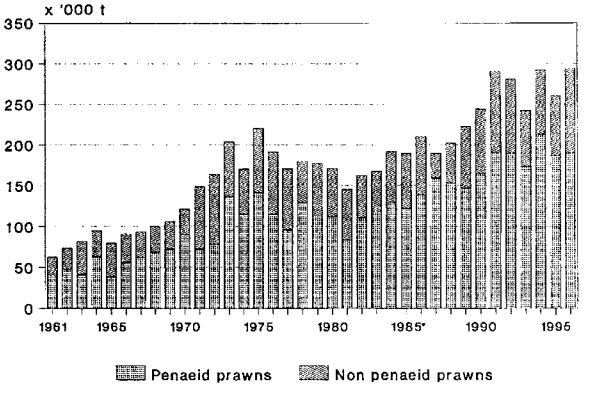
Of the total of fish and prawn seeds collected (4136) during this period, 3563 seeds were from mangrove habitat and 573 from marine habitat. 26 species were collected. The most abundant species in the mangrove habitat were *Ambasis* sp. (1205 nos with size range of 7 to 48 mm) and *Liza macrolepis* (769 nos. with size range of 12 to 158 mm). In the marine habitat, *Sardinella sirm* and *Metapenaeus* sp. were abundant (335 nos/ in the size range of 18 to 50 mm; 126 nos in size range of 10 to 68 mm respectively).

In the *Rhizophora* zone, *Ambasis* sp. and *Liza macrolepis* were the abundant species of (1092 nos with size range of 7 to 48 mm and 473 nos with size range of 13 to 61 mm respectively) and *Terapon* sp the least abundant (16 nos with size range of 11 to 40 mm).

In the *Avicennia* zone the most dominant species of was *Liza macrolepis*, followed by *Cyprinus laubuca* and *Ambasis sp.* (252 nos with size range of 12 to 58 mm; 215 nos with size range of 10 to 33 mm and 113 nos with size range of 9 to 33 mm respectively); the least abundant species was *Gerres* sp. (13 nos. with size range of 16 to 38 mm.)

IV. CRUSTACEAN FISHERIES DIVISION

With a total production of 3,98,496t in 1996, crustaceans formed 16.5% of the all India marine fish landings; their landings registered an increase of 10.8% over those of the previous year. Penaeid prawns accounted for 47.7% of the crustacean landings followed by nonpenaeids (26.2%), stomatopods (18.2%), crabs (7.3%) and lobsters (0.7%). Nonpenaeids and lobsters recorded increases of 41.2% and 36.7% respectively over the previous year. Penaeid prawns and stomatopods registered marginal increase of 1.8% and 9.1% respectively whereas crab landings declined by 5.1%.



Prawn landings in India

ASSESSMENT OF FISHERY AND RESOURCE CHARACTERISTICS OF THE PENAEID SHRIMPS OF THE WEST COAST OF INDIA (CF/RE/1.11)

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Work was carried out at Veraval, New Ferry Wharf (Mumbai), Karwar, Tadri, Malpe, Mangalore, Kozhikode, Kochi and Sakthikulangara (Neendakara).

An estimated 1,39,339t of penaeid prawns were landed along the west coast in 1996 which accounted for 73.3% of the country's annual penaeid prawn production. The fishery improved over the previous year by 3% along this coast. Gujarat accounted for 21.5% of penaeid prawn landings along the west coast followed by Maharashtra (38.0%), Goa (2.3%), Karnataka (5.1%) and Kerala (33.1%). The fishery improved by 31% in Maharashtra, 71.5% in Goa and 6.8% in Kerala over the previous year. However, it declined by 28.9% in Gujarat and 7.9% in Karnataka.

Trawl fishery

Trawlers accounted for 77% of the landings along the west coast. They contributed to 70.8% in Gujarat, 88.4 % in Maharashtra, 72.2% in Goa, 81.2% in Karnataka and 67.2% in Kerala. In Kerala, in addition to trawlers, ring seines (22.4%) and mini trawls (7.3%) added substantially to the penaeid landings.

The estimated penaeid prawn catch and catch rate during 1996-97 was 5,497t (6.0 kg/hr) at Veraval, 15,994t (10.5 kg/hr) at New Ferry Wharf, 586t (32.5 kg/boat trip) at Karwar, 683t (46.2 kg/boat trip) at Tadri, 558t (1.1 kg/hr) at Malpe, 1,683t (1.6 kg/hr) at Mangalore, 1,515t (42.5 kg/boat trip) at Kozhikode, 6,426t (9.7 kg/hr) at Kochi and 13,228t (11.8 kg/hr) at Sakthikulangara. The

landings increased by 46% at Veraval, 37% at New Ferry Wharf, 2% at Karwar, 27% at Tadri, 44% at Kozhikode and 26% at Kochi over those of previous year and declined by 23% at Mangalore, 42% at Malpe and 16% at Sakthikulangara.

Trawling was banned for 2 months beginning from the middle of June 1996 along the Maharashtra coast. The landings as well as the average size of constituent species (eg. *Parapenaeopsis stylifera, Metapenaeus affinis, Metapenaeus monoceros*) showed appreciable increases when compared to the same period of previous year, when there was no trawl ban.

Landings of *P. stylifera* during monsoon amounted to 1,210t at Kochi and 5,603t at Sakthikulangara. While the monsoon fishery improved by 28% over the previous year at Kochi, a decline of 51% was recorded at Sakthikulangara.

P. stylifera was the dominant component of the prawn fishery at Veraval (36.4%), New Ferry Wharf (47.7%), Karwar (66.5%), Tadri (50.7%) and Sakthikulangara (57.7%), *M. monoceros* at Mangalore (49.7%) and *M. dobsoni* at Malpe (35.9%), Kozhikode (48.7%) and Kochi (47.7%). Other important species were *Solenocera crassicornis* (33.3%) and *P. hardwickii* (13.1%) at Veraval, *M. affinis* (19.8%) and *Metapenaeopsis stridulans* (7.6%) at New Ferry Wharf, *M. dobsoni* (20.4%) and *M. affinis* (11.3%) at Karwar, *M. dobsoni* (29.7%) and *M. affinis* (16.4%) at Tadri, *M.monoceros* (29.0%) and *P. stylifera* (26.2%) at Malpe, *P. stylifera* (16.5%) and *M. dobsoni* (10.7%) at Mangalore, *P. stylifera* (27.5%) and *P. indicus* (8.7%) at Kozhikode, *P. stylifera* (36.1%) and *Trachypenaeus curvirostris* (6.9%) at Kochi and *T. curvirostris* (16.9%) and *M. dobsoni* (6.8%) at Sakthikulangara.

Solenocera sp. at Mangalore and Sakthikulangara and *T. curvirostris* and *P. semisulcatus* at Mangalore are emerging as potential resources as a result of night trawling operations and extension of fishing to deeper grounds.

Bulk of the catch of *P. stylifera* was in the length range of 86-125 mm at Veraval, 71-110 mm at New Ferry Wharf, 71-105 mm at Karwar and Tadri, 61-95 mm at Mangalore and Malpe, 76-95 mm at Kozhikode, 66-100 mm at Kochi and 71-95 mm at Sakthikulangara. In *M. dobsoni* the same was 81-105 mm at Karwar, 76-120 mm at Tadri, 61-85 mm at Mangalore, 56-95 mm at Malpe, 66-95 mm at Kozhikode and 61-85 mm at Kochi. In *M. monoceros*, the major component in the catch was in the length range of 106-145 mm at Mangalore, and 96-150 mm at Malpe. In *T. curvirostris* at Sakthikulangara the bulk of the catch was in 61-85 mm length range.

Artisanal fishery

South west monsoon was the peak season for artisanal prawn fishery along Karnataka and Kerala coasts. 'Matubala' and hand trawls landed 580t of prawns at Mangalore showing a decline of 5.3% over previous year. 87% of the prawn landing in this sector was contributed by *M. dobsoni*. Ring seines at Fort Kochi landed 254t of prawns at a catch rate of 75 kg/unit in June and July. Almost the entire fishery was supported by *M. dobsoni* with the length ranges of 51-60 mm in June and 81-105 mm in July dominating the fishery.

457t of penaeid prawns at a catch rate of 24 kg/unit were taken by ringseine at Purakkad in the 'Chakara' fishery in the monsoon months, registering a decline of 29% over the previous year. 97% of the 'Chakara' fishery was supported by *M. dobsoni*.

'Konchuvala' (bottom set gill net) at Vizhinjam and Manakudy landed 52t at a catch rate of 2.8 kg/unit; the catch registered a decline of 55.6% over the previous

year. The entire fishery was composed of *P. indicus* with the 141-175 mm size range being dominant.

Minitrawls at Valanjavazhi (Alapuzha Dt.) fished 517t (27.2 kg/unit) of prawns in the nonmonsoon period registering a decline of 53% in the landings over the previous year. *P. stylifera* (81.5%) and *M. dobsoni* (18.5%) supported the fishery. Operation of this close meshed (10-12 mm) gear in the nearshore waters causes extensive damage to the juvenile *P. stylifera* along this coast; 50 to 60% of the catch by this gear consisted of undersized prawns.

Fishery in Nursery grounds

Stake nets at Korapuzha estuary (Kozhikode) landed 108t of penaeid prawns at a catch rate of 15 kg/unit. The fishery registered an increase of 99% over the previous year. *M. dobsoni* (79.2%) was the dominant constituent of the fishery followed by *M. monoceros* (12.1%) and *P. indicus* (8.7%).

Stake nets operating in the backwaters at Thevara and Elamkunnapuzha landed 614t (3.5 kg/unit) of which *M. dobsoni* contributed to 68.8% followed by *P. indicus* (22.7%) and *M. monoceros* (8.5%).

Assessment of Fishery and Resource Characteristics of the Penaeid Shrimps of the East Coast of India (CF/RE/1.12)

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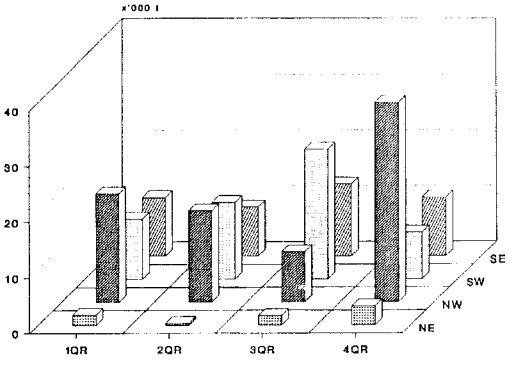
With a total production of 50,383t, the east coast of India contributed to 26.5% of the country's penaeid prawn landing in 1996. The landings declined by 1.3% over the previous year. Statewise contribution along the coast in the order of abundance was, Tamilnadu (54.7%), Andhra Pradesh (30.0%), West Bengal (7.5%), Orissa (7.1%) and Pondicherry (0.7%). The landings declined by 1.8% in Tamilnadu, 12% in West Bengal, 33.5% in Orissa and 21.2% in Pondicherry over those of previous year. However, the fishery improved by 9% in Andhra Pradesh. Trawlers landed 87% of the catch along this coast. Contribution of trawlers was 92.1% in Tamilnadu, 72.3% in Pondicherry, 71.3% in Andhra Pradesh, 94.4% in Orissa and 79.0% in West Bengal.

Trawl fishery

Data on the penaeid prawns were collected from trawl landings at Paradeep, Visakhapatnam, Kakinada, Madras, Pamban, Mandapam and Tuticorin.

The estimated catch and catch rate (in parantheses) during 1996-97 at important trawl landing centres along the east coast



Regionwise, quarterly landings of penaeid prawns in 1996

were: 792t (7.4 kg/hr) at Paradeep, 269t (2.2 kg/hr) at Visakhapatnam, 6,360t (8.3 kg/hr) at Kakinada, 2,650t (3.8 kg/hr) at Madras, 839t (1.6 kg/hr) at Mandapam, 228t (2.1 kg/hr) at Pamban and 128t (1.9 kg/hr) at Tuticorin. Over the previous year, landings declined at all the centres: 22.8% at Paradeep, 50% at Visakhapatnam, 8.7% at Kakinada, 39% at Madras, 16% at Mandapam, 25.4% at Pamban and 22.3 % at Tuticorin.

Dominant constituents of the trawl fishery were *Parapenaeopsis* spp. (42%) at Paradeep, *M. dobsoni* (37%) at Visakhapatnam, Kakinada (40%) and Madras (21%) and *P. semisulcatus* (44%) at Mandapam, Pamban (36%) and Tuticorin (67%). Other major species in the fishery were *M. dobsoni* (21%) and *M. affinis* (11%) at Paradeep, *M. monoceros* (21%) and *Metapenaeopsis* spp. (6%) at Visakhapatnam, *M. monoceros* (22%) and *S. crassicornis* (9%) at Kakinada, *P. indicus* (14%) and *P. maxillipedo* (12%) at Madras, *M. stridulans* (41%) and *T. pescadonensis* (11%) at Mandapam, *P. maxillipedo* (31%) and *P. indicus* (19%) at Pamban and *P. uncta* (14%) and *P. maxillipedo* (5%) at Tuticorin.

In recent years smaller species such as *Parapenaeopsis* spp. and *Metapenaeus dobsoni* have replaced larger ones like *Penaeus* spp. and *Metapenaeus monoceros* as dominant constituents in trawl fishery along the northeast coast. Species such as *M. stridulans* and *P. maxillipedo* have gained importance in the fishery in the Palk Bay and Gulf of Mannar regions respectively along the southeast coast. Because of the extension of fishing to deeper waters by larger vessels, nonconventional species such as *Metapenaeopsis* spp. and *Trachypenaeus* spp. are caught in good quantities along the Chennai coast.

A disturbing trend in the fishery at Kakinada was the large scale capture of juveniles of *M. monoceros* by trawlers. Nearly 70% of *M. monoceros* catch was dominated by sizes less than 100 mm.

'Sona' boats (43' OAL) based at Visakhapatnam, landed 1,220t of prawns at a catch rate of 3 kg/hr of trawling. The catch registered an increase of 24.5% over the previous year, whereas the catch rate improved by 19%. *M. dobsoni* (33%), *M. monoceros* (24%) and *P. indicus* (12%) were the major components of the fishery. Catch of *M. dobsoni* doubled over the previous year. Small-sized prawns formed nearly 25% of the fishery.

Deepsea prawn fishery at Tuticorin: 533t of deepsea prawns were landed at Tuticorin during 1996-97 against 1,856t in the previous year registering a decline of 71%. The fishery was dominated by *Heterocarpus* spp. and *Plesionika* sp.

Artisanal fishery

'Thallumadi' operations at Tuticorin registered a catch of 24t of prawns at a catch rate of 2.3 kg/unit. Fishery improved by 6% over the previous year. Fishery was dominated by juveniles of *P. semisulcatus* in the size range of 96-130 mm in length. At Chinnappalam (Gulf of Mannar) 'Thalluvalai' landed 5.8t of *P. semisulcatus* at a catch rate of 0.2 kg/hr. 91-110 mm sized prawns dominated the fishery.

Fishery in Nursery grounds

Stake nets at B.V. Palem (Kakinada) fished 269t (24 kg/unit) of juvenile prawns dominated by *M. monoceros* (64%), *M. dobsoni* (12%) and *P. indicus* (6%). Over the previous year, the fishery suffered a decline of 22%.

INVESTIGATIONS IN THE NONPENAEID SHRIMP FISHERY OF NORTHWEST COAST OF INDIA (CF/RE/1.13)

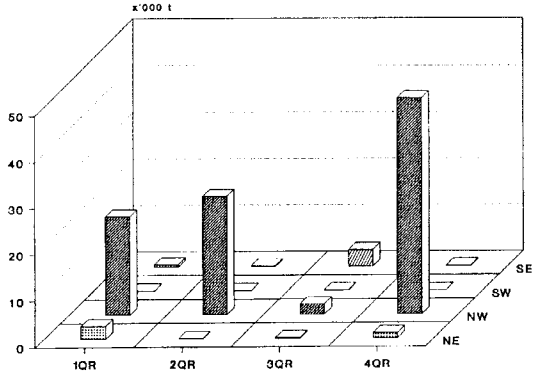
V.D. Deshmukh and A.P. Dineshbabu

In the total nonpenaeid prawn production of 1,04,462t in 1996, Gujarat contributed to 64.5% and Maharashtra to 27.1% of the fishery. Against the previous year, the fishery improved by 90% in Maharashtra and 26.6% in Gujarat. Trawl and 'Dol' nets were the major gears employed for the exploitation of this resource. Trawlers accounted for 77% of the fishery in Gujarat whereas in Maharashtra 89% of the landing was accounted by 'dol' nets. Landings by trawlers improved by 17% in Gujarat and by 120% in 'Dol' nets in Maharashtra.

Data on 'dol' net fishery were collected at Nawabunder and Rajapara in Gujarat and New Ferry Wharf and Versova in Maharashtra. Trawl fishery was studied at Veraval, New Ferry Wharf and Versova.

Trawl fishery

At Veraval, nonpenaeids formed 67% of the crustacean catch landed by trawlers. With a total catch of 21,166t (23 kg/hr) landed by trawlers, the nonpenaeid fishery improved by 46% over the previous year.



Regionwise, quarterly landings of Nonpenaeid prawns in 1996

98% of the nonpenaeid catch composed of *Acetes* spp, the rest being shared by *Nematopalaemon tenuipes* and *Exhippolysmata ensirostris*.

Nonpenaeid landings by trawlers at New Ferry Wharf and Versova amounted to 1,661t (1.1 kg/hr) and 599t (2 kg/hr) respectively. While the fishery declined by 16% at New Ferry Wharf the catch improved by 63% at Versova. *N. tenuipes* formed 97-100% of the fishery at these centres.

'Dol' net fishery

At Nawabunder 'dol' nets landed 1,815t (9.6 kg/haul) of nonpenaeids registering a decline of 30% in the fishery over the previous year. 59% of the fishery was supported by *Acetes* spp. and the rest being equally shared by *N. tenuipes* and *E. ensirostris*.

At Rajapara, the landings amounted to 2,559t at a catch rate of 10 kg/haul, catch showing a marginal decline of 2% over the previous year. *Acetes* spp. (62.4%) supported the fishery followed by *N. tenuipes* (21.4%) and *E. ensirostris* (16.3%).

N. tenuipes of the length range of 41-55 mm and *E. ensirostris* of the length range of 66-85 mm dominated the fishery. Berried females were in abundance during September-December in *N. tenuipes* and April, June and August to October in *E. ensirostris*.

At Mumbai, the 'dol' nets landed 142t (40 kg/haul) at New Ferry Wharf and 2,037t (31 kg/haul) at Versova. The catch showed no variations from the previous year. At both the centres *Acetes* spp. supported nearly 75% of the fishery. *N. tenuipes* formed the rest of the fishery. In *N. tenuipes* 39-57 mm sizes dominated the fishery. Peak spawning was recorded in April and May.

INVESTIGATIONS ON LOBSTER AND CRAB RESOURCES OF INDIAN COAST (CF/RE/1.14)

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LOBSTER

2,660t of lobsters were fished from Indian coasts in 1996, showing an improvement of 36.7% in production over the previous year. Gujarat (43.6%) and Maharashtra (42.6%) contributed to the bulk of the lobster fishery in the country. Tamil Nadu (9.5%) and Kerala (4.2%) contributed to the rest of the fishery. Over the previous year, fishery improved by 293% in Maharashtra and 15% in Kerala. Fishery declined by 7% in Gujarat and 14% in Tamil Nadu. Trawlers contributed to 82 to 93% of the production along the northwest coast. In Kerala 62% of the catches were taken by trawlers, and in Tamil Nadu artisanal gears accounted for 67% of the catches. Traps in the southwest coast and bottom set gill nets in the southeast coast were the principal gears employed for the capture of lobsters.

Data were collected at Veraval, New Ferry Wharf (Mumbai), Kozhikode, Vizhinjam, Tuticorin and Madras.

Trawl Fishery

Lobster landings by trawlers in 1996-97 amounted to 200t (0.23 kg/hr) at Veraval, 78t (0.05 kg/hr) at New Ferry Wharf, 16t (0.54 kg/boat trip) at Tuticorin and 30t (0.05 kg/hr) at Madras. When compared with the previous year the fishery improved by 49% in Veraval and 6% at New Ferry Wharf, whereas it suffered a decline of 29% at Tuticorin and 31% at Madras.

Thenus orientalis dominated the fishery at Veraval (56%), and Madras (76%) and *Panulirus polyphagus* (97%) at New Ferry Wharf. *P. polyphagus* formed 44% in the trawlers at Veraval and *P. homarus* contributed to 24% at Madras. At Tuticorin *P. ornatus* (69.5%) and *P. homarus* (30.5%) were the constituents of the lobster fishery. An encouraging observation was the reappearance of *T. orientalis* in small numbers in the lobster fishery at Mumbai after a gap of 3 years.

In *P. polyphagus* of 56-90 mm (carapace length) size range at Veraval and 171-240 mm (total length) size range at New Ferry Wharf dominated the fishery. At Tuticorin *P. ornatus* in the size range of 201-320 mm (Total length), *P. homarus* in the length range of 161-225 mm (T.L.) were dominant in the fishery.

Deepsea trawlers landed 56t (29 kg/unit) of *Puerulus sewelli* during January and March 1997 at Tuticorin. The catch and catch rate improved by 93% and 140% respectively over the previous year.

Artisanal fishery

Bottom-set gill nets at Tikkoti near Kozhikode landed 0.5t (0.5 kg/unit) of lobsters of which *P. homarus* formed 78% followed by *P. polyphagus* (17%). 51-70 mm sizes (carapace length) in *P. homarus* dominated the fishery. At Tharuvaikulam and Kayalpattanam in Tuticorin, bottom-set gill nets fished 12t of lobsters at a catch rate of 0.96 kg/unit; *P. ornatus* (62%) and *P. homarus* (37%) supported the fishery which declined by 68% over the previous year.

Traps operated at Vizhinjam, Colachel and Muttom along the southwest coast landed 10t of *P. homarus* at a catch rate of 0.6 kg/unit. Fishery improved by 34% over the previous year. 56-80 mm (carapace length) sized lobsters dominated the fishery. Berried lobsters were caught in good numbers between March and August.

CRABS

The total crab production in the country amounted to 29,041t in 1996, showing a decline of 5.4% over the previous year. Tamil Nadu (33%), Gujarat (33%), Kerala (12%) and Andhra Pradesh (8%) contributed to the major portion of the landings. Trawlers accounted for 95% of the crab catch along the west coast and 60% along the east coast. In Tamil Nadu, in addition to trawlers (60%), gill nets (38%) added substantially to the crab landings.

Trawl Fishery

Estimated catch and catch rate in 1996-97 amounted to 3,015t (3.3 kg/hr) at Veraval, 361t (0.24 kg/hr) at New Ferry Wharf (Mumbai), 222t (12 kg/boat trip) at Karwar, 147t (0.3 kg/hr) at Malpe, 209 (0.2 kg/hr) at Mangalore, 349t (10 kg/boat trip) at Kozhikode, 157t (0.6 kg/hr) at Kochi, 182t (0.3 kg/boat) at Mandapam, 594t (0.9 kg/hr) at Madras and 189t (0.3 kg/hr) at Kakinada. Over the previous year, fishery improved by 167% at Veraval, 78% at New Ferry Wharf (Mumbai), 14% at Malpe, 105% at Kozhikode and 131% at Kochi. Fishery declined by 38% at Mangalore, 31% at Madras, 8% at Mandapam and 7% at Kakinada.

The dominant species were *Charybdis feriatus* at New Ferry Wharf (69%), Mangalore (57%), Kozhikode (51%) and Kochi (43%). *Charybdis lucifera* (98%) at Veraval, *Portunus pelagicus* at Karwar (55%) and Mandapam (100%) and *Portunus sanguinolentus* at Malpe (37%), Madras (36%) and Kakinada (71%). Species of minor landings were *P. sanguinolentus* (12%) and *P. pelagicus* (8%) at New Ferry Wharf, *P. sanguinolentus* (44%) at Karwar, *P. pelagicus* (24%) and *P. sanguinolentus* (19%) at Mangalore, *P. pelagicus* (31%) and *C. feriatus* (32%) at Malpe, *P. sanguinolentus* (30%) and *P. pelagicus* (19%) at Kozhikode, *P. sanguinolentus* (33%) and *P. pelagicus* (24%) at Kochi, *P. pelagicus* (19%) and *C. natator* (16%) at Madras and *C. feriatus* (16%) and *P. pelagicus* (11%) at Kakinada. With trawling extending to deeper waters, *C. feriatus* has replaced the conventional species like *P. pelagicus* and *P. sanguinolentus* as the leading component of the fishery at most of the centres along the west coast.

Artisanal fishery

'Konchu vala' at Vizhinjam landed 17t of crabs at a catch rate of 1.6 kg/boat. The fishery declined by 81% over the previous year. *P. pelagicus* (52%) and *P. sanguinolentus* (30%) were the main constituents of the fishery. With a total catch of 77t (8.6 kg/unit) by bottom set gill nets at Tharuvaikulam, the fishery registered a decline of 40% over the previous year. *P. pelagicus* supported more than 85% of the gill net landings at Tharuvaikulam. 'Nandu vala' operations at Thoppukadu (Mandapam) registered a catch of 9t (3 kg/unit) dominated by *P. pelagicus* (61%) followed by *Scylla serrata* (39%).

STUDIES ON DEVELOPMENT OF ARTIFICIAL REEFS AS AREAS OF HIGH FISHERIES POTENTIAL THROUGH SEA RANCHING AND SEA FARMING (CF/RE/3)

M. Rajamani, K.K.Philippose, K.Prabhakaran Nair, S. Krishna Pillai, E.V.Radhakrishnan, K.P. Said Koya and V.S.Kakati

The project initiated in 1996 aims at establishment of artificial reefs and study the habitat generation in such reefs. After initial surveys between Tuticorin and Vaipar, 3 centres namely Vaipar, Vellappatti and Hare Islands were identified for construc-

tion of artificial reefs. Vaipar and Vellappatti were selected for construction of fish reefs and Hare island for lobster reefs. 11 modules were released at Hare island at a depth of 5 meters in September 1996. Modules were constructed with hollow concrete blocks of 3 dimensions viz. 38 x 20 x 20 cm, 38 x 20 x 15 cm and 38 x 20 x 10 cm and condemned sewage pipes. Hollow blocks formed the base on which pipes numbering 3, 5 and 6 were tied. Fishing carried out in the vicinity of the reefs showed the availability of lobsters in these areas.

Laboratory experiments at Tuticorin on the behaviour of lobsters and crabs showed that spiny lobsters preferred PVC pipes with wide openings, whereas crabs were attracted towards concrete rings.

At Vizhinjam 35 fish reefs and 40 lobster reefs were fabricated and installed at depths of about 20-25 meters and 10 meters respectively. Fish reef is triangular in shape with 5' x 5' x 5' size in concrete with 1" thickness. Each concrete slab is provided with a window in the middle (size 2'x 2') and round holes along outer margin. Lobster reef is also triangular in shape (3' x 3' x 3') with stoneware pipes inside. Pipes (10 in numbers) are open at both ends and provide ideal shelter for lobsters. Fish shoals were sighted in the reef site from the very next day of installation in March, indicating that reefs are acting as very good fish attracting devices. These reefs are expected to mature by September-October months.

Consultancy services were extended to Fisheries departments of Maharashtra, Lakshadweep, Orissa and Kerala on planning and implementation of artificial reefs. Technical assistance was rendered to Poovar Panchayat for establishment of a massive reef of 15,000 M2 to 20,000 M2 area off Poovar.

Seed Production, Experimental Farming and Tagging of Marine Prawns (CF/CUL/1.9)

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Five hatchery runs were carried out at the mini shrimp hatchery at Mandapam Camp and 6.9 lakh postlarvae of *Penaeus semisulcatus* were produced. In addition to the mixed diatom culture, larvae were also fed with rotifer and this has helped to increase the survival from nauplii to postlarva I. In a few experiments 88% survival was also obtained.

During this period 4.1 lakh postlarvae, produced from the hatchery have been used for searanching experiments.

Postlarvae I were further reared in nursery tanks provided with flowthrough system. They were fed with prawn meat-egg- custard and reared for 25 days. Out of the 95,000 PL 25 produced, 45,000 have been used for carrying out farming experiments.

Farming experiments have been carried out in 3 ponds, each of 0.25 ha. Pond bottom was properly prepared and lime was applied @ 400 kg/ha. Ten days before stocking, pond water was fertilized with urea and super phosphate @ 135 kg/ha and 67kg/ha respectively. Each pond was stocked with seed @ 60,000/ha. They were fed with prepared shrimp feed @ 20% of biomass during first 15 days and gradually reduced to 4% of bio-

mass during the last 2 months. Feeding rate was adjusted by close monitoring. Within 4 months shrimps have reached 14-17 g weight from 0.02 g and ovary of one female specimen of 132 mm TL was found to be in third stage of maturity. Regular monitoring of the environmental parameters has been carried out. Salinity varied from 30 ppt to 38 ppt, dissolved oxygen from 5.5 ml/l to 9.2 ml/l and pH from 8.0 to 9.0. The initial experiments have revealed the possibility of introducing *P. semisulcatus* as a candidate species along the coastal Tamilnadu. Further, the experiments have also revealed the possibility of broodstock maintenance of this species in grow out systems.

Regular monitoring on the crustacean larval resources from Minicoy lagoon was carried out. A total of 62 lakh decapod larvae were collected from the lagoon during this period which accounted for 57.5% of the total zooplankton. 95.7% of the crustacean larvae were of protozoea and mysis stages of shrimps, 4% of zoea and megalopa of crabs. Postlarvae of *P.latisulcatus* have been sorted out and used for rearing experiments. The total length of the larvae used for experiments varied from 16 to 37 mm (average 25.4 mm) and under controlled conditions a growth rate of 20.9 mm was observed during the first month. Larvae were fed ad *libitum* with clam meat.

Live feed culture mainly of *Chlorella* sp., *Chaetoceros* sp., *Brachionus* sp. and *Moina* sp. was initiated and maintained for feeding crustacean larvae. A steady culture of rotifer @ 300-350 no/ml and Moina @ 8-10 no/ml was obtained.

Broodstock Development, Seed Production and Farming of Commercially Important Spiny and Sand Lobsters (CF/CUL/1.10)

E.V. Radhakrishnan, K.K. Philippose, D.B. James, M. Rajamani, G. Maheswarudu and Josileen Jose

Preliminary experiments were carried out on fattening of *Panulirus homarus* at Vizhinjam. Disconet operations bring in a good number of juveniles of this sp. which are around 25 g minimum weight and fetch only Rs.30-50/kg. Juveniles weighing 25-40 g were collected and stocked in 1.5t FRP tanks @ of 2 nos per sq. foot area until they reached 150 g and then the stock density was decreased to 1 lobster/sq.foot and reared until they reached 500 g. They were fed with mussels *ad libitum*. An average weight of 30 g per month was obtained and a 25 g size lobster took 18-19 months to reach 600 g size. It was also observed that growth was faster after reaching about 200 g. Marketable size of about 500 g can be obtained within 14 months.

Experiments on the breeding and larval rearing of spiny lobster *Panulirus homarus* has been initiated at Calicut and Tuticorin. The phyllosoma larvae of *P. homarus* have reached stage II during March 1977 and experiments are being continued. Sterilized sea water is used for rearing and larvae were fed with freshly hatched *Artemia* nauplii.

MARICULTURE OF CRABS (CF/CUL/1.11)

G. Sudhakara Rao, V. S. Kakati, C. Suseelan, P.E.Sampson Manickam, K.R. Manmadhan Nair, Grace Mathew, R. Marichamy, G. Maheswarudu and Josileen Jose

Initial experiments on the seed production and farming of *Portunus pelagicus* gave encouraging results at Mandapam Camp. 14 breeders ranging from 80 to 200 g, were collected from regular trawling operations and brought to the laboratory. 87 lakh zoeae were obtained from these breeders of which 14.8 lakh were used for experiments. Zoeae were reared through five zoeal stages, Megalopa and first instar. Survival varied from 0% to 16%. 13,277 baby crabs were produced and 1,148 were used to carry out farming experiments.

F1 and F2 generations were maintained under controlled conditions. Baby crabs were further reared for a period of 198 days feeding with clam meat and smaller crustaceans *ad libitum*.

Males attained an average weight of 5.36 g in 39 days which became 140 g in 198 days and females attained average weight of 5.0 g in 39 days which became 97.8 g in 198 days. 3 females attained maturity in captivity within 5-7 months. Experiments revealed the possibility of farming of this species under controlled conditions and the harvestable size (100 g) can be obtained within 120-150 days in growout systems.

One female of 125 g from F1 generation matured in captivity and gave 3 lakh active zoeae. These zoeae were further reared in the hatchery. 3,388 baby crabs have been obtained from these experiments.

Experiments were carried out on the brood stock maintenance and induced maturation of *Scylla oceanica*. 4 males and 12 females of this species have been individually marked and introduced in a pool, fitted with recirculation facility. Nine females matured and got 'berry' in captivity. Repeated spawnings were also observed. The interval between the successive spawnings was 30-35 days and incubation period 10-11 days.

Experiments were carried out on the farming of *Scylla oceanica* at Tuticorin with 400 baby crabs of an average size of 92 mm cw/136 g weight in a 0.12 ha farm. They were fed @ 7-10% of body weight with gutted chicken waste and trash fish. Growth and survival were assessed periodically. Harvesting was done after 150 days. 47.5% survival was obtained. 105 kg (@ 840 kg/ha/ 150 days) of crabs of average size 133.8 CW and 565 g have been harvested.

A short duration experiment carried out at Narakkal (Cochin) on the fattening of *Scylla tranquebarica* gave encouraging results. In a pond of 0.1 ha, 292 water crabs of 70 to 1,760 g were stocked and fed with salted trash fish. Water exchange was carried out through tidal influx daily. After 20 days, partial selective harvesting of crabs was carried out at regular intervals. Hard shelled and marketable size crabs of above 550 g were harvested and sold. Experiment was carried out for 60 days. A total of Rs.8,572/- was incurred towards the purchase of crabs and Rs.600/- towards feed. Net profit within two months was Rs.3,000/-. Initial experiment showed that from one ha water area, spending Rs.2.5 lakh a farmer can earn Rs. 4.8 lakhs in an year (8 months operation) with a net profit of Rs.1.2 lakh, provided adequate numbers of water crabs are available in time for stocking.

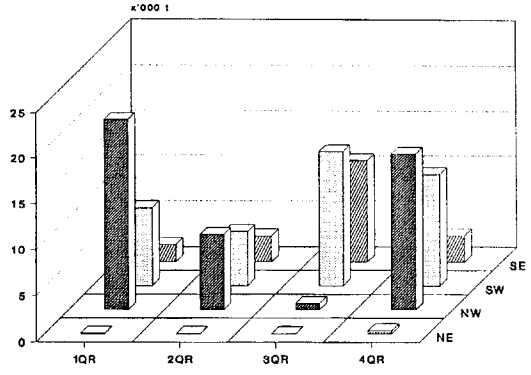
V. MOLLUSCAN FISHERIES DIVISION

INVESTIGATIONS ON THE RESOURCE CHARACTERISTICS OF CEPHALOPODS (MF/RE/1)

M.M. Meiyappan, K.K. Joshi, Kuber Vidyasagar, K. Sunilkumar Mohamed, P. Laxmilatha, K. Prabhakaran Nair, A.P. Lipton, R. Sarvesan, E.M. Abdusamad, G. Syda Rao

The total cephalopod production during 1996-97 was estimated as 107,000 t. The landing by trawlnet was estimated as 4,548 t at Veraval, 1,264 t at Mangrol, 11,122 t at Bombay, 3,542 t at Mangalore, 1,673 t at Malpe, 4,069 t at Cochin, 1,303 t at Mandapam, 2,153 t at Madras and 133 t at Visakhapatnam. Boat seines and hooks and lines landed 1,201 t at Vizhinjam. When compared to the production of 1995-96, the production during this year increased by 25% at Veraval, 44% at Mangrol, 111% at Vizhinjam and 38% at Mandapam. At other centres it declined by 17 to 46%. Maximum CPUE of 242 kg was obtained at Bombay. The cephalopod contribution to all fish production ranged between 5 and 13% at different centres. Among squids *Loligo duvauceli* dominated, followed by *Doryteuthis sibogae*; among cuttlefish, *Sepia aculeata* and *S. pharaonis* were dominant. *Octopus* landing was reported from Cochin, Mandapam and Madras centres only. Peak spawning activity was observed during monsoon and post monsoon periods along west coast and during Ocotober-December period along east coast.

The study on stock assessment of the Indian squid *Loligo duvauceli* off Karnataka coast showed that the MSY of this species is 6059 t and MSE Rs 270.3 million, against the present average annual catch (1990-94) of 5,157 t valued at Rs 234.9 million. There is need to reduce the trawl effort in the state to 44% of the present to obtain sustainable returns.



Regionwise, quarterly landings of cephalopods in 1996

Three specimens of the diamond back squid, *Thysanoteuthis rhombus* of 300-340 mm were taken on hooks & line, at 75-100 m depth off Vizhinjam. This is the first time that this oceanic squid is obtained in the traditional coastal fishery.

INVESTIGATIONS ON THE RESOURCE CHARACTERISTICS OF BIVALVES AND GASTROPODS (MF/RE/2)

P.S. Kuriakose, K.K. Joshi, K. Sunilkumar Mohamed, P. Laxmilatha, T.S. Velayudhan, N. Ramachandran, K. Ramadoss, A.P. Lipton, P.V. Sreenivasan, P. Natarajan, R. Sarvesan, K. Satyanarayana Rao

Green Mussel: The total production from Challiyam near Calicut to Koduvally near Kannur was estimated at 5393 t. The total effort was 80,437 mandays and the average

catch per manday was 64 kg. The price per 100 kg shell-on mussels at the landing centre varied from Rs 550 to 1000 and Rs 650-1100 in the market. About 50% of the mussel was sold as shucked meat and rest shellon to restaurants and distant places.

Brown mussel: The total production of brown mussel from Kovalam to Kadiapatnam in the Southwest coast has been estimated at 2040 tonnes with a total effort of 75298 man-days. The average catch per man-day was 27 kg. Price of mussels was Rs 6-10 per 100 numbers at the landing centre.

Clam : The total estimated production of black clam *Villorita cyprinoides* from the Vembanad lake was 37173 t. The meat range was 11-18%. The clam resource of Ashtamudi was estimated by a short survey funded by MPEDA. The total standing stock was 61,000 t of which 12,000 t was *Paphia malabarica*.

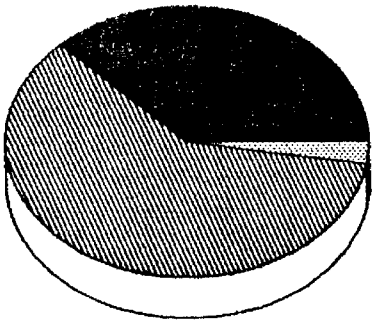
At Ashtamudi Lake a total of 9360 t of *Paphia malabarica* (shellon) was landed during the whole year with 164 fishing days involving 1925 canoes and 3460 persons. The average catch/canoe/day was 197.5 kg. The highest 2141 t and lowest 56 tonnes with catch rate 270 and 100 kg respectively during the months of 1996 April and February 1997. There was a total ban on fishery of *Paphia malabarica* during the breeding period October 1996 to January 1997.

There was replenishment of *Paphia malabarica* transplanted during 1995 in Chettuva estuary. The fishery initiated after this is under observation for further activities.

There was targeted fishing for whelks *Babylonia* spp off Quilon by trawl net operators. 450-500 t were landed in March-May period and these whelks were exported.

The total landings of bivalves in Karwar bay was estimated at 28 t, of which clams contributed 16.4 t, (*P. malabarica* 4.7 t, *M. meretrix* 11.0 t and *M. casta* 0.66 t), green mussel 3.2 t and oysters 8.5 t.

The total landings of bivalves and gastropods from the Kakinada bay was estimated at 3467 t. The bivalves constituted 46% and gastropods formed 54% of the landings. Among the bivalves, *A. granosa* contributed 30.39% followed by *M. meretrix* 5.9%, *Mercia opima* 4.03%, *Geloina bengalensis* 1.74%, *P. malabarica* 1% and *A. rhombea* 0.4%. Among gastropods, *Cerithidea* sp formed 32.45%, *Telescopium* sp 11.54%, *Umbonium* sp 9.09%, *Thais* sp 0.66% and *Hemifusus* sp 0.18%.



Estimated Blomass of Clams in Ashtamudi Lake

The clam fishery in Mulki estuary (Mangalore) started only in December. The estimated catch in December was 6,465 t with a catch rate of 13.4 kg/man day.

Place	Resource	Production t
	MUSSEL	
Malabar coast	*Perna viridis*	5393.27
Karwar	"	3.19
Southwest coast	*P. indica*	2040.00
	EDIBLE OYSTER	
Ashtamudi	*Crassostrea madrasensis*	200.00
Chettuva	"	7436.39
	CLAMS	
Ashtamudi Lake	*Paphia malabarica*	9360.9
Vembanad Lake	*Villorita cyprinoides*	37173.2
Karwar	*P. malabarica*	4.73
	Meretrix meretrix	11.0
	M. casta	0.66
Kakinada	*Anadara granosa*	421.4
	M. meretrix	81.8
	Mercia opima	55.8
Mangalore	*M. casta*	37.8
Total bivalve production		54783.75

Tagging and recapture: A total of 303 chanks were tagged and released in the Gulf of Mannar. From the earlier batch, 35 tagged chanks were recaptured from Gulf of Mannar and Palk Bay off Mandapam, Veladai, Pudumadam, Athankarai, Irumeni and Uchipuli along Ramnad.

Seed Production of Bivalve Molluscs and Ranching of Clam Seed in Coastal Waters (MF/CUL/4)

K.A. Narasimham, K. Ramadoss, P. Muthiah, D. Sivalingam, A.C.C. Victor, A. Chellam, S. Dharmaraj, G.P.K. Achary

A total of 21 spawning experiments were conducted on edible oyster of which 13 were successfully carried out to settling; 7 experiments were discarded due to ciliate attack/contamination during rearing and one experiment is under rearing process.

A total of 640 strings with hatchery spat were transferred to nursery for further rearing. From nursery, 808 strings with oysters of above 25 mm were transferred to the edible oyster farm for further rearing. 600 shell valves with an average of 10-15 hatchery produced spat were utilized for rearing by stake method of culture.

Ranching: A total of 2076 shells with 1-70 spat/shell were ranched in the natural bed area. A total of 300 shells and 50 strings each bearing 35-40 oysters of 31 mm mean length were ranched in the Korampallam and Karapad creeks.

Pearl oyster: A total of 7.72 lakh spat were produced in the hatchery and distributed to various research centres of CMFRI and entrepreneurs. Delay in gonadal maturity re-

sulted in spawning postponement from June to September. The effect of water exchange was studied. The larvae with no water change upto settlement yielded higher rate of settlement. Another batch of larvae are being reared.

Selection of Suitable Sites for Bivalve Culture (MF/CUL/8)

K. Satyanarayana Rao, K. Sunilkumar Mohamed, P.S. Kuriakose, T.S. Velayudhan, P. Natarajan, R. Sarvesan, G. Syda Rao, E.M. Abdusamad

Visakhapatnam: Bheemunipatnam estuary was selected for location testing but experiments could not be conducted as the salinity in the estuary dropped to very low level following heavy rains. Culture experiments will be conducted during the next season.

Kakinada: A stock of *Crassostrea madrasensis* obtained during the previous season perished due to fall in salinity as a result of the monsoon rains. Also a part of the stock was lost due to predation. Green mussel *Perna viridis*, settled on rens grew to an average size of 37.9 mm with average weight of 6.7 g by the end of December 96. The growth of the stock of pearl oysters, *Pinctada fucata* was slow due to fluctuations in salinity and temperature. The average DVM of the pearl oysters was 37.36 mm and average weight 6.45 g in December 96. The salinity decreased to a low of 22.09%. during October-November, 96 and recovered to 26.34% in December 96. The water temperature varied from 25 to 33°C during October-November and declined to 23-24.5°C in December 96.

Mangalore: Demonstration of mussel culture in the Mulky estuary was initiated in November 96. 170 kg of green mussel seed were stocked on bamboo stakes. Seeding was done on fortyfive synthetic and coir ropes of 1 m length. 150 numbers of new seeding material - stretchable tubular nylon bags were also used. The growth of the mussels is being monitored. At Bindur,a fisherman has initiated longline mussel culture in January 1997 in the opensea with the technicalassistance from the CMFRI and anticipate a harvest of 700kg of mussel by end of May.

13 strings of edible oyster were harvested on 25.5.96. The production rate was poor as majority of the settled spat were *Saccostrea cucullata*. Their mean size after 6 months of rearing was 42.4 mm. Only 10% of the spat settled on the 13 strings were *Crassostrea madrasensis* and their mean size was 75.9 mm.

Kochi: The edible oyster spat *Crassostrea madrasensis* obtained during January 96 at Quilon were shifted to Chettuvai estuary. 350 strings were suspended from a rack of 20 x 5 x 2.5 m set up in the estuary. Another 150 strings were suspended from a longline unit established near the bar mouth. The oyster transferred from the nursery to farm. A total of 1050 strings with oysters are being reared from 30 racks in the farm. Regular farm maintenance works were attended to. Totally, 55.75 kg of shucked oyster meat were sold locally and 3.5 kg of oyster meat were utilized for demonstration purpose.

A study on the strength and suitability of synthetic rope (2.5 mm, 3.5 mm, 4.5 mm and 5 mm) for ren method of oyster culture is in progress.

The hydrological parameters of the oyster farm site were monitored regularly. The fouling rate in the farm area was observed to be 470 g/string during July-August-September.

Participants of the Summer Institute on 'Recent advances in Mariculture of Molluscs' were acquainted with oyster hatchery and farming activities. Eleven participants of UGC training programme on 'Industrial Fish and Fisheries' and personnel from Gujarat Fisheries Department were trained on edible oyster culture and seed production through hatchery system.

UPGRADATION, LOCATION TESTING AND TRANSFER OF TECHNOLOGY OF PEARL CULTUR (MF/CUL/10)

A.C.C. Victor, A. Chellam, S. Dharmaraj

Upgradation: Several grafting experiments were carried out to produce pearls of better quality. The details of these experiments are given below.

Graft experiment	No. of oysters	Results
1. *P. sugillata* with *P. sugillata* graft	38	The box containing oysters lost in the sea
2. *P. sugillata* with *P. fucata* graft	38	- Only 15 oysters survived - Only one black congregation was obtained
3. *P. fucata* with *P. sugillata* graft	28	- 25 oysters survived - One pearl with blemishes - 3 nuclei without pearl formation
4. *P. fucata* with *P. fucata* graft	55	- All 55 oysters survived - Good quality pearls - 6 Nos. - Pearls with blemishes - Black congregation - - 1 No. - Nucleus without any formation - 3 Nos.

Transfer of technology: Technology upgradation was done in different environmental conditions to assess the growth of oysters and production of pearls. As per the MOU signed with entrepreneurs, consignment of 25,000 spat, 800 adult oysters and 200 nucleated oysters were shifted to NCC Bluewater, Kakinada during April-June and another batch of 6000 spat was shifted during July-August. Their facilities were inspected and guidelines on maintenance of pearl oysters, water quality monitoring, production of microalgae, feeding schedules, rearing densities, were given to the company. The spat showed tremendous growth in static water system in round fibre glass tanks.

Under a similar MOU programme, a consignment of 52,000 spat, 1100 adult oysters and 200 nucleated oysters and 6.9 million veliger larvae was given to M/s.Balaji Biotech and also to Gem hatchery at Madras and Visakhapatnam. The details of supply were given below:

Name of entrepreneurs/ Research Centre	Veliger larvae	Spat	Adult	Nucleated
1. M/s.Balaji Biotech	69 lakhs	52,000	1100	200
2. M/s.NCC Bluewater	-	31,000	800	200
3. Visakhapatnam	-	30,000	-	-
4. Madras	-	10,000	110	-
5. Mandapam Camp	50 lakhs	2,00,000	550	-
6. Kochi	11.4 "	1,500	62	-
7. Minicoy	-	500	-	-
Total	130.4	3,25,000	2622	400

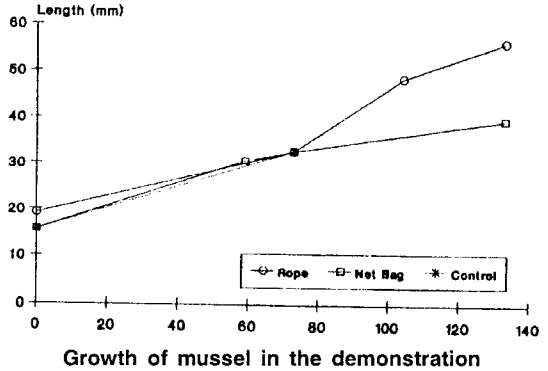
Popularisation and Transfer of Bivalve Culture Technology at Selected Centres Along Kerala Coast (MF/CUL/11)

K.K. Appukuttan, T.S. Velayudhan, P. Laxmilatha, P.S. Kuriakose, N. Ramachandran

Transplantation and demonstration experiments of edible oyster: The edible oyster spat collected in the demonstration farm at Dalavapuram in the Ashtamudi lake were transplanted to Narakkal backwaters in Cochin and Chettuva estuary (Trichur Dist.)

A total of 350 strings holding 8100 shells were transplanted from Dalavapuram to Chettuva and suspended from a rack of 20 x 5 m (100 sq m) at a depth of 2.5 m.

In another experiment, a long-line of 12 m length with 3 horizontal lines 30 m apart were anchored at 2 to 2.5 m depth near the barmouth. 150 strings were suspended from the long-line. The average length of the oysters increased from 40.1 mm in April to 45.8 mm in September 1996. The average total weight decreased from 23.2 g to 21.9 g in September.



Growth of mussel in the demonstration farm at Mulky (Dakshina Kannada)

During monsoon, due to drastic drop in salinity, over 50% mortality occurred in oysters suspended in the estuary and the remaining 25 strings were shifted to the bar mouth of the estuary.

A total of 500 strings from Dalavapuram were transplanted at Narakkal. Meat percentage of 18.03 was observed by end of the growout period. A total of 300 kg of shell-on oysters were harvested in August 96 and supplied to CIFT, Cochin for analysis of the meat and processing.

Transfer of technology: As a result of the adoption of the CMFRI technology of edible oyster farming, seven farmers successfully harvested the edible oysters from their farms and sold to Integrated Fisheries Project, Cochin at the rate of Rs.45/kg of shucked meat. The details are as given below.

Name	Meat sold (kg)	Revenue earned Rs.
1. Mukkadan	438.2	19717
2. Bruno	88.75	3994
3. Mohan Das/Asokan	78.5	3532
4. Devadas	62.0	2790
	667.45	30033

A total of 554.25 kg of shucked meat from the CMFRI demonstration farm was sold to IFP fetching a revenue of Rs.24,941.

Mussel culture in estuaries: The high production potential of mussel culture in the

estuaries and backwaters was demonstrated at Dharmadam. The fixed rack farm was established in December 1995 in the Dharmadam estuary. 86 seeded ropes of 1.5 m each were suspended from the racks. 1300 kg of mussels was harvested from the farm on 30.5.1996. The average production per meter of rope was 12 kg. The meat was handed over to M/s.Abad Fisheries at Rs.14/ kg shell-on during the Harvest mela organised in this connection.

A progressive farmer Shri Gul Mohamed, who adopted this technology and set up a farm of 250 sq.m area in Padanna backwaters, Kasargod Dist, successfully harvested 25000 kg of mussels from 160 ropes with an average production of 15 kg/meter length of rope. The meat was sold to M/ s.Abad Fisheries at Rs.14/kg shell-on, on 30.5.1996 during the Harvest mela,.

Trainings:

i) 16 officials of the MPEDA, Cochin were trained on oyster farming during 10-15 June, 1996 organised by TTC of CMFRI.

ii) 100 farmers were trained on edible oyster farming at Quilon under the sponsorship of MPEDA, Cochin.

iii) About 50 farmers were trained on edible oyster farming at KVK, Narakkal during 20-21, June 1996.

iv) 40 farmers in two batches were trained on 'Mussel culture' at KVK, Narakkal of CMFRI during March 1997.

v) One day training was conducted at Trikaripur for the selected DWCRA/ IRDP women groups on mussel farming

vi) One day seminar on mussel culture was organised for 100 fishermen (covering 4 panchayats) on 8.6.96 at Cheruvathur Panchayat.

vii) Two-day training for 100 farmers on edible oyster farming on 21-22.3.97 organised by Kerala State Inland Fisheries Society at Kollam.

Technology adoption: Govt. of Kerala has approved the implementation of edible oyster farming in 4 districts. 15 groups comprising 125 women farmers will adopt and implement edible oyster farming scheme during the next season. BFFDA will provide financial assistance by way of subsidy. Spat production has been initiated.

A total of 67 women (5 groups each comprising 13-15 women) identified by the local administration, have adopted mussel farming in Padanna under DWCRA/IRDP programme. The farm area is 800 sq.m and about 2260 nos. of seeded ropes of average 1.5 m have been suspended in the farm.

Another group of 20 persons (5 in each group) have adopted mussel farming in Dharmadam estuary under financial support from NABARD, in an area of 500 sq.m. 500 seeded ropes of 1.5 m length have been suspended in the farm.

An intensive stake culture of mussel in 5 acres area has been initiated by a successful farmer in Padana who harvested about 2.5 t of mussels during the previous season as a result of CMFRI demonstration and assistance.

At Chettuva demonstration farm 107 mussel ropes were released during January-February and good growth rate was observed.

More demonstration programme will be taken up. Mixed farming will be done in all estuaries. Training and consultancy for more farmers and entrepreneurs will be taken up.

SELECTIVE BREEDING OF BIVALVES AND EVALUATION OF PERFORMANCE BY FARM TRIALS (MF/CUL/12)

T.S. Velayudhan, K.K. Appukuttan, P. Laxmilatha, P.S. Kuriakose

Attempts were made to maintain the brood stock of the clam *Villorita cyprinoides*, collected from the natural beds off Nettoor during February 1996, in the laboratory. The clams were kept in freshwater as well as seawater of 34 ppt. However, mortality was high in both the cases. The clams were then subjected to salinities ranging from 10 ppt to 34 ppt and maximum survival was observed in 15 ppt. They were provided sufficient quantities of diatom and algae as food. The gonad condition in September was found to be in spent stage. During April, 30% were in maturing and 10% in mature condition and the remaining spent.

Paphia malabarica collected from Ashtamudi lake, was also maintained in the laboratory at 19-30. Morality was high below 15 ppt. Further breeding studies are in progress.

CULTURE OF CEPHALOPODS (MF/CUL/13)

D. Sivalingam

Four batches of eggs of *Sepioteuthis lessoniana* (squid) were collected on 5.3.96, 26.4.96, 12.6.96 and 29.8.96 from Hare island, Vanthivu and Tharuvaikulum and one batch of eggs of *Sepia pharaonis* was collected from Hare island on 30.11.96. The eggs were maintained in FRP tanks for hatching. A total of 458 squid hatchlings were obtained by hatching, but heavy mortality over a period of one month occured and all juveniles were lost.

The eggs of *Sepia* were observed for the first time in Tuticorin coast. Of the 202 eggs collected, 100 healthy hatchlings were released on 12.12.96. The size at hatching was 8 mm ML. At the end of January 97, they attained size ranging from 34 to 61 mm ML, and weight of 4.6 to 8.6 g.

By the end of March, only 23 young cuttlefish survived, the reason for mortality is not known. They were fed with mysids collected from Korampallam creek. They were later fed on *Acetes* and fish fry also.

SEED PRODUCTION AND PEARL CULTURE IN ABALONES (*HALIOTIS* sp.) (MF/CUL/14)

A.C.C. Victor, A. Chellam, S. Dharmaraj

Spawning experiments were attempted in abalones. Freshly collected specimens were treated for spawning. Prior to spawning they were kept in a glass beaker 5 l covered with a black cloth. The abalones were observed for three days. The larvae were observed for three days. The larvae showed settlement from the 4th day onwards. The stones with algal growth were collected from the harbour and provided as spat collectors. In view of the small size of spat, they could not be observed on the stones. *Isochrysis* was given as food during the larval phase. Further work is in progress.

ONSHORE PEARL CULTURE (MF/CUL/15)

G. Syda Rao, E.M. Abdusamd, P.V. Sreenivasan, M.M. Meiyappan

Visakhapatnam: As a stop-gap arrangement, brood stock was being maintained in a private shrimp hatchery till facilities are developed in the CMFRI campus. Pearl oyster larvae were reared upto umbo stage by feeding *Nanochloropsis salma*. Due to collapse of water tank, further rearing could not be done.

Kakinada: Due to lack of facilities, work has not been initiated.

Madras: A total of 1000 adult oyster and 20,000 spat transported from Tuticorin Hatchery to Madras in two batches in April and May, were being reared in RCC tanks, feeding with microalgae.

A total of 25000 spat was produced in the hatchery as a result of spawning in May. The initial larval strength was 5,00,000. The spat are being reared in the RCC tanks, provided with mixed microalgae.

A total of 1,700 pearl oysters were implanted with 3 mm and 4 mm nuclei in two batches. By March 1997, total 272 pearls were obtained from the oysters of which 91 were with fully formed good nacre, 25 with 4 mm and 66 with 3 mm pearls.

During August, four women candidates from the local area were given training in nucleus implantation and post-operative care of oysters.

DEVELOPMENT OF LOW COST TECHNOLOGY SYSTEM FOR SEAFARMING OF PEARLS AND MUSSELS (MF/CUL/16)

G.P.K. Achary, V.S. Kakati, M. Sivadas, P.T. Sarada, A.K.V. Nasar, R. Marichamy, A. Chellam, D. Sivalingam, V.S. Rengasamy, R. Paul Raj, R. Sarvesan, P. Natarajan, C. Muthiah, K. Sunilkumar Mohamed

70 spat settlers, each having two metres length below water level were suspended from the raft. 1200 pearl oyster spats were collected in the sea. Settlement of *P. margaritifera* was also observed in April.

Heavy settlement of *Pteria* sp., an allied form of pearl oysters, is simulated using the two-in-cages and hapa. A portion of the *Pteria* spat were stocked in hapa type cages for further growth during the middle of June 1996.

A survey was conducted off Muttom, Kolachl, Kadiyapatnam and Enayam; it was observed that *P. fucata* and *P. maculata* (flat oyster) occur in stray members in these localities at a depth of upto 5 metres.

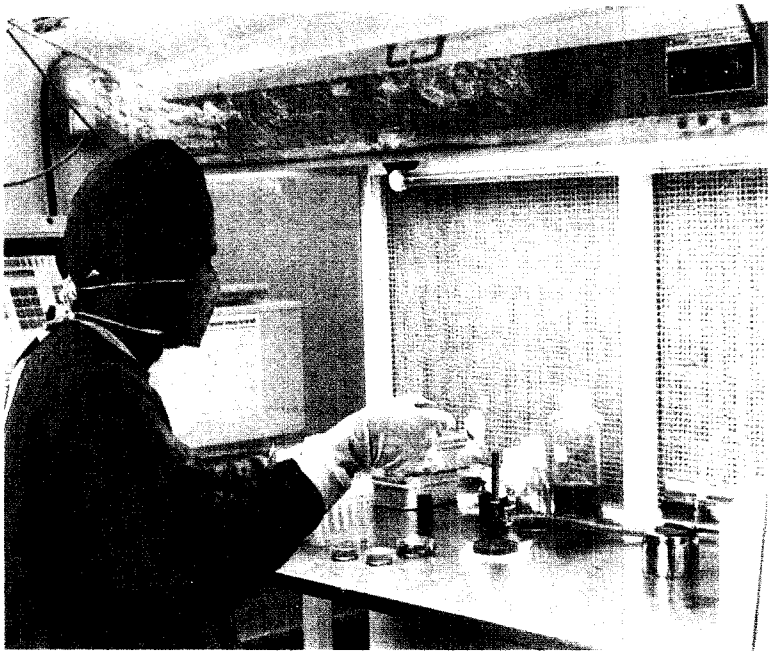
25 kg of three species of Ascidians, 1 kg of crinoids and 0.5 kg of sponges farmed in the hapa, cages and spat collectors was given to Dr.Madhusudan Rao, Scientist of Regional Research Laboratory, Trivandrum on 21.11.96 for the extraction of pharmaceutical grade biochemicals.

A pedestal cage which can be dismantled and assembled at the site for the farming cages for oysters and mussels has been designed for use in the shallow waters and lagoons of Gulf of Mannar, Palk Bay and Laccadive Islands.

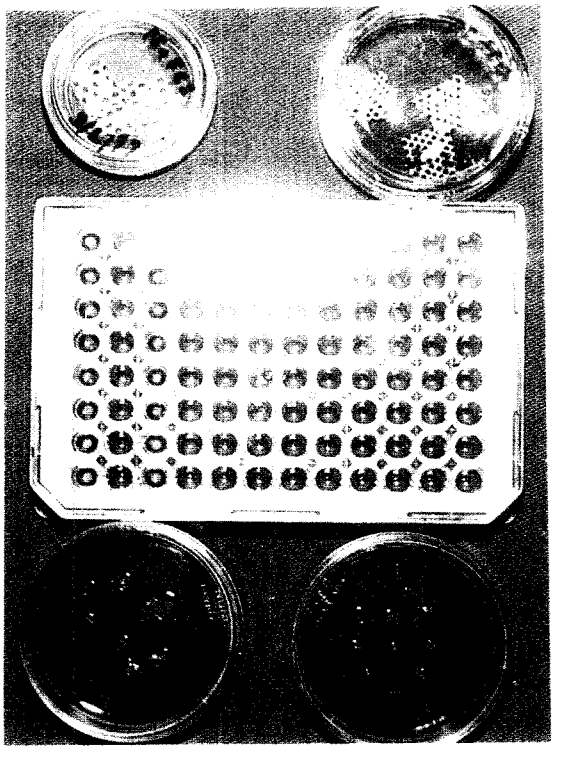
Heavy infestation by *Modiolus* was observed on the spat collectors during November and were cleared from the raft.

Mussel ready for harvest at CMFRI
demonstration farm at Chettuva (Kerala)

Harvested mussel at Karwar (North Kanara)



Tissue Culture laboratory (Pearl Culture) at Tuticorin Research Centre



Explant culture in Pearl oyster at the Tissue Culture Laboratory at Tuticorin Research Centre

The spat collectors also proved to be sanctuaries for cephalopods (*Sepia pharaonis*) for depositing their eggs/egg capsules.

At Mangalore, cages stocked with mussels were introduced in the Mulky estuary and good growth has been recorded so far.

Farming of Bivalves and Integration with Artificial Fish Habitats (MF/CUL/17)

P. Natarajan, R. Sarvesan, E. Vivekanandan

Suitable sites between Ennore and Thiruvettriyur were identified for mussel and pearl oyster farming cum demonstration programmes through integration with artificial fish habitats. However, due to lack of funds, further work could not be carried out.

Hatchery Production of Clam (*Meretrix* Sp) Seed (CMFRI/SPO/3)

P.V. Sreenivasan, D. Sivalingam

Brood stock: Broodstock of *Meretrix casta* numbering 50 were collected from Muthukadu backwaters near Madras and transported to Tuticorin. There was no mortality among the clams during transportation. Besides them, broodstock of 30 numbers of *M. casta* and 20 individuals of *M. meretrix* were also maintained.

Induced spawning: Success was achieved in two of the four experiments on induced spawning in *M. meretrix*. Similarly, three of the five experiments on *M. casta* were also successful.

From the above spawnings, 0.05 million seed of *M. meretrix* and 0.13 million seed of *M. casta* were produced and are being reared in cages.

Hatchery Production of the Green Mussel, *Perna viridis* (CMFRI/SPO/4)

P.S. Kuriakose

The construction of the hatchery was completed by July 1996. Power connection was obtained in August 1996. Procurement of larval rearing tanks and establishment of infrastructure facilties were completed by August.

The trial run was initiated in September. Induced breeding by thermal stimulation was carried out in October and about 5.6 lakh larvae were obtained by the 7th day of rearing. The survival of the larvae was 23% and a total of 1.28 lakh spat were obtained. The settled spat were further reared for 45 days, upto 10-15 mm size. The juveniles were fed mixed cultures of phytoflagellates and phytoplankton reared in outdoor mass culture tanks. The survival at this stage was 80% (1,02,000).

During December, 1 lakh juveniles of 10-15 mm size were transferred to the mussel culture farm and the remaining 2000 were retained in the hatchery for further studies.

STUDIES ON THE BIOLOGY AND SEARANCHING OF THE SACRED CHANK *XANCUS PYRUM* WITH SPECIAL REFERENCE TO THE PROTECTION OF SPECIES IN THE MARINE NATIONAL PARK OF GULF OF MANNAR (CMFRI/SPO/5)

A.P. Lipton

During this period, 14 egg capsules were collected from Periapattanam chank bed area at a depth of 17 m. The length of egg capsules ranged from 228 mm to 356 mm, width from 18 mm to 45 mm weight from 58 g to 178 g and the number of chambers from 25 to 43.

187 babies were hatched out from one egg capsule which had 35 chambers and the reamining egg capsules were oozed. The babies in the new batch grew to 3.81 mm length per month (1.60 mm MSD/month). They registered a weight increase of 1.48 g/month.

Two tagged chanks were recaptured from Gulf of Mannar and Palk Bay off Mandapam.

A total of 303 tagged chanks were searanched in Gulf of Mannar.

To find out suitable feed for chank culture, 180 baby chanks were segregated and used for the feeding experiments. Six different types of feed were given and growth experiments are being continued.

TISSUE CULTURE IN PEARL CULTURE (CMFRI/SPO/6)

S. Dharmaraj

The establishment of the tissue culture laboratory was almost completed and tissue culture work was initiated.

Live pearl oysters *P. fucata*, pre-conditioned in filtered seawater for48 hours, were soaked in 70% alcohol for 15 seconds. The mantle tissue was removed and washed in 35% alcohol and treated with a drop of penicillin and streptomycin in sterile seawater, the tissue was cut into small fragments. The fragments were used for *Explant* culture.

Explant culture: A few fragments were kept in glass/plastic petridishes at 28°C. The fragments of explant tissue were fed with different media such as 199, pf 35, foetal calf screen (FCS) and sterile seawater in different combinations. The cells dissociated from the explants and attached to the substratum. Formation of colonies and crystals was monitored and the sequences of development were photographed.

Live pearl oysters were taken to the National Centre for Cell Science (NCCS), Pune and set up explant, primary and organ culture. Different culture media were used, but cells did not dissociate due to contamination.

Further work on standardisation of culture media is progressing.

COMMERCIAL PROPAGATION OF MARINE PEARL CULTURE TECHNOLOGY (CMFRI/SPO/7)

K.A. Narasimham, A.C.C. Victor, A. Chellam, D. Kandaswamy, I. Jagadish

MOUs have been signed with the following private companies for the commercial propagation of marine pearl culture technology.

1) NCC Blue water, Chandanada, Andhra Pradesh

2) Gem Holiday Resorts Ltd., Madras, Tamil Nadu

3) Balaji Bio-tech Ltd., Nellore, Andhra Pradesh

4) M/s Sterling Shrimpex (P) Ltd., Chirala, Andhra Pradesh

5) Mr. Jagadeswara Rao, Visakhapatnam, Andhra Pradesh

6) Smt. V. Sarala, Visakhapatnam, Andhra Pradesh

7) M/s Aqua Prime International, Nellore, Andhra Pradesh

At Mandapam Regional Centre: Out of 16000 spat/mother oysters transported from Tuticorin during the previous year, 1760 oysters were operated during March 1996 and nuclei of 3 and 4 mm were used. The oysters, after laboratory care were further cultured in the onshore tank and the nearshore farm at the ratio of 1:3. The examination of the operated oysters during June showed the lost/mortality to be 1336. The trial harvest of 56 oysters in 7 cages showed that in the nearshore farm, pearl formation was 40%, malformation 10%, no formation 7.5% and empty 42.5%. Among the oysters reared in the onshore tank, no pearl formation was seen. The malformation was 37.5%, no formation 16.5% and empty 43.5%.

Another consignment of 15,000 spat received from Tuticorin and grown. The larvae taken in March '97 had settled as spat. 50,000 spat were also transported during March, '97 for growing into mother oysters for nucleus implantation and supply to the farmers under the DOD project.

At Balaji Bio-tech, Thupilipalem (A.P.): As per the MOU signed with Balaji Bio-tech Ltd., a pearl culture farm was established using the existing facilities of larval rearing tanks and the large water storage reservoir, with the spat/mother oysters transported from Tuticorin. A further consignment of 22,000 spat were supplied during March, '97. The spat/mother oysters were grown in the larval rearing onshore cement tanks feeding them with mixed algae. The spat/mother oysters showed better growth increments but the spat grown in the reservoir was very good.

Veliger larvae were transported in two spells and grown in the existing facilities in the larval hatchery. Larvae transported during March fared better and were in the advanced stages of metamorphosis.

At Gem Aqua, Madras: The pearl oysters supplied from Tuticorin and reared in the onshore tanks for more than 6 months were subjected to nucleus implantation. During May and August more than 1,900 oysters were implanted with nuclei of 3 and 4 mm. During the operation, the oysters without the menthol narcotisation survived better than those narcotised. In the test harvest of pearls after 5 months, it was found that the oysters produced lustrous pearls with thin coating of nacre.

VI. Fishery Environment Management Division

During the period under report, the Division was engaged in a total of 14 Institute's Research Project and 2 Sponsored Research Projects.

Investigations on Environmental Parameters of Inshore Waters in Relation to Fisheries (FEM/ES/1)

C.P. Gopinathan, V. Chandrika, S. Muthusamy, T.S. Naomi, Pon Siraimeetan, V.V. Singh, P.K. Krishnakumar, C.V. Mathew, S. Krishna Pillai, M. Rajagopalan, K. Vijayakumaran, P.T. Sarada, B.S. Ramachandrudu

Environmental data collection was undertaken at Cochin, Calicut. Mangalore, Karwar, Bombay, Minicoy, Vizhinjam, Tuticorin, Mandapam, Madras, Kakinada and Visakhapatnam Centres. The salient findings at different centres are given below.

Cochin

Sea-surface temperature varied between 22-31°C, minimum observed during July and Maximum in April. Salinity varied between 15.74 ppt (August) and 35.25 ppt (May). The lowering of salinity was due to the effect of rainfall and river run off. The dissolved oxygen content showed a low value of 0.42 (ml/l) at 10 m during August. Phosphates and Silicates showed comparatively high values during July/August and September/October (1.54 - 4.32 ug at/l and 6.33 to 12.29 ug at/l for phosphate and silicate respectively).

The potential primary production in terms of chlorophyll a in the inshore waters of Cochin during the premonsoon period indicated moderate to high values observed at 10-20 m depth stations (1-9 mg/m^3) while during the monsoon months, low values were noted (1-2 mg/m^3) . Again, during the postmonsoon period, moderate to high values of chlorophyll a was observed in the inshore waters (1-8 mg/m^3) revealing that the pre and post monsoon periods were slightly more productive compared to the monsoon period.

Highest zooplankton volume (65.11 ml/100 m^3) was observed during August at 30 m depth and lowest (1.3 ml/100 m^3) at 10 m depth in May.

Calicut

SST varied between 27.3°C (April), salinity between 0.36 ppt (July) and 34.24 ppt (March). Dissolved oxygen varied between 1.98 ml/l (November) and 4.66 ml/l (July). Among nutrients silicate showed large variations, 7.26 ug at/l (January) to 68.26 ug at/l (August).

Mangalore

Seawater temperature showed a peak (30°C) in April and the lowest value (22.5°C) was recorded in September. Surface salinity varied between 12.5 ppt in September to 35.0 ppt in May. Bottom dissolved oxygen content showed very low values at 10 m and 20 m stations, between May and September (2.68 & 0.13 ml/l respectively). This may be due to the accumulation of organic load with high biochemical oxygen demand in the bottom waters during the monsoon season (May to September).

Karwar

SST varied between 25.85°C in January and 30.5°C in April. The lowest surface salinity of 7.01 ppt was recorded in July and highest (29.69 ppt) in April. Dissolved oxygen content at surface level varied between 3.09 ml/l in November to 4.64 ml/l in February. Primary productivity varied at surface levels 61.75 mgC/m^3/day to 627.76 mgC/m^3/day in July.

Bombay

SST varied between 25.0°C (January) to 34.0°C (November), salinity between 8.39 ppt (April) and 35.67 ppt (Feb.). Dissolved oxygen values were found in the range of 1.7 ml/l (Feb) to 5.75 ml/l (November). Among nutrients, silicates in the nearshore waters varied between 9.3 ug at/l (March) and 49.0 ug at/l (Sept.). Phosphates varied between 1.2 ug at/l (March) and 68.0 ug at/l (November). Nitrates varied between 0.0 in November and 5.15 ug at/l in May.

Minicoy

SST of inshore waters varied between 27.2°C in January and 30.0°C during April-May. Minimum salinity of 25.5 ppt was observed in July and maximum of 36.8 ppt in April. Dissolved oxygen content was minimum (2.6 ml/l) in October.

Vizhinjam

SST ranged between 26.4 °C in July to 27.1°C in March and salinity from 33.54 ppt in July to 35.82 ppt in March and dissolved oxygen from 3.94 ml/l in August to 5.04 ml/l in December. The total biomass of zooplankton varied from 0.5 ml in February to 6.5 ml in September.

Tuticorin

SST varied from 25.8°C in February to 31.4°C in May. Salinity from 25.44 ppt in September to 35.4 ppt in July. Diss. oxygen content at surface levels varied between 4.15 ml/l in April and 4.96 ml/l in July. Primary production recorded a maximum of 737 mg C/m^3/day during May and a minimum of 93.8 mgC/m^3/day in February. The volume of zooplankton varied between 1.36 ml in March to 6.0 ml in August.

Madras

SST varied from 24.5°C in September to 29.5 in May, salinity from 29.2 ppt in October to 34.5 ppt in May. Dissolved oxygen varied from 4.2 ml/l in June to 5.7 ml/l in September.

Kakinada

SST varied between 26.25°C in December to 31.75°C in April and salinity from 18.4 ppt in October to 33.93 ppt in May. Minimum dissolved oxygen content at surface level (3.72 ml/l) was observed in the month of June.

Mandapam

SST varied between 26.3°C in August to 30.8°C in June, salinity varied between 29.27 ppt in May to 35.5 ppt in July. Low values of dissolved oxygen at surface level (3.71 ml/l) were observed in April. Gross primary production varied between 220 mgC/m^3/day to 1427 mgC/m^3/day in May and August respectively. Zooplankton volume ranged from 2.6 ml (September) and 6.8 ml (May).

Visakhapatnam

Upwelling indices such as seawater temperature, salinity and dissolved oxygen content at surface level indicated upwelling in the inner shelf during end of May and also during July. SST varied between 22.75°C in January to 29.87°C in September. Salinity varied between 23.58 during October to 34.8 ppt in May. Dissolved oxygen concentration varied between (1.9 ml/l) in Feb. to 5.85 ml/l in June.

Biological Productivity of the Indian EEZ in Relation to Oceanographic Parameters (FEM/SS/1)

V. Narayana Pillai, V.K. Pillai, K.G. Girijavallabhan, S. Natarajan

During the period under report, 5 cruises were undertaken on board FORV *Sagar Sampada*, 3 in the south eastern and 2 in the north eastern Arabian Sea for collection of sea truth pertaining to pre-monsoon, southwest monsoon and postmonsoon seasons. The variations noticed in the major upwelling indices viz. seawater temperature, salinity and dissolved oxygen concentration at surface levels confirmed the presence of upwelling in the area between Mangalore and Kasargod during southwest monsoon season (July-August). Higher chlorophyll a concentrations observed at surface levels south of Kasargod during the postmonsoon season possibly indicated the effect of southerly drift and the time lag between the arrival of nutrient rich waters at surface levels due to upwelling and the resultant photosynthetic activity.

Investigations on Zooplankton Components of the EEZ of India (FEM/SS/3)

K.J. Mathew, T.S. Naomi, Molly Varghese, R. Sarvesan, Geetha Antony

The completion report on the Project highlighted the following major features:

1. A total of 2114 zooplankton samples collected from FORV *Sagar Sampada* were studied. This is the first time that such a voluminous zooplankton sample is analysed from the EEZ.

2. Average zooplankton biomass in the EEZ has been estimated to be 88.33 cc per 1000 m^3 of water.

3. Arabian sea was found to be two times more productive than the Bay of Bengal; the shelf area was 3 times more productive than oceanic area. Maximum quantity of zooplankton was found in August.

4. The values of secondary production ranged between 0.5 and 20.92 gC/m^2/ year.

5. The fish production in the EEZ estimated on the basis of secondary production was 7.48 million tonnes (mt) and the MSY was 3.74 mt.

6. Foraminifers were more abundant in the Bay of Bangal than in the Arabian Sea. Maximum abundance in Arabian sea was in December and in Bay of Bengal, in February.

7. Chaetognath density was more along the west coast. The population decreased from shelf towards oceanic and *vice versa* along the east coast. Highest density in the Bay of Bengal was in the Andaman-Nicobar sea.

8. The cladoceran population was found to be more during July to October, with greater abundance in the Arabian sea. The highest density 245899/1000 m^3 of water was recorded off Cochin.

9. 93 species of pelagic copepods were identified; high density was recorded in the slope of the central west coast during premonsoon season (368/m^3) and from the inshore area of the southeast coast (4.2/m^3). A latitudinal shift in seasonal abundance was observed .

10. The average number of mysidacea was estimated as 364 per 1000 m^3 of water. The shelf had two times more mysids than the oceanic areas. While south-west monsoon was favourable in the west coast, the premonsoon was favourable for mysids along the east coast.

11. Amphipods occurred at a density of 2274/1000 m^3 of water along the west coast whereas along the east coast, the density was 1501; in the oceanic area the density was 1014 and 925 respectively. The average density in the EEZ was 1291/1000 m^3. The premonsoon accounted for the maximum quantity of amphipods.

12. The average density of Euphausiacea in the EEZ was 3214/1000 m^3 of water. More euphausiids were present in the eastern Arabian sea (3680/1000 m^3) than in the Bay of Bengal (2517/1000 m^3). The shelf area contained double the number of euphausiids. The south-west monsoon accounted for more euphausiids along the west coast whereas premonsoon was more favourable along the east coast.

13. *Lucifer* was present in the EEZ at an average rate of 2499 per 1000 m^3. No significant variations were found in the distribution between Arabian sea and the Bay of Bengal. A four times increase was noticed in the shelf area than in the oceanic area.

14. Stomatopod larvae were widely distributed in the EEZ and their number varied between 3 and 3347/1000 m^3. More number of larvae were encountered in the shelf waters. A striking regional difference was noticed in the two sea areas.

15. The average density of pteropods and heteropods in the EEZ was 734 and 335 respectively per 1000 m^3. Both were more abundant in the eastern Arabian sea. A kind of population explosion was observed among pteropods in the shelf area. A trimonthly abundance was noticed with this group.

16. The planktonic gastropods had an average density of 877/1000 m^3. The population density was more than double in the Arabian sea while in the Bay of Bengal, February to March was more favourable.

17. The planktonic cephalopods ranged between 1 and 112 per haul. The night samples contained about 2 times cephalopods than in day samples. The material belonged to families namely Sepiolidae, Sepiidae, Enoploteuthidae, Onychoteuthidae, Ommastrephidae, Cranchiidae and Octopodidae. Greater abundance of cephalopods was seen in the west coast and Andaman & Nicobar seas. Their occurrence was more prominent from March to June and August to December on the west coast and March to September in the east coast.

18. A study of the vertical distribution and abundance of zooplankton and the component groups over a diurnal period indicated that an average at the rate of 6.24, 6.70 and 6.07 ml/1000 m^3 was present in the 0-30 m, 30-60 m and 60-90 m depth zones respectively and the average counts of the various groups together were 14490, 13355 and 11290 per each depth zone respectively. The night samples collected more zooplankton. Amphipods and ostracods indicated vertical migration.

19. 13 species of Chaetognaths belonging to 3 genera: *Krohnitta, Pterosagitta* and *Sagitta* were recorded from the eastern Arabian Sea. The distribution pattern of *Sagitta dicipiens* indicated upwelling in the study area.

20. Study of the cladocera in the eastern Arabian Sea showed that 86% of the specimens belonged to *Penilia avirostris* and the rest to *Evadane tergestina*. Both the species were abundant in the shelf waters particularly during night.

21. The average density of ostracods was 17395/1000 m^3. They were more abundant in the shelf waters. Out of the total ostracods taken from the EEZ, 95%, was from the Arabian Sea.

22. A study of the zooplankton of the Arabian Gulf area made for understanding the effect of oil pollution on the plankton showed no positive evidence of its being affected by the oil.

23. A familywise study of the amphipods of the EEZ showed 13 families in the area. Oxycephalidae, Phronimidae and Platyseclidae were widely distributed in the west coast while Phrosinidae was the abundant family on the east coast.

24. The distribution of Atlantidae, Carinariidae and Pterotrachciade of the Andaman sea was studied. Two species namely *Oxygrus keraudreni* and *Protatlanta souleyeti* have been reported for the first time from these waters.

25. Distribution of 12 species of Ostracods was studied from the Andaman waters. It was found that *Euconchaceia aculeata* was the commonest, which occurred at a rate of 9732/1000 m^3.

26. A study of the quantitative distribution of the amphipods of the Andaman-Nicobar waters showed that their maximum abundance (1763/1000 m^3) was in January and minimum (315) in July.

27. High density of icthyoplankton of the Andaman & Nicobar seas was found in the shelf waters, maximum fish larvae were taken during November.

28. Forty four species of hydromedusae belonging to 20 families were identified from the zooplankton samples from the Lakshadweep. The dominant species were *Solumndella bitentaculata, Liriope tetraphylla, Aglaura hemistoma, Rhopalonema velatum* and *Cytacis tetrastyla*.

29. A study of seasonal abundance of zooplankton of the northeast coast indicated higher concentrations in the regions of Chilka and Paradeep during January and off Visakhapatnam during November and April. The neritic zone upto 50 m depth was the richest. Fish eggs were predominant in February-May and larvae in July and January-February.

Ecological Investigations on the Intertidal and Surf Zones of the Kerala and Kanyakumari Coasts in Relation to Fin and Shell Fish Seed Resources (FEM/ES/6)

G.S. Daniel Selvaraj, Molly Varghese, C.V. Mathew, S. Krishna Pillai, S. Jasmine

Investigations were carriedout at Calicut, Cochin and Vizhinjam in the surf regions and adjoining inter-tidal estuarine systems. The SST in the surf zone varied between 24.2 and 30.7 C at Calicut, 25.8 and 30.1 C at Cochin and 26.5 and 30.0 C at Vizhinjam and 26.1 and 30.1 at kanyakumari, with the minimum in August and Maximum during March-April. Salinity variations were between 30.45 ppt and

36.1 ppt at Calicut, 9.0 and 34.9 ppt at Cochin, 30.4 and 35.9 ppt at Vizhinjam and 31.0 and 34.9 ppt at kanyakumari. Lowest values were observed during June-July due to effect of rainfall and river run off. In general, Korapuzha estuary recorded relatively low oxygen levels. Both nutrient levels and primary production values observed in the surf zone and estuarine region showed wide seasonal fluctuations. Fish eggs and larvae and juvenile fishes in the surf zone and estuaries showed large scale fluctuations both qualitatively and quantitatively.

SEAWEED INVESTIGATIONS - RESOURCES ASSESSMENT OF SEAWEEDS AND THEIR CULTURE (FEM/SW/1)

V.S.K. Chennubhotla, N. Kaliaperumal, Pon Siraimeetan, Reeta Jayasankar

The work was carriedout at Visakhapatnam, Mandapam and Tuticorin. Cultivation of agar yielding seaweed, *Gracilaria edulis* by vegetative propagation method was carried out during May- August on long -line coir rope in the Gulf of Mannar

Growth of seedlings on horizontal coir ropes was good and they attained harvestable size with mean length of 19 cm and maximum length of 28cm after 45 days.

During the period under report, the following quantities of seaweeds were exploited from the natural beds along TamilNadu coast:

Sargassum spp.	:	3161	Tonnes
*Turbinaria*spp.	:	234	,,
Cystocera spp.	:	35	,,
Gelidiella spp.	:	307	,,
Gracilaria edulis	:	161	,,
Gracilaria folifera	:	7	,,
Total		3905	Tonnes (dry wt.)

MARINE POLLUTION (FEM/MP/1)

V.K.Pillai, P. Kaladharan, P.K. Krishnakumar, D.C.V. Easterson, M. Rajagopalan, S. Krishna Pillai

Pollution monitoring work was continued at Cochin, Mangalore, Madras and Tuticorin.

Cochin

Low dissolved oxygen concentrations at bottom levels (0.8ml/l) during August indicated upwelling. Higher levels of Ammonia were recorded (79.31 μg/l) in the estuary which decreased to 39.6 μg/l in the inshore waters. Heavy metal levels in fin fishes, prawns and bivalves were found to be within the range recommended for seafood for human consumption.

Mangalore

Generally concentarions of nutrients like phosphate, nitrate and silicate in seawater collected from Thanneer Bavi near the effluent discharge point of the fertilizer factory were higher compared to those collected from cleaner areas at Chitrapurt near Petroleum Refinery, Oil and grease content at surface levels varied from 2.33 - 3.67 mg/l,

phenol from 0 - 0.9 mg/l and BOD from 1.06-2.62 mg/l. Chlorophyll-a showed a steady increasing trend while zooplankton biomass showed a gradual decrease.

Tuticorin

Studies have indicated that the fly ash from the thermal plant is released directly into the Karapad Bay waters. It was found that there was no direct discharge of mercury contaminated effluent since the factory has changed the process.

Madras

At Ennur phosphate levels were high during January-March (0.5ppm) and Lead levels are also found to be comparatively higher (0.1 ppm) during August - October period.

Biodiversity Studies on Auxilliary Marine Resources (FEM/AR/1)

P.A. Thomas, Rani Mary George

On the southwest coast, area between Vizhinjam and Cape Comorin is found to be very rich in sponge distribution. The identification of auxilliary resources, especially those previously known bio-active substances was continued.

Susceptibility of Heterotrophic Bacteria to Antibiotics and Their Characterisation (FEM/MB/1)

V. Chandrika

The completion report on the project highlighted the following major features:

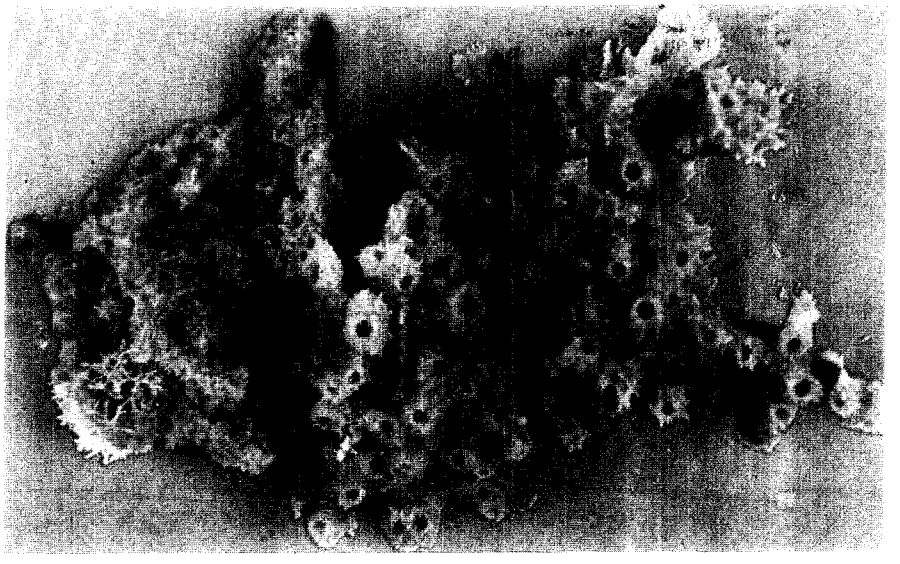
1. Microbial communities contribute to the production of the pond through heterotrophic food chain as well as to the production. Different functional groups of bacteria were isolated (5 types) which are involved in the decomposition of organic matter and nutrient cycling and their carbohydrate fermentation pattern were studied. These studies will assess the fertility of the environment and are valuable in determining the types, doses and periods of fertiliser application.

2. Excessive use of antibiotics in aquaculture ponds will induce antibiotic resistance in indigenous bacteria. The intensity of Multiple ding resistance (MDR-strains) has been assessed in the project as resistance can be transferred to other gram-negative pathogens of different genera. Knowledge gained from our culture systems in this regard will help us in management.

Development of Artificial Seawater (IDP/AS/1)

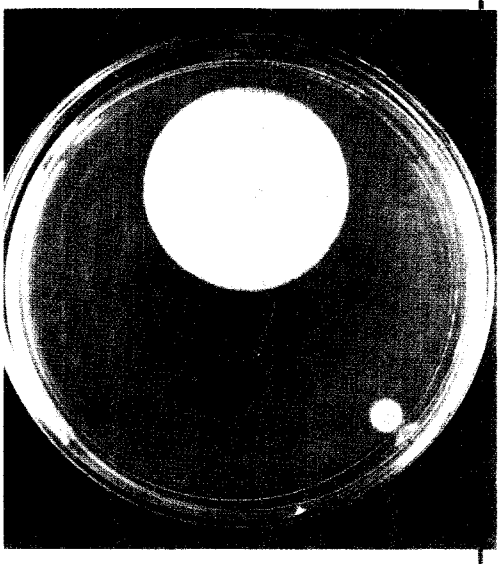
P. Natarajan, G. Maheswarudu, K. Vijayakumaran, S. Muthusamy, Grace Mathew

Two more culture media were developed for the culture of *Chlorella* sp. It was found that the declinig phase of the cells in these media occured only after 35 days when compared to 25 days period in the conventional culture solutions.

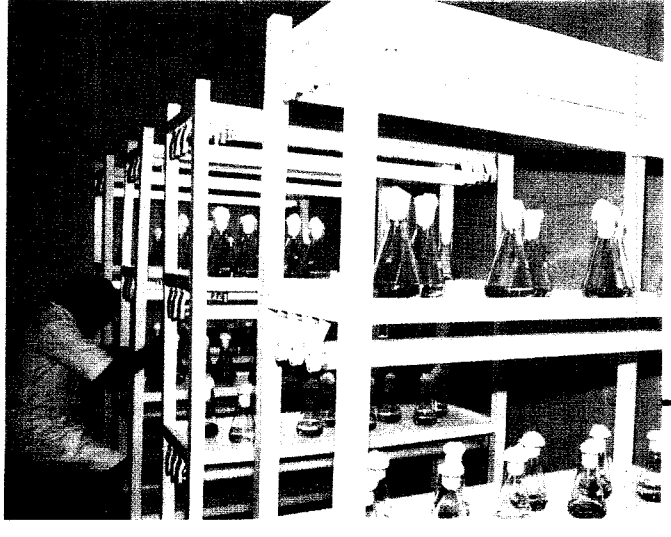


Sponge *Callyspongia diffusa* (Ridley) with wonderdurg potential,
from S.W. coast of India.

Gorgonid *Echinomuricea indica* Verrill — rich
in prostaglandins



Bacterial flora screened
from *pokkali* field
useful in probiotics



Seaweed biotechnology
laboratory
at Headquarters

BREEDING, SEED PRODUCTION AND SEARANCHING OF THE SEA CUCUMBER, *HOLOTHURIA SCABRA* (FEM/CUL/2)

D.B. James, Asha.P.S.

Sea cucumbers were subjected to thermal stimulation to induce spawning by introducing them into the seawater with temperature 5°C more than the water in the brood stock tank. males spawned on 3 occasions but there was no response from the females.

CONSERVATION OF MARINE TURTLES (FEM/MT/1)

M. Rajagopalan, M.M. Meiyappan, R. Thiagarajan, S. Krishna Pillai, Ameer Hamsa, A. Bastin Fernando

Data collected by FRAD of CMFRI on the incidental catch of sea turtles in all the maritime states during 1985-95 have been analysed. The analysis showed that only 335 sea turtles were incidentally caught all over the coast barring Gahirmatha coast in Orissa. 17.8 % of incidental catch was by trawlers and the balance by the gill netters.

DESIGNING, DEVELOPING AND FABRICATION OF AUTOMATIC ELECTRICAL BLINKER FOR MARKER BUOY (FEM/INST/1)

S. Natarajan

Feasiblity studies conducted at Tuticorin showed that it is possible to use 6 V lamps as blinkers operated from a 6 V solar rechargable battery. Two blinker circuits have also been designed.

CULTURE OF LIVE FEED ORGANISMS (FEM/LF/1)

K.G. Girijavallabhan, C.P. Gopinathan, P. Kaladharan, T.S. Naomi, Molly Varghese, Reeta Jayasankar, Rani Mary George, S. Jasmine, C.V. Mathew, D. Sivalingam, M. Rajagopalan, K. Vijayakumaran, P.T. Sarada, V.K. Balachandran, Geetha Antony, S. Natarajan

During the year, studies on the live feed organisms, (both phyto and zooplankon) was initiated at Cochin Fisheries Harbour, Vizhinjam, Minicoy, Tuticorin, Mandapam and Chennai. At HQ 11 spp of microalgae are maintained as stock culture in laboratory conditions. Making use of the innoculam of these microalgae at the Fisheries Harbour laboratory the culture of Rotifers and Cladocerans has been initiated.

At Cochin, a comparative analysis on the biochemical constituents such as proteins, total amino acids, soluble sugars and total lipid content of six spp of micro algae were estimated. It was found that the diatom, *Chaetoceros calcitrans* and the flagellate, *Isochrysis galbana* are having the maximum biochemical constituents, required for the growth of larvae in a hatchery system.

Ultrastructural Studies of Marine Organisms (IDP/EM/1)

K. Rengarajan. N. Sridhar, K.C. George, P.C. Thomas, N.K. Sanil

Structural morphology and ultrastructure of eggs, sperms and larvae of Pearl oyster, Edible oyster and Clam; immune cells of the Fish *Tilapia* and inflammatory reaction at the site of injection and ultrastructural alterations in *Tilapia* were studied.

Eggs, sperms and larvae were collected from Tuticorin Hatchery of CMFRI, processed and observed in TEM. Encouraging results were obtained in Peral oyster eggs. The methodologies are to be improved for better results and recording to be done with new films.

Colloidal carbon (0.5 ml) was injected into the peritoneal cavity of *Tilapia* to study the ultrastructure of immune cells. After varying time intervals, the spleen and kidney were dissected, processed for TEM and observed. The ingested carbon particles around leucocytes were observed as round dark dots and photographed.

Freund's adjuvant (0.5 ml) was injected to healthy *Tilapia* to study the inflammatory reaction at the site of injection and structural alterations in the tissue. The tissues were processed and blocks made for TEM and all works are in good progress.

Cultivation of Agar Yielding Seaweeds in Green House Conditions (CMFRI/SPO/9)

N. Kaliaperumal

Culture of agar yielding seaweeds was carried out by vegetative propagation method in continuous running seawatersystem using FRP tanks. Maximum increase in biomass was obtained after 35 days. there was no increase in growth in *Gelidiella acerossa*. Experiments were conducted with *Gracilaria edulis* and *G. folifera* by pretreating the seaweed materials with different concentrations of EDTA and ascorbic acid for 12 hrs. The biomass was higher in the plants treated with low concentrations of these chemicals.

The pigments chlorophylls, phycocyanin and phycoerythrin , biochemical constituents such as proteins, carbohydrates, lipids: yield, gel strength, gelling temperature, melting temperature and gel clarity of agar were estimated from wild and cultured seaweeds. There is no marked variation in the values obtained on these aspects from the wild and cultured species.

Application of Remote Sensing Technology in Marine Fisheries (CMFRI/SPO/11)

V. Narayana Pillai, C.P. Gopinathan, V.K. Pillai, M. Srinath, K.M. Santhosh, K.M. Shivaraj, Saji K. David, G. Subbaraju

SST data for satellite Infra-red imagery validation was collected at 6-hourly interval onboard FORV *Sagar Sampada* in 5 cruises in the southeast and north east Arabian Sea,

covering premonsoon, southwest monsoon and post monsoon seasons.

Validation of PFZ forecasts received from NRSA during the period November 1996 to March 1997 was undertaken along the Kerala coast at selected landing centres. Positive correlation were obtained for pelagic fishing activities such as purse-seining and gill netting. Validation of PFZ forecast for Minicoy waters for obtaining positive correlation with tuna pole and line fishing for skipjack tuna yielded positive results. PFZ forecasts were translated into local language and displayed for the benefit of active fishermen and feedback obtained along Kerala coast, Minicoy Island and also at Kakinada.

VII. PHYSIOLOGY, NUTRITION AND PATHOLOGY DIVISION

This division implemented ten research projects in genetics, pathology, biotechnology, endocrinology and nutrition.

DEVELOPMENT OF FEEDS FOR CULTURABLE CRUSTACEANS, MARINE FINFISHES AND HOLOTHURIANS (PNP/35)

R. Paul Raj, M. Vijayakumaran, D.C.V. Easterson, D. Kandaswami, Manpal Sridhar and P. Vijayagopal

a. Dry cassava chips were fermented using fungi *Beauveria*. The fermented material showed increase in protein from 1.6% to 10.8%. The enriched material is being incorporated in varying concentrations in the feeds for postlarvae of *Penaeus indicus* to study their growth response.

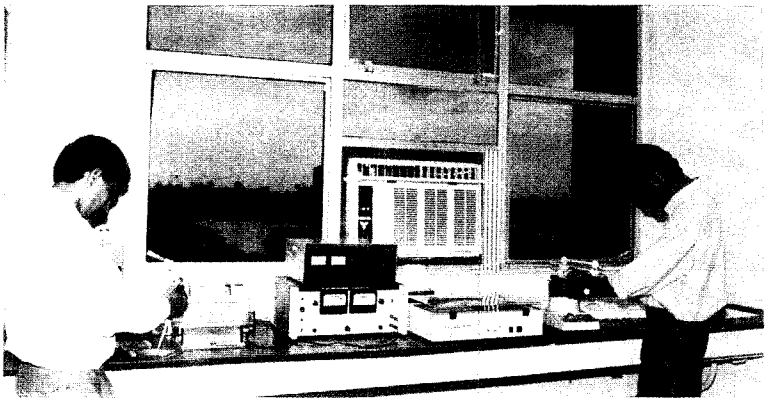
Cashew fruit (a waste from cashew processing units) was crushed in a mixer, sterilized and innoculated with 2 ml of fungal spores (*Beauveria* sp.) and incubated at 28 +/- 1°C for 78 hours. The material was dried at 60°C for 12 hours. The dry fermented product had 13.08% protein as compared to 2.44% in the raw cashew fruit.

b. Fresh *Garcilaria edulis* was washed with tap water, cleaned of extraneous material and dried at 80°C for 24 hours and pulverized. The material was sieved through 110 microns mesh before being used for feed preparation. As such the material contained 75% moisture, 11.62% crude protein, 0.91% crude fat and 26.52% nitrogen free extractives. Feeds were compounded incorporating *G.edulis* at levels ranging from 10% to 50% and proximate chemical composition and hydrostability were evaluated subsequently. In the nutritional evaluation in the postlarvae of *Penaeus indicus* the best digestibility for protein and weight gain was obtained at an incorporation level of 20% .

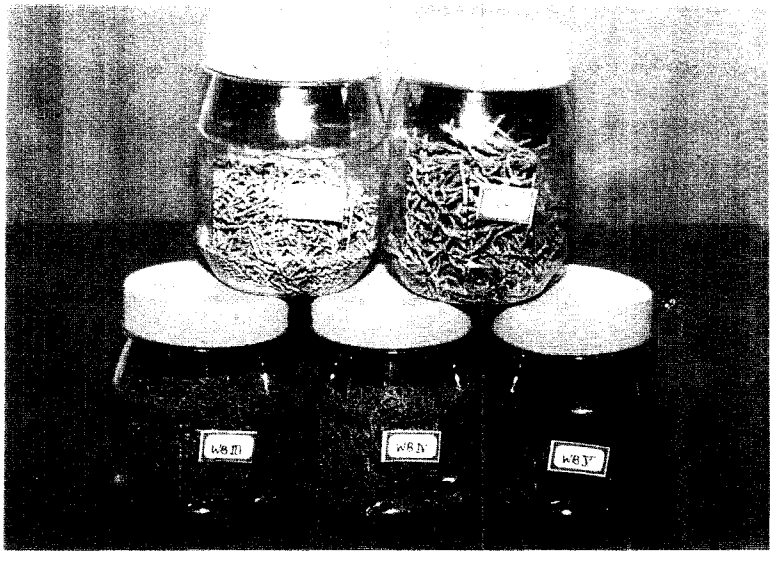
c. A pellet feed was prepared for mudcrab using dry fishpowder, small shrimpmeal, soyabeanmeal as protein sources, cod liver oil as lipid and fatty acid source, wheat flour as a carbohydrate source and binder, supplemented with calciumdiphosphate, calcium carbonate, vitamin premix, cholesterol and guar gum as binder. Of the several die sizes tried for pellet making 5 mm diameter pellets were well-accepted.

d. Two sets of experiments were conducted. In the first experiment mudcrab juveniles of carapace length 56 - 92.5 mm and weight 22 - 105.5 g, were fed pelleted feeds at the rate of 4 - 5% of body weight in plastic cages. Gain in carapace length of 7 - 16 mm and weight gain of 27 - 37.5 g was recorded in 102 days. Temperature, salinity and pH of the water were in the range of 26 - 29°C and 22 - 28 ppt and 7.5 - 8.1 respectively.

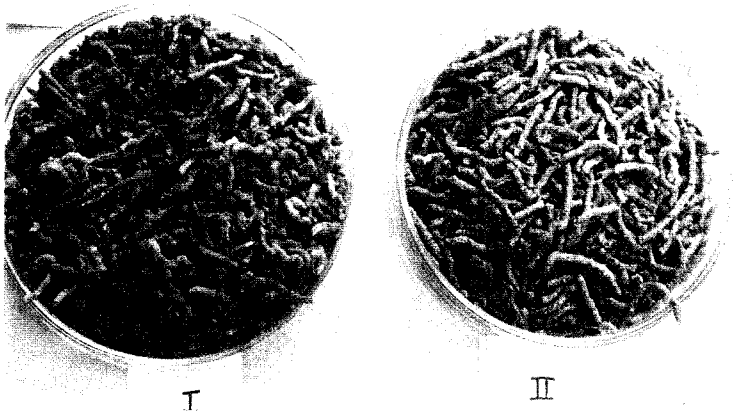
In the second experiment, 6 crabs reared in individual plastic cages showed gains in carapace length 4 - 9.5 mm and weight gain of 8.1 to 16.5 g after 105 days. Temperature, salinity and pH



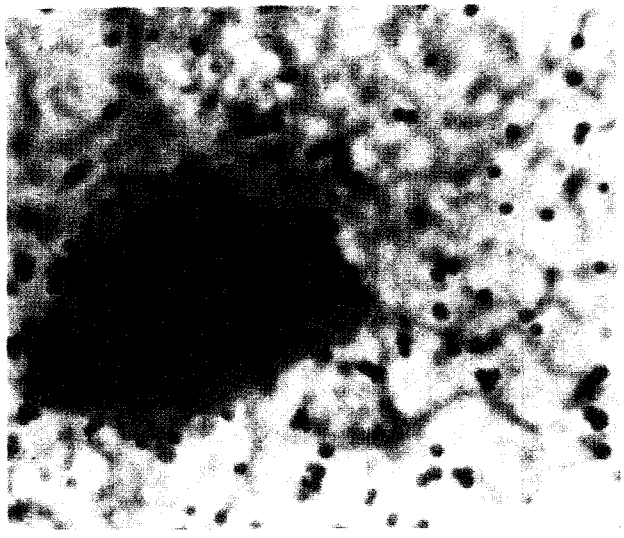
The new genetics laboratory at Headquarters



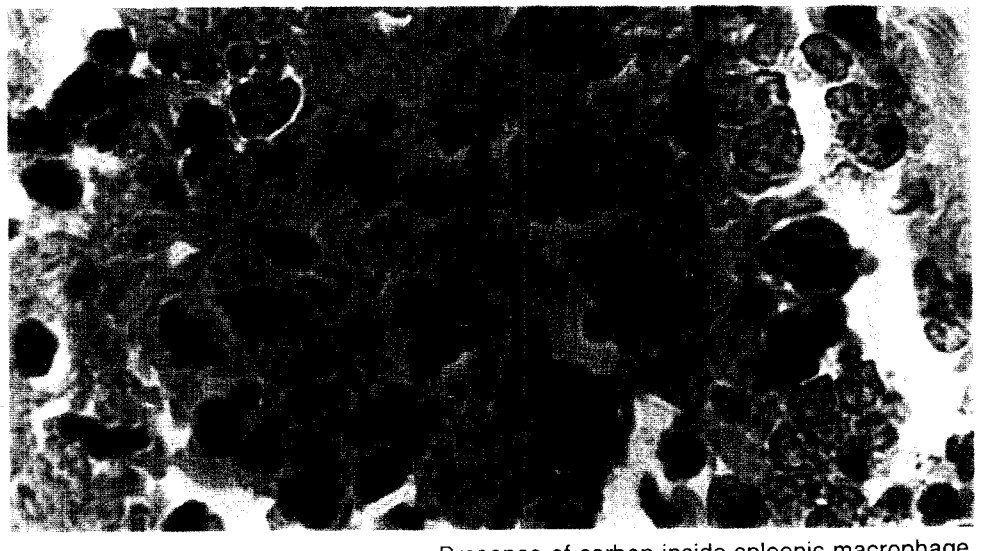
Compounded feeds for *P.indicus* prepared using fermented ingredients



Feeds for *P. indicus* compounded using the seaweed *G.edulis*



Demonstrational phagocytic ability by cultured macrophage — see the ingested yeast inside cell



Presence of carbon inside spleenic macrophage

Endocardial cells of fish heart showing phagocytic activity

were in the range of 21 - 25°C, 22 - 29 ppt and 7.5 - 8.1 respectively during the rearing period. The observed differences in growth between the two experiments were due to the variations in water temperature and food intake. The lower temperature recorded in the second experiment resulted in lower feed intake (2 - 3%) in crabs.

e. Drying of beach dried fish at 50 - 55°C for 4 - 6 hours was found to reduce the moisture content of beach dried fish.

f. At Tuticorin, one experiment was conducted to evaluate the protein requirement of *Penaeus semisulcatus* using shrimp meal as a protein source. The response parameters indicated that *Penaeus semisulcatus* requires about 35% protein in the diet.

g. Essential amino acid profile of *Penaeus semisulcatus* and the essential amino acid requirement per day was worked out following the protein deposition method of Ogino. The daily requirement was highest for lysine followed by arginine and the lowest was found to be for tryptophan.

h. Two sets of grouper broodstock are being maintained at Mandapam. The groupers are fed with sardines at 3 - 4% of body weight daily. Growth data is being collected.

i. Black-lip oyster *Pinctada margaretifera* was fed daily 100 l of mixed algae, 80% *Chaetoceros* sp., 20% blue green algae in the morning at 50,000 cells/ml. Experiments are also on with implanted pearl oysters, mother oysters and spat.

Tolerance Limits of Certain Environmental Factors Affecting Physiological Behaviour of Some Cultivable Organisms (PNP/44)

M. Peer Mohamed, D.C.V. Easterson and N. Sridhar

Salinity tolerance studies were conducted with edible oyster *Crassostrea madrasenis* and clam *Meretrix casta*. The duration of each experiment was 45 days.

Crassostrea madrasenis of 40 - 50 mm size having a mean weight of 11.445 - 17.782 g were exposed to 5 - 45 ppt salinities at temperature ranging from 29 - 30 °C. For the 45 day study period the highest mean survival of 85% was observed in salinities 20 and 25 ppt. The mean survival of 60% and 70% were observed for the oysters kept at 40 and 5 ppt salinities. The oysters kept at salinities 10, 30 and 35 ppt showed 77% survival. The maximum percentage weight gain of 5.62 was observed for the oysters kept at 20 ppt, followed by 4.85 and 4.12% for the salinities 25 and 15 ppt. The percentage weight gain of 1.73, 1.84, 2.60, 3.40 and 3.43 were observed for salinities 5, 40, 10, 35 and 30 ppt.

The clam *Meretrix casta* exposed to 10 to 45 ppt salinities at 29 - 30 °C for 45 days showed maximum survival of 75% at 20 ppt. While at 10, 15 and 25 ppt salinities the mean survival was 70%. 65 and 40% survival was observed for salinities 30 - 35 ppt. The clams exposed to 45 ppt salinity survived only for 30 days with 10% survival rate. The percentage weight gain of 7.18 was observed for clams exposed to 20 ppt salinity. The percentage weight gain of 6.43, 5.33, 4.87, 4.51 and 2.34 were observed for those exposed to 25, 30, 15, 10 and 35 ppt salinities. The clams exposed to 45 and 40 ppt salinities survived for 30 and 35 days with 5 and 10% survival.

Disease Investigations in Marine Shellfishes (PNP/46)

M. Vijayakumaran, R. Paul Raj, A.P. Lipton and N.K. Sanil

Study of white spot disease syndrome (WSS) in shrimps was continued. Histopathological examination of WSS revealed intranuclear inclusion bodies on mesodermal and epidermal tissues. In one of the shrimps (*Penaeus monodon*) severely affected with WSS, a protozoan was detected in the inter and intra tubular spaces of the hepatopancreas, which is a unique feature, not reported earlier. Whether the protozoan has anything to do with the disease is yet to be ascertained. The tissues are being processed for electron microscopy.

The "red disease" of the spiny lobster *Panulirus ornatus* reported in late March 1996 did not occur in any of the lobster holding centres. Investigations on the samples collected were continued. Nine gram negative bacteria were isolated from the haemocoel, hepatopancreas and exoskeleton of the diseased lobsters. These were subcultured and stored for charecterization. The tissues are also being processed for EM studies.

Formulation of Nutritional Strategies for the Management of Aquaculture Wastes (NSMAW) Through Low Pollutiondiets for Shrimp (PNP/47)

Manpal Sridhar, M. Peer Mohamed and P. Vijayagopal

In order to formulate high nutrient-dense diets a number of conventional and nonconventional feed ingredients were screened for their P/N ratio. Two formulations of 'Mahima' feed were also analysed for their P/N ratios; the P/N ratios of these formulations (0.294 and 0.23) were less than 1.0 suggesting their ecofriendly and efficient nature.

The studies on digestibilities of soyabean flour and mantis shrimp meal were completed. The former gave the best digestibility and growth at the 30% level of incorporation and the later at the 20% level of incorporation. Feeds will be formulated using these and some other ingredients and they will then be tested for their nutrient retention efficiencies and total wastage under laboratory and farm conditions.

Development of DNA Fingerprints and Probes for Diagnosis of Pathogens of Finfish and Shellfish (PNP/48)

P.C. Thomas and M.K. George

Two of the major fish pathogens Viz. *Vibrio parahaemolyticus* and *V.harveyi* were cultured in laboratory and protocols for the isolation of both nuclear DNA and plasmid DNA from them were standardized, using the alkaline lysis method appropriately modified for the purpose. These were checked spectrophotometrically for purity, integrity and yield. Qualitative integrity was checked using submarine gel electrophoresis and found to be intact. The molecular weight of the nuclear and plasmid DNA from *V.parahaemolyticus* was observed to be about 23 kilobase and 19 kilobase respectively.

Nuclear DNA was subjected to restriction digestion using two of the type II endonucleases namely Hind III and Pst.I, to generate restriction fragments and for the preparation of restriction maps. As there were numerous restriction sites it was impossible to resolve these innumerable fragments in the submarine agarose gel electrophorosis. Hence, experiments with enzymes having rare cutting sites are underway to generate less numerous fragments.

Trials are underway to standardise the parameters for the restriction of plasmid DNA also using various endonucleases. Plasmid vectors like pBR 322 and V 517 have been procured and successfully cultured. These vectors are being maintained in the laboratory to be used for cloning in the future.

POPULATION GENETIC STUDIES IN *RASTRELLIGER KANAGURTA*, *SARDINELLA LONGICEPS* AND *PENAEUS INDICUS* (PNP/49)

M.K. George, P.C. Thomas and N.K. Verma

Methods for flat gel electrophoresis, mtDNA analysis and morphometric measurements were standardised to study the intraspecific genetic variability in Indian mackerel *R. kanagurta* and oil sardine *S. longiceps*.

Proteins extracted from the mackerel muscle got resolved into five electrophoretic zones of bands. The fasted zone showed intraspecific phenotypic variability. The fast allele F had a frequency of 0.78 in the sample tested.

MtDNA present in the liver and ovary tissues of mackerel and oil sardine was tested by alkaline lysis method. The integrity of mtDNA extract was confirmed by DNA-specific ethidium bromide staining of the samples after electrophoresis. Both the tissues yielded sufficient amount of mtDNA for detection. The mt DNA isolated from the specimens of mackerel and oil sardine were digested with *Pst*I and *Eco*RI to study the intraspecific haplotype variability in the species. The *Pst*I enzyme produced polymorphic haplotypes in both the species while *Eco*RI produced haplotype polymorphism only in oil sardine. The comparative molecular size of the mtDNA of oil sardine was 13 kb while that of mackerel was 15 kb. The results show that muscle proteins of mackerel and mtDNA of mackerel and oil sardine are potential genetic markers for evaluation of genetic variability and genetic stock heterogeneity in these species.

INDUCED MATURATION IN GROUPERS (PNP/50)

M. Peer Mohamed, N. Sridhar, Manpal Sridhar and P. Vijayagopal

Three feeds were selected from the literature survey for feeding trials.

The protein content of the Feed I was 52% and lipid 4.8%. Protein content of Feed II was 49.2% and lipid 5.0% while in Feed III protein was 51.8% and lipid 7.3% respectively.

When Feed I (moist pellets) was fed to twelve groupers (*E.malabaricus*) a very favourable response was not obtained, rather

water pollution setin often due to the feed remaining in water for long. When Feed II was given as such, the fish spat it out immediately after gulping. However, when the pellets were offered after softening, they were readily accepted.

Another feed was prepared based on the composition of Meyer, incorporating 46% beef liver in place of fresh ground minced fish. This had a protein content of 53.2% and lipid content of 8.2%. The moisture content of this feed was 9.2%. This feed was given to two fishes weighing 3.5 to 4.0 kg, but it was refused. The animals started showing a favourable sign by accepting few of the pellets. Two animals of total length 31 and 32 cm and weight 540 and 620 g respectively were being maintained on fresh fish supplemented with cod liver oil (twice a week) in order to prepare them for maturation studies. However, heavy mortality of animals occurred due to power failure and infestation by *vibrio* and *bacteria* and the results of all experiments could not be obtained as only three animals survived. Fresh efforts are on to stock juveniles and restart the feeding experiments. The proximate composition analysis of carcasses of the dead animals is being carried out.

In Vitro Effects of Neurohormones on Ovary Development in Crustaceans (PNP/51)

N. Sridhar and M. Peer Mohamed

A layout plan was drawn for setting up a invertebrate tissue culture laboratory; equipments (CO_2 incubator, Laminar flowhood and inverted microscopes) were requisitioned. Since 5-hydroxy tryptamine induces the synthesis of moult inhibiting hormone in crustaceans, it was decided to identify the precursor amino acid tryosine and its tissue of predominance. To identify the amino acid and other catecholamines namely Dopa, Dopamine and Epinephrine, thin layer chromatography was carried out using tyrosine, phenyl alanine and tryptophan as standards. The run was carried out using Butanol acetic acid and water solvent mixture (12:3:5) and the plates were heated in an oven and then sprayed with Ninhydrin (0.2%) dissolved in ethanol. The spots developed were measured for their relative mobility values.

The thin layer chromatography with regard to the catecholamines viz. Dopa, Dopamine and epinephrine using the silica gel plate and the solvent mixture Butanol: acetic acid and water in the ratio 12:3:5 was also carried out. The identification was carried out using ferric chloride ferricynide reagent. After developing the spots the area and their Rf values were measured. Since 5-hydroxy tryptamine was not available it could not be used. This procedure will be applied to identify the aminoacid tryosine and the biogenic amine present in the neuroendocrine centres, Hepatopancreas and ovary of the shrimp *P.indicus* during different phases of maturation. Experiments were also being designed to test the effect of 5-hydroxy tryptamine in the prawn *P.indicus* on ovary development along with thoracic ganglion extracts.

The extracts, in buffer of hepatopancreas and ovary, of 12 mature females of *P.indicus* were applied on to silica gel chromatographic plates using butanol- aceticacid - water (BAW) (4:1:1) . After developing the spots the area and their Rf values were measured and compared with the standard Rf values obtained with tyrosine, phenylalanine and tryptophan. The experiment is being repeated after injecting the animals with 5-hydroxytryptamine.

Studies on the Effect of Toxins, Pollutants and Probiotics on Fish Health with Special Reference to Immune System (PNP/52)

K.C. George, N.K. Sanil and K.S. Sobhana

The procedure for isolating live leucocytes from whole blood, peritoneal cavity, anterior kidney and spleen were standardised. They were successfully maintained in artificial media and in vitro phagocytosis was demonstrated using killed bacterial/yeast cells.

Separation of leucocyte and demonstration of *in vitro* phagocytosis:

Blood: Blood leucocytes were separated from healthy fishes using gradient centrifugation method. The isolated leucocytes were maintained in live condition in Hank's balanced salt solution containing 10% foetal calf serum and antibiotics. These cells were adhered on sterile glass coverslips and incubated with killed yeast and bacterial cells. High phagocytic activity by the blood leucocytes was demonstrated.

Peritoneum: Inflammation was induced in live fishes in the peritoneal cavity. At different intervals, the peritoneal cavity was washed with PBS and the washings collected in sterile condition. From these washings leucocyte pellets were collected by centrifugation and were resuspended in tissue culture media containing 10% foetal calf serum alongwith antibiotics and maintained live. The suspended cells were incubated alongwith killed yeast/bacterial cells and showed phagocytosis.

Spleen: Spleen was removed from healthy fishes and teased in Hank's balanced salt solution. The leucocytes were separated using gradient centrifugation. Phagocytosis was demonstrated in coverslip adhered cells.

Collection of serum and electrophoresis: Serum samples were pooled and subjected to Agarose gel electrophoresis using barbiturate buffer.

In vivo localisation of phagocytes: Phagocytes were localised *in vivo* in peritoneum, kidney, spleen and heart using colloidal carbon particles.

Development of probiotic feed: Probiotic incorporated fish feed was developed using pure culture of *Lactobacillus* sp.

Screening and Isolation of Bioactive Substances from Marine Organisms (PNP/53)

N. Sridhar, P. Kaladharan, P.A. Thomas, Kumaraswamy Achari, K. Girijavallabhan and A.P. Lipton

Seven species of ascidians and two species of sponges were collected from Rameswaram and Vizhinjam. For standardisation of the extraction procedure, two species of sponges collected from Rameswaram were selected and the methanol fraction was filtered and concentrated in a rotary evaporator at an atmosphere of Nitrogen. The sponges were treated with chloroform methanol (1:1) for further extraction. The extract was concentrated further and stored for IR and NMR spectral analysis. The concentrated methanolic fraction was treated with Hexane. The supernatent obtained was treated with ethylacetate. The ethylacetate and methanolic fraction were separated and concentrated as before and stored for analysis. Further fractionation through chromatographic procedure, is being carried out. By the standardised proce-

dure, other samples are also being processed for extraction of bioactive compounds from them.

The methanolic extracts of the sponge *Spongia officianalis* collected from Mandapam was found to give good inhibition against pathogenic viruses. Details on the distribution and ecology of some sponges were given to Andhra University, Visakhapatnam; Regional Research Centre, Bhubaneswar and Indian Institute of chemical Technology, Hyderabad.

Methanol extracts of sponges, ascidians, soft corals and seaweeds collected from Vizhinjam and Mandapam coasts were condensed by vacuum evaporation and are being purified by various techniques for assay of their bioactivity.

Amylolytic enzymes responsible for degradation of cell walls of seaweed from Abalones (for somatic hybridization of seaweed) and GABA a morhogenetic hormone for bivalves from red seaweeds were also included in the study and the methodology for their extraction is being standardised.

A major contribution of the project during the period under report was the development of a farming system for marine invertebrates (Ascidians, Sponges, Crinoides, Bryozoans, Holothurians, Sea urchins and Sea anemones) as a side crop of pearl oyster/mussel farming using rafts, hapas and cages. These raw materials, rich in bioactive substances, are otherwise very costly. The farmed material has been supplied to various laboratories for further analysis.

Genetic Studies in Marine Penaeid Prawns (SPO/12)

M.K. George and N.N. Pillai

The electrophoretic screening of six enzymes extracted from the population samples of *Penaeus indicus* collected from Mandapam, Madras and Calicut and that of *P. monodon* collected from Calicut and Madras was carried out to study the population genetics of the two species. Morphometric data were also collected from the samples. The analysis of the polymorphic loci in the two species indicated regional allelic frequency differences at certain loci.

VIII. SOCIO-ECONOMIC EVALUATION AND TECHNOLOGY TRANSFER DIVISION

There are five ongoing projects in the Division, three in Extension and two in Economics. Besides, the division is engaged in the programme of collection of fish price data from all important landing centres, wholesale and retail markets. The division was involved in organising exhibitions at U.C. College, Alwaye, Mar Augustins College, Ramapuram, St. Albert's school ground in Ernakulam and Trissur Pooram festival. Several visiting teams from various colleges/schools to the Institute were taken round and the activities of the Institute were explained. Further, the scientists in the Division, actively participated in the state level planning process on the request of State Planning Board, Kerala and Tamil Nadu.

MODELLING AND EVALUATION OF EXTENSION METHODS FOR FISHERIES DEVELOPMENT (FE & E/31)

Krishna Srinath, R. Sathiadhas, Sheela Immanuel and R. Narayana Kumar

Besides Chellanam, the activities were undertaken at Kandakadavu, Valappau and Nayarambalam. The group farming programme was extended to north Chellanam Padasekharam also bringing a total of 90 farmers operating in an area of 150 acres. The new farmers were imparted training in the technology with the help of KVK. An inter-divisional team from the Institute made visits to the farm and rendered technical advice to the new farmers. Shrimp feed production continued at Chellanam, Palluruthi and Nayarambalam and a new unit was initiated at Valappu. Training in Mahima Feed production was given to three women groups from Trivandrum, Quilon and Valappu.

Under the special component plan for SC, a financial assistance of Rupees 6 lakh was made available by the District Administration to *Matsya Mahilavedi* at Chellanam, SC/ST Society at Kandakadavu and AMSF Society at Valappu for promoting net making, ornamental fish culture, fish processing, prawn farming and feed production.

At *Matsyamahilavedi* 50 women were trained in net making and an amount of Rs 1000/- each was provided as capital input to start production activities. Five units of ornamental fish culture were also set up and the first harvest was done in November 1996 which demonstrated the feasibility of producing angel fish in the brackishwater during June to November.

At AMSF prawn harvest was done in September 1996 and the building construction for *Mahima* unit is in progress. A group of 5 women were trained in *Mahima* shrimp feed production. At Kandakadavu the fish processing training was imparted to 15 women with the help of CIFT in December 1996. The District Administration has sanctioned Rs. 2,64,450/- to the *Matsyamahilavedi* for implementation of integrated fish and poultry farming, crab farming and ornamental fish culture. Other activities organised at Chellanam included:

1. Organisation of DWCRA group for ornamental fish culture
2. Celebration of 'women in Agriculture Day' jointly with CIFT, on 4 December 1996.
3. Visits of IMG trainees consisting of presidents of 25 Panchayats from dif-

ferent parts of Kerala, 12 December, 1996.

4. Visits of AIR/Trissur Team to cover the group farming project in the *Vayalum Veedum* programme, 9 February, 1997

5. Visits of All India Radio Advisory Committee, Trissur consisting of heads of Government departments, educational institutions and NGOs.

6. All India Radio Trissur broadcast features on *Matsyamahilavedi* and *Mahima* shrimp feed production and ornamental fish culture at Chellanam in *Vayalum Veedum* programme on 12 March, 23 March and 27 March respectively.

7. All India Radio Trissur, has also approved the broadcast of a series of lessons in the *Krishi Padam* programme to be coordinated by the institute with the participation of other R & D agencies in fisheries.

The group farming model was found to be very effective due to the social and economic gains it demonstrated for the first time. The interagency linkages developed under the project could lead to the integration of technologies developed by the Institute into poverty alleviation programme .

The Chellanam model received wide coverage in the media. It is cited and described as a suitable model for women and development in the hand book released by the state planning board in connection with participatory planning. With the video facility available in the division a film on innovations developed at the Institute entitled 'Sankethika Vidyakal Samoohika Nanmakku' was produced and screened to the user groups. A cassette on mariculture technologies was produced in connection with the Director's visit to Egypt. Video coverage of TOT activities were also made using institute facility and outside agencies. Coordinated Mussel farming and harvest at Andhakaranazhi and it was telecast in the *Vipani* programme of Doordarshan, Trivandrum. The project is continuing with the modified title of'empowerment of coastal communities through fisheries extension'.

Integration of Small Scale Mariculture with Small Scale Fisheries Along the Peninsular India (FE & E/32)

M. Devaraj, A. Regunathan, N. Kaliaperumal, A.P. Lipton, P. Jayasankar, A.C.C. Victor, D. Sivalingam, M.E. Rajapandian, P.V. Srinivasan, M. Vijayakumaran, G. Syda Rao, G. Mohanraj, K. Vijayakumar, N. Ramachandran, S. Krishna Pillai, R.Sathiadhas, Krishna Srinath, Sheela Immanuel, K.K. Appukuttan, P. Kaladharan, P.S. Kuriakose, C. Muthiah, Prathibha Rohit, Preetha

A number of demonstrations and extension activities were undertaken under this project during the period under report. At Headquarters 11 fishermen-industry-institution meets were organised. The response for these meets was very good due to excellent participation of the end users and good coverage in the media. These meets were conducted by all Research Centres. In Mangalore, mudcrab culture was demonstrated successfully. A harvest of 349.3 kg of *S. tranquebarica* was achieved out of 500.5 kg of soft crabs stocked in an area of 800 m sq. and a net profit of Rs 36,000.00. In Vizhinjam, good response from the farmers for propagating artificial reef to enhance the

production in the inshore belt have been received. Potentiality of open sea mussel culture was demonstrated successfully at Mandapam camp. 187 ropes of brown mussels with a total seeds input of 467.5 kg @ 2.5 kg /m of rope were cultured on an offshore rack and the production was estimated to be in the order of 3.372 tonnes in a unit area of approximately 150 m^2 indicating a total production potential of nearly 22 tonnes/ha (21.812 t).

Similarly 241 ropes of green mussels with a total seed weight of 602.5 kg @ 2.5 kg /m of rope were cultured and the production was estimated to be 4.0 tonnes @ 16.6 kg/m indicating a potential yield of 20 tonnes/hact.

However a part of the yield was lost in the inclement weather and 2.0 tonnes of brown and 1.45 tonnes of green mussels were harvested. Of this 1.4 tonnes of brown mussels were sold to IFP, Cochin @ Rs.14/ Kg and 1.0 tonne of green mussels was sold to Amalgam Fisheries Company, Mandapam @ Rs.15/Kg and a sum of Rs.13,500 was realised for green mussels.

Culture of mussels in Mandapam waters and the harvest mela organised during the year under report gave wide publicity and various interest groups from Rameswaram, Pamban, Meemisal, Thiruchendur, Thangachimadam etc. approached the associate project leader for off shore culture of mussels. Site inspections were made at Olakuda, Thangachimadam, Pamban, Manapad, and Thiruchendur. A private entrepreneur (M/s. Femina prawn culture Pvt. Ltd) has sent proposal to the Institute for signing MOU to propagate the commercialisation of off shore culture of mussels in Mandapam area involving Institute-fishermen-industry. The same entrepreneur has proposed to enter into an MOU with the Institute for onshore pearl culture also. The prospects of Seaweed culture is also evoking good response from the fishermen. The Madras Research Centre, besides giving technical guidance on onshore culture of pearls and organisation of monthly meets involving the Institute fishermen Industry has organised training programmes on pearl oyster surgery for developing local talents with the help of Tuticorin Research Centre of CMFRI. M/s Master Aquaproducts, Chirala, M/s Maheswari and Co, Madras and M/s Rank Marine hatchery, Pondichery were given technical guidance on onshore culture of pearls. Technical guidance on fattening of lobster and crabs were also extended. At Visakhapatnam good response was obtained at meets on prawn and clam culture. An entrepreneur from Orissa seeking for prawn feed technology was given information about *Mahima* Feed. The demand of *Mahima* shrimp feed among the prawn farmers is continuously increasing and several commercial units have been established in and around Cochin with the technical advice of CMFRI. The project is progressing well in accordance with the Technical Programmes.

Resource Management and Socio-Economic Survey of Smallscale Fisheries in Lakshadweep Island (FE &E/33)

R. Sathiadhas, Krishna Srinath and R. Narayana Kumar

Collection of data from secondary source has been completed. Three types of schedules were prepared to collect data on the cost and earnings of different craft-gear at selected landing centres and socio-economic parameters through household survey. The preliminary analysis of data indicated that there are 11 landing centres, 10 fishing villages and about 5600 active fishermen in Lakshadweep Islands. There are about 550

traditional boats, 300 motorised boats and 415 mechanised boats in the island. The per capita production per active fishermen works out to 1750 kg. Steps are being initiated to collect data from households at Lakshadweep from May 1997 onwards.

A Study on Diffusion and Adoption of Selected Mariculture Practices (FE & E/34)

Sheela Immanuel

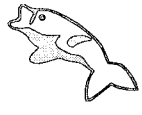
Mariculture technologies developed by the Institute have been identified to study the diffusion and adoption pattern. Narakkal, Chellanam and Kumbalangi in the Ernakulam District, Dalavapuram in Kollam District and a few areas in Kozhikode and Kasargod Districts which are dominated by fishermen involved in the selected technologies have been identified for detailed study.

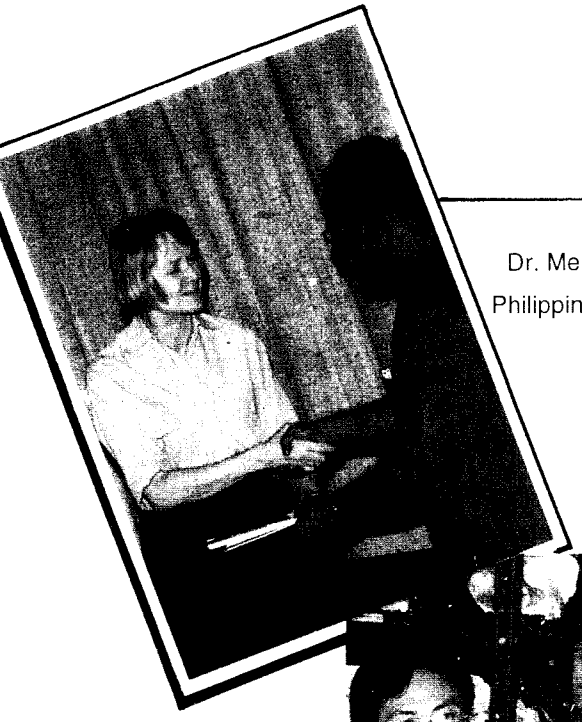
Using simple random sampling technique, a total of about 500 respondents in the case of prawn, crab and mahima feed, and all the farmers who have taken up mussel and oyster culture in Kerla were selected for observation. Interview schedule/questionnaire on diffusion pattern of the technology, extent of adoption and problems in taking up the culture were prepared to collect data. Data collection work has been initiated and is in progress.

Economic Evaluation of Mechanised Fishing Units in Cochin Fisheries Harbour (FE &E /35)

R. Narayana Kumar and R. Sathiadhas

Cost and earnings data from sample units of gillnetters and trawlers were collected weekly from Cochin Fisheries Harbour. The operational cost and earnings of a single-day and multiday fishing units of trawlers were tabulated. The initial investment of the trawler ranges from Rs 7-10 lakhs. The fishing trip of multiday unit consist of two to three days. The average operational cost of a single day unit comes out to Rs 3500/- per trip and a multiday fishing unit comes out to Rs 7700/-. Fuel and wages to labourers are the major operating expenses constituting 40% and 35% respectively for both type of fishing units. The average gross earnings works to Rs 6000/- per trip for single day unit as against Rs 13200/- per trip for multiday fishing unit. The net operating income of a single day fishing unit works out to Rs 2500/- and the same for multiday fishing units comes out to Rs 5500/-. The detailed analysis like net profit, rate of return, pay back period and other economic parameters in progress.





Dr. Meryll Williams, Director General, ICLARM Philippines with Dr. M. Devaraj, at CMFRI Cochin

Delegation of Chinese fisheries Scientists at the Institute

Dr. Meryll Williams D.G., ICLARM and Dr. M.V. Gupta, Director, International Relations, ICLARM, Philippines at the

Mudbank fishery — Landing centre at Chavakkadu in Trichur district, Kerala

Trawl landing centre at Sakthikulangara, near Quilon

संपन्न कार्यों का मुख्य अंश

मछली उत्पादन का आकलन

समुद्री मात्स्यिकी सांख्यिकी का संग्रहण करना और गिअरवार व जातिवार उत्पादन का आकलन करना सी एम एफ आर आइ के प्रमुख दायित्वों में एक है. विभिन्न विकासात्मक और योजनापरक उद्देश्यों के अतिरिक्त यह सूचना समुद्री प्रग्रहण मात्स्यिकी का प्रमुख योगदान बनती है और वहनीय उत्पादन केलिए आवश्यक उपाय व्यवस्थित करने केलिए भी सिद्ध हो जाती है. भारत में वर्ष 1996 के मछली उत्पादन में पिछले वर्ष की अपेक्षा 6.9% की वृद्धि हुई है और आकलित उत्पादन 2.41 मिलियन टन था.

कुल उत्पादन का 87.3% यंत्रीकृत और मोटोरीकृत एककों और बाकी परंपरागत एककों का योगदान था. कुल समुद्री मछली उत्पादन का 52% वेलापवर्ती फिन फिशों और बाकी सब तलमज्जी और कवच प्राणियों का योगदान था. इस वर्ष के दौरान तारलियों की मात्स्यिकी में पुनरुज्जीवन की प्रवणता दिखाई पडी. बांगडों के अवतरण में भी पिछले वर्षों की अपेक्षा एक लाख टन की वृद्धि देखी गई. पेनिआइड, नॉन पेनिआइड और फीतामीनों के अवतरण में भी उल्लेखनीय वृद्धि देखी गई. लेकिन उपास्थिमीनों, लेसर सारडीनों, श्वेत बेटों, करंजिडों और सीरफिशों के अवतरण में घटती दिखाई पडी. शीर्षपादों का उत्पादन इस वर्ष 1.07 लाख टन था जो पिछले वर्ष की तुलना में 10,000 टन कम था.

महाराष्ट्र और गुजरात के उत्तर-पश्चिम तट से भारी अवतरण (देश के कुल अवतरण का 34.9%) हुआ जिसके बाद दक्षिण - पश्चिम तट (केरल, कर्नाटक और गोवा) (32.8%), दक्षिण-पूर्व तट (आंध्रा प्रदेश, तमिलनाट्ट और पॉडिच्चेरी) (25.6%), उत्तर-पूर्व तट (पश्चिम बंगाल और उडीसा) (5.3%) और लक्षद्वीप और आन्डमान (1.4%) आते हैं.

उत्तर-पश्चिम तट में यंत्रीकृत एककों (ट्राल, कोप संपाश और गिलजाल) द्वारा कुल उत्पादन का 46% और दक्षिण-पश्चिम तट में मोटोरीकृत एककों द्वारा 49% योगदान हुआ.

ए आर आइ एम ए नमूनों के उपयोग से समुद्री मछली उत्पादन के पूर्वानुमान से अनुमानित उत्पादन पिछले साल 23.7 लाख टन था जो 24.1 लाख टन आकलित मूल्य से विचलित भी हो गया.

मात्स्यिकी और संपदा विशेषताओं का अध्ययन

पिछले कुछ वर्षों से लेकर समुद्री मछली उत्पादन लगभग 2.3 मि टन में स्थिर रहा था और हाल के विदोहन धरातल में यह 2.2 मि टन की वहनीय शक्यता स्तर में स्थिर रहा. यह स्थिति विशेष विदोहन पर अत्यधिक मॉनीटरन और आधुनिक अनुसंधान परिणामों के परामर्श स्वीकार करते हुए अनुकूल वहनीयता के लिए अनुयोज्य उत्पादन रीतियाँ खोजने की ओर इशारा करता है. इस आवश्यकता की पूर्ति केलिए प्रग्रहण क्षेत्र में कई अनुसंधान परियोजनाओं का कार्यान्वयन किया जाता है.

वेलापवर्ती फिनफिश: दोनों तटों से तारलियों की संपदा विशेषताओं के आंकडे संग्रहित किए गए. मांगलूर और कोचिन से कोप संपाश द्वारा पकडी गई तारलियों का लंबाई रेंच 50-100 मि मी था. वलय संपाश द्वारा कालिकट और कोचीन से पकडे गए नमूनों का लंबाई रेंच 90-120 मि मी था. विशाखपट्टणम से गिल जाल अवतरण से प्राप्त तारलियों के तीन प्रकार के लंबाई रेंच थे, जो हैं, 110-205 मि मी, 130-150 मि मी और 180-190 मि मी. मांगलूर में अगस्त-नवंबर महीनों के

दौरान अंडपूर्ण और भागिक रूप से अंडरिक्त अवस्था की तारलियाँ अधिक थी और नवंबर-मार्च के दौरान छोटी तारलियाँ भी. कालिकट में अप्रैल-जून के दौरान किशोर तारलियाँ अधिक थी और विशाखपट्टणम में जनवरी-मार्च के दौरान अंडरिक्त और पुनःप्राप्त अंडों के प्रौढ़ नमूने अधिक थे.

कोचिन में ट्राल जाल द्वारा प्राप्त नमूनों में *स्टोलिफोरस बटाविएन्सिस* प्रमुख थे जबकि मांगलूर और मालप में वलय सेपाश द्वारा *एस. डेवीसी* की अधिक पकड़ हुई. *एस. डेवीसी* का लंबाई रेंज ट्राल जाल में 50-100 मि मी और कोप सेपाश में 65-95 मि मी था. ट्राल जाल में *एस. बटाविएन्सिस* का आकार रेंज 60-105 मि मी और कोप सेपाश में 80-105 मि मी था.

नौ केन्द्रों से गीरफिश के विदोहन पर आंकड़े संग्रहित किए गए. पूर्वी तटों में कौंटा डोर के अलावा ड्रिफ्ट गिल जाल और बोटम ट्राल द्वारा मत्स्यन किया गया. इन केन्द्रों में ड्रिफ्ट गिल जाल का योगदान कुल उत्पादन का 66.4%, बोटम ट्राल का 20%, कौंटा डोर का 7.7%, कारीगरी गिअर का 1.1% और कोप सेपाश का 0.3% था. *स्कोमबरोमोरस कमेर्सन* और *एस. गटाटस इस* मात्स्यिकी की प्रमुख जातियाँ थी. स्टॉक निर्धारण अध्ययन यह सुझाव देते हैं कि गीरफिश संपदा का विदोहन उड़ीसा और कर्नाटक में अधिकतम वहनीय प्राप्ति के स्तर में किया जाता है. पश्चिम बंगाल और केरल में इस स्तर से अधिक और अन्य क्षेत्रों में इस स्तर से कम किया जाता है.

देश के आठ क्षेत्रीय केन्द्रों के समुद्रवर्ती तटों और मिनिकोय में ट्यूनाओं की संपदा विशेषताओं का अध्ययन किया गया. तटीय केन्द्रों में *यूथिनस एफिनिस* और मिनिकोय में लंबी डोर मात्स्यिकी में *केट्सुओनस पेलामिस* मुख्य जातियाँ थी. *के. पेलामिस* में प्रौढ़ मछलियाँ 50 से मी की लंबाई की थी और भागिक रूप से अंड युक्त प्रौढ़ मछलियाँ अधिक थी. टूटिकोरिन में पारुवले के प्रयोग से प्राप्त *ई. एफिनिस* और *ए. थासार्ड* के स्टॉक निर्धारण के अध्ययनों से इन जातियों की विदोहन दर क्रमशः 0.71 और 0.58 देखी गयी. मांगलूर में *ई. एफिनिस, टी. टोंगोल* और *ए. थासार्ड* के विदोहन अनुपात क्रमशः 0.05, 0.48 और 0.26 आकलित किया गया जो यह दिखाते है कि इन जातियों का विदोहन और भी किया जा सकता है. बंबई में *ई. एफिनिस* का विदोहन अनुपात 0.79 था जिससे यह व्यक्त हो जाता है कि इस जाति का विदोहन अनुकूलतम स्तर तक कम किया जाना है.

आठ केन्द्रों में बांगडों के अवतरण का मॉनीटरन किया गया. अखिल भारतीय स्तर पर इस जाति के अवतरण में पिछले साल की अपेक्षा एक लाख टन की वृद्धि हुई. पश्चिम तट में कोप सेपाश और वलय सेपाश द्वारा मुख्य अवतरण हुआ. कालिकट में अक्तूबर-मार्च के दौरान परिपक्व प्रौढ़ और मार्च-जून के दौरान अंडावस्था की मछलियों को प्राप्त हुआ. पूर्व तट में ड्रिफ्ट गिल जाल, ट्राल जाल और बोट सेपाशों द्वारा बांगडों का अवतरण हुआ. टूटिकोरिन में बांगडो की विदोहन दर ड्रिफ्ट गिल जाल द्वारा 0.82 और ट्राल जाल द्वारा 0.73 आकलित की गई.

बंबई और वेरावल में बेंबिलों के अवतरण का मॉनीटरन किया गया. गुजरात और महाराष्ट्र से प्राप्त इस जाति का लंबाई रेंज 30-314 मि मी था और फरवरी-जून के दौरान 30 मि मी आकार वाली मछलियों का अधिक अवतरण हुआ. गुजरात तट में पूर्व मानसून और ग्रीष्म मौसमों में अंडजनन हुआ.

फीतामीनों का अनुसंधान आठ केन्द्रों में किया गया और विषिंजम को छोडकर सभी केन्द्रों में ट्राल जाल द्वारा मुख्य अवतरण संपन्न हो गया. *ट्रेक्यूरस लेप्टयूरस* अति प्रमुख जाति थी. विभिन्न केंद्रों में ट्राल जाल से प्राप्त नमूनों की लंबाई इस प्रकार है कि काकिनाडा में 8 से मी, विशाखपट्टणम में 16 से मी, वेरावल में 20 से मी, मांगलूर में 30 से मी, कोचिन में 32 से मी और बंबई में 40 से. मी कोचिन में नवंबर से जून तक अंडजनन काल था. बंबई में विदोहन का अनुपात 0.85

और मांगलूर में 0.32 आकलित किया गया.

मलवार उत्स्रवण क्षेत्र में किए गए मात्स्यिकी पूर्वानुमान कार्यक्रम में तारलियों के अवतरण और बारिश दोनों के बीच में आपसी संबंध देखा गया.

तलमज्जी फिनफिश: चार केन्द्रों में उपास्थिमीनों के विदोहन का मॉनीटरन किया गया और सभी केन्द्रों में ट्रालरों द्वारा अधिकांश पकड प्राप्त हुई. बंबई में *स्कोलियोडोन लैटिकॉडस* का आकार रेंच 160-640 मि मी देखा गया और अप्रैल और दिसंबर-मार्च के दौरान गर्भधारी सुराओं को अधिक रूप से देखा गया.

पांच केन्द्रों में पर्चों की संपदा विशेषताओं का अध्ययन किया गया. बंबई में 10-52 से मी के आकार रेंच के और कोचीन में ट्रालरों द्वारा 10-37 से मी आकार रेंच के *एपिनिफेलस इयाकांतस* प्रमुख रूप से प्राप्त हुए. कोचीन में कांटा डोर द्वारा प्राप्त इस जाति का लंबाई रेंच 23-50 से मी था. विषिंजम में मई-जुलाई के दौरान प्राप्त पकड में *लेथरिनस लेन्टजान* का लंबाई रेंच 180-730 मि मी और *एल. नेबुलोसिस* का 140-440 मि मी था. टूटिकोरिन में *एल. नेबुलोसस* का लंबाई रेंच 100-660 मि मी और *ई. अन्डुलोसस* का 330-580 मि मी था.

तीन केन्द्रों में शिंगटियों की संपदाओं का अध्ययन चलाया गया और *टैकिसुरस डसुमेरी* और *ओ. मिलिटारिस* प्रमुख जातियाँ थी. *ओ. मिलिटारिस* का विदोहन अनुपात 0.74 आकलित किया गया. कोचीन में जुलाई-नवंबर के दौरान बंपर पकड प्राप्त हुई. यह आकलित किया गया कि अक्तूबर महीने में दो दिनों के कोष संपाश परिचालन से *टी. सेराटस* के 280 कि ग्रा अंडों और भ्रूणों का अवतरण किया गया. विशाखपट्टणम में पकड का 50% *टी. टेनुस्पिनिस* था.

सूत्रपख ब्रीमों की संपदाओं का मॉनीटरन नौ केन्द्रों में किया गया और सभी केन्द्रों की बंपर पकड में *एन. जापोनिकस* और *एन. मीसोप्रिओन* प्रमुख जातियाँ थी. बंबई में इन दो जातियों की अधिकतम वहनीय प्राप्ति 315 टन और 1551 टन आकलित किया गया. कर्नाटक में *एन. जापोनिकस* की अधिकतम वहनीय प्राप्ति 3410 टन आकलिक किया गया जो वर्तमान वार्षिक पकड के करीब आता है. टूटिकोरिन में पकड की प्रमुख जाति *एन. डिला* थी. मद्रास में *एन. जापोनिकस* और *एन. मीसोप्रिओन* की अधिकतम वहनीय प्राप्ति क्रमशः 1075-1410 टन आकलित किया गया जो बढ़ते हुए उत्पादन की ओर इशारा करते है.

नौ केन्द्रों में मुल्लनों के अवतरण का मॉनीटरन किया गया. भारत में दिखाई पडनेवाली 20 जातियों में मांगलूर, मद्रास, काकिनाडा और विशाखपट्टणम से प्राप्त *लियोग्नाथस विन्डस और सेक्युटर इन्सिडियाटर* प्रमुख जातियाँ थी. फिर भी भारत के दक्षिण-पूर्व तट विशेषतः पाक उपसागर में *एल. ब्रेविरोस्ट्रिस, एल. जोनीसी और एन. डसुमेरी* प्रमुख जातियाँ देखी गई. मद्रास में *एल. विन्डस* की अधिकतम वहनीय प्राप्ति 1285 टन आकलिक की गई जो 1045 टन की वार्षिक औसत प्राप्ति से अधिक थी.

सयनिड संपादाओं का भी नौ केन्द्रों में मॉनीटरन किया गया. इस मात्स्यिकी में काकिनाडा में 18, वेरावल में 16, मद्रास में 15, विशाखपट्टणम में 10, कालिकट में 7 और कारवार, कोचीन और टूटिकोरिन में 2 से 4 जातियों का योगदान हुआ. वेरावल, बंबई और कारवार में ट्राल पकड में *ओटोलिथस क्यूवीरी* प्रमुख जाति थी. वेरावल में ट्राल परिचालन द्वारा सबसे बडी सयनिड जाति *पी. इयाकांतस* और *ओ. बयॉरिटस* का विदोहन किया गया. बंबई में अक्तूबर और फरवरी-मार्च के दौरान *जे. सीना* के परिपक्व प्रौढ़ों को प्राप्त हुआ.

विभिन्न केन्द्रों में तुम्बिलों की दो जातियाँ प्रमुख थी और बंबई में ट्राल परिचालन द्वारा 100-440 मि मी, मांगलूर से 180-450 मि मी, कालिकट में 100-

329 मि मी और कोचीन में 240-440 मि मी आकार रेंच के *सॉरिडा तुंबिल* को पकडा गया. बंबई में अक्तूबर-नवंबर के दौरान और कालिकट में जनवरी के दौरान परिपक्व प्रौढ़ों को प्राप्त हुआ. मद्रास में अक्तूबर-नवंबर के दौरान *एस. अन्डोस्क्वामिस* के अंडयुक्त वयस्क प्राप्त हुए थे.

ट्रालरों द्वारा पकडी जाने वाली चपटी मछलियों में 5-17 से मी आकार रेंच की *साइनोग्लोसस माक्रोस्टोमस* प्रमुख जाति थी. मांगलूर में नवंबर-जनवरी इस जाति के अंडजनन का ऋतुंगकाल था.

पकडी गई श्वेतमछली का लंबाई रेंच 8-20 से मी था और मांगलूर में नवंबर-मार्च के दौरान मुख्यतः इस जाति का अंडजनन संपन्न हो जाता है.

क्रस्टेशियन कवच प्राणीः देश के कुल 1.88 लाख टन वार्षिक समुद्री मछली अवतरण का 7.8% पेनिआइड झींगों का योगदान था. पश्चिम तट में ट्रालरों द्वारा 77% पेनिआइड झींगों का अवतरण हुआ. कोचीन और शक्तिकुलंगरा में मानसून अवधि के दौरान *पैरापेनिओप्सिस स्टाइलिफेरा* का क्रमाशः 1210 और 5603 टन अवतरण हुआ जिससे वर्ष 1995 की अपेक्षा कोचीन में 28% की वृद्धि और शक्तिकुलंगरा में 51% की घटती नज़र आती है. पश्चिम तट के विभिन्न केन्द्रों में *पी. स्टाइलिफेरा* का लंबाई रेंच 60-125 मि मी, *मेटापेनिअस डोबसोनी* का 56-120 मि मी और *एम. मोनोसिरस* का 96-150 मि मी आकलित किया गया. कर्नाटक और केरल में मानसून की अवधि कारिगरी गिअरों द्वारा पेनिआइड झींगों के अवतरण का ऋतुंगकाल था. इस क्षेत्र के कारीगरी सेक्टर में हुए 87% झींगा अवतरण में प्रमुख जाति *एम. डोबसोनी* थी. केरल में छोटे ट्रालरों द्वारा 27.2 कि ग्रा प्रति एकक की पकड दर में *पी. स्टाइलिफेरा और एम. डोबसोनी* का अवतरण हुआ. 10-12 मि मी जालाक्षि आकार वाले इस गिअर के परिचालन द्वारा तटीय समुद्र से कम आकार वाले झींगों (इस गिअर की पकड का 60%) का शोषण हुआ है.

भारत के पूर्व तट में पेनिआइड झींगों का अवतरण 50,383 टन आकलित किया गया जो पिछले साल की अपेक्षा 1.3% घटती दिखाता है. तमिलनाडु से अवतरण का अधिक योगदान हुआ. पूर्व तट की ट्राल मात्स्यिकी में पारादीप में पेनिआइड झींगों का 42% पैरापेनिओप्सिस जातियाँ थी, बिशाखपट्टणम में 37%, काकिनाडा में 40% और मद्रास में 21% *एम. डोबसोनी* प्राप्त हुए और मंडपम में 44%, पाम्बन में 36% और टूटिकोरिन में 67% *पी. सेमीसुल्केटस* प्राप्त हुए. इस क्षेत्र के पेनिआइड झींगों की पकड यह सुझाव देती है कि उत्तर-पूर्व तट के पेनिअस और *एम. मोनोसिरस* जैसे बडी जातियों की अपेक्षा कुछ सालों से *पैरापेनिओप्सिस जैसी छोटी जातियों* की अधिकता हुई है और *एम. डोबसोनी* प्रमुख जाति थी. पाक उपसागर व मन्नार खाडी क्षेत्रों में क्रमशः *एम. स्ट्रिडुलन्स और पी. मेक्सिल्लिपेडो* अवतरण की प्रमुख जातियाँ थी. इसी प्रकार चेन्नै तट में बडे पोतों द्वारा गभीर सागर में मत्स्यन किए जाने पर साधारणतः मिलनेवाली जातियों जैसे मेटापेनिओप्सिस और ट्रैकिपेनिअस जातियों को पकडा सका. काकिनाडा में ट्रालरों द्वारा *एम. मोनोसिरस* के किशोरों का बडी मात्रा में विदोहन किया गया और इस पकड के 70% नमूनों का आकार 100 मि मी से कम था.

टूटिकोरिन में वर्ष 1995 की अपेक्षा गभीर सागर झींगों के अवतरण में 71% घटती देखी गई और *हेटेरोकार्पस* ओर *प्लेसियोनिका* जातियाँ प्रमुख थी. काकिनाडा के निकट स्टेक जाल द्वारा पालन क्षेत्रों से कुल 269 टन किशोर झींगों का अवतरण हुआ और अवतरण का 80% *एम. मोनोसिरस, एम. डोबसोनी और पी. इन्डिकस था*.

भारत में नॉन पेनिआइड का अवतरण लगभग 1.04 लाख टन था जिसका 64.4% गुजरात से और 27.1% महाराष्ट्र से संपन्न हुआ. दोनों क्षेत्रों में पिछले

वर्ष की अपेक्षा उत्पादन बढ़ गया. गुजरात में कुल अवतरण का 77% ट्रालरों का और महाराष्ट्र में 89% ट्राल जालों का योगदान था. वेरावल में नॉन पेनिआइड झींगे पकड का 98% *असेटस* जातियाँ और मुंबई में पकड का 90% *नेमाटोपालेमन टेन्युपस* थी.

चिंगटों के अवतरण में पिछले साल की अपेक्षा 36.7% वृद्धि हुई है. भारत की कुल चिंगट पकड का 86% गुजरात और महाराष्ट्र से प्राप्त हुआ जिनके बाद तमिलनाडु (9.5%) और केरल (4.2) आते हैं. पिछले साल के अवतरण की तुलना करने पर महाराष्ट्र में पकड में तिगुनी वृद्धि और गुजरात में 7% की घटती दिखाई पडी. उत्तर-पश्चिम तट के कुल चिंगट उत्पादन का 80% और केरल में 62% ट्रालरों का योगदान था. लेकिन तमिलनाडू में चिंगट पकड का 67% कारीगरी सेक्टर का योगदान था. मुंबई में तीन सालों के बाद पकड में फिर से *थन्नस ओरिएन्टालिस* प्राप्त हुए.

वर्ष 1996 में कर्कटों का उत्पादन 29,000 टन था जो पिछले वर्ष से 5.4% कम था. कुल कर्कट अवतरण का 95% तमिलनाडु, गुजरात, केरल और आंध्राप्रदेश का योगदान था. मुंबई, मांगलूर, कालिकट और कोचीन में *कैरिबिडिस फेरियाटस*, वेरावल में *सी. लूसिफेरा*, कारवार और मंडपम में *पोर्ट्नस पेलाजिकस* और माल्प, चेन्नै और काकिनाडा में *पी. संग्विनोलेन्टस* प्रमुख जातियाँ थी.

विपिंजम में 20-25 मी और 10 मी की गहराई में क्रमशः 35 मछली भित्तियाँ और 40 चिंगट भित्तियाँ स्थापित की गई हैं. ये भित्तियाँ सितंबर-अक्तूबर, 1997 के दौरान परिपक्व होने की आशा है. भित्ति के समीप भागों में मछलियों की अधिकता दिखाई पडती है.

मोलस्कन कवचप्राणी: लगभग सारे केन्द्रों में दोनों तटों पर सेफालोपोडों का अवतरण ट्राल के द्वारा हुआ था. विपिंजम में तट संपाशों और काँटा डोरों के ज़रिए मोलस्कों का अवतरण हुआ. मुंबई में आनायकों से प्रति एकक प्रयास पकड 242 कि ग्रा थी. प्रमुख जातियाँ *लोलिगो डुआसेली और सीपिया अक्युलेटा* थी. पश्चिम तट में अंडजनन मानसून मानसूनोत्तर अवधि में और पूर्व तट में अक्तूबर-दिसंबर अवधि में देखा गया. *एल. डुवोसिली* का स्टॉक निर्धारण अध्ययन अधिकतम वहनीय पकड प्राप्ति केलिए कर्नाटक के आनायन कम करने की आवश्यकता पर इशारा करती है. केरल में चालियम और कोडुवल्ली से लगभग 5390 टन हरे शुबंओं का और दक्षिण-पश्चिम तट से 2040 टन भूरे शंबुओं का अवतरण हुआ था. वेम्बनाड झील से काली सीपी *विल्लोरिट्टा साइप्रनाइड्स* का कुल अवतरण लगभग 37,000 टन था. अष्टमुडी से सीपियों का कुल खडी स्टॉक 61,000 टन आकलित किया था, जिसमें 12,000 टन *पाफिया मलबारिका* था. कारवार खाडी में द्विकपाटियों का कुल अवतरण 28 टन आकलिक किया था. काकिनाडा खाडी के 3467 टन की मोलस्कन पकड में 46% द्विकपाटी और 54% गास्ट्रोपोड्स थे. मुल्की ज्वारनदमुखी से दिसंबर 1996 में लगभग 6465 टन सीपियों का अवतरण हुआ था.

मात्स्यिकी परिस्थिति मॉनिटरिंग

पूर्वमानसून, दक्षिण-पश्चिम मानसून और मानसूनोत्तर मौसमों के दौरान संग्रहित सी ट्रूथ डाटा ने माँगलूर और कासरगोड के बीच के क्षेत्र में दक्षिण-पश्चिम मानसून के दौरान उत्प्रवाह की उपस्थिति व्यक्त किया.

भारत की अनन्य आर्थिक मेखला के प्राणिप्लवकों पर किये गये अध्ययन अनन्य आर्थिक मेखला के औसत प्राणिप्लवक उत्पादन प्रति 100 मी^{3} में 88.3 मि लि पर आकलित करने केलिए सहायक हुआ और बंगाल की खाडी की तुलना में अरब समुद्र का उत्पादन दुगुना था. रात में प्लवकीय शीर्षपाद प्रचुर थे. आन्डमान-निकोबार समुद्र में इतियोप्लांक्टोन की उच्च सघनता देखी गई. यह उपतट जलों में नवंबर के दौरान अधिकतम देखा गया.

उत्तर पूर्व तट पर प्राणिप्लवकों की मौसमी प्रचुरता चिल्का-पारद्वीप क्षेत्रों में जनवरी के दौरान देखी गयी और नवंबर और अप्रैल में विशाखपट्टणम में. फरवरी-मई के दौरान मछली के अंड और जनवरी-फरवरी में पश्चडिंभक अधिक थे.

कोचीन में अमोणिया का उच्च स्तर (79.31) ज्वारनदमुख में रिकार्ड किया था. उपतट जल में अमोणिया का स्तर कम था. मछली, झींगे और द्विकपाटियों में भारी धातु का स्तर समुद्री खाद्य केलिए निर्धारित रेंच के अंदर ही था. एन्नोर में (चेन्नै) फोस्फेट के स्तर जनवरी-मार्च के दौरान उच्च थे ((0.5 पी पी एम). अगस्त-अक्तूबर अवधि में लड के स्तर भी उच्च थे ((0.1 पी पी एम).

दूर-संवेदन और शक्य मत्स्यन क्षेत्र

पकड पर मिनिकोय क्षेत्र के शक्य मत्स्यन क्षेत्रों पर किया गया पूर्वानुमान ने स्किपजैक ट्यूना की उच्च पकड की अनुकूलता व्यक्त की. इस प्रकार कोचीन में भी कोप संपाश और गिलजाल के ज़रिए प्राप्त उच्च पकड इस तंत्र की विश्वसनीयता व्यक्त करती है.

समुद्री संवर्धन प्रौद्योगिकियाँ

पोर्ट्नस पेलाजिकस के बीजोत्पादन में 14 प्रजनकों ने 87 लाख जोइए का उत्पादन किया जिनमें 14.8 लाख को 5 जोइआ अवस्था, मेगलोपा और प्रथम इंस्टार अवस्थाओं के ज़रिए पालित किया था. उसमें अतिजीवितता 0 से 16% के बीच देखी गयी और कुल 13,277 में 1148 को पालन करने केलिए संभरण किया था. *सइला आब्यानिक* के भ्रूण स्टाक अनुरक्षण और प्रेरित परिपक्वन पर भी परीक्षण चलाये थे. इस प्रकार एक ताल में अनुरक्षित 12 मादाओं में 9 परिपक्व हुये थे. 10-15 दिनों के ऊष्मायन-अवधि में 30-35 दिनों के अंतराल में सफल आवर्ती अंडजनन देखे गये थे.

एस. ट्राक्युबारिका को स्थूल बनाने केलिए किये गये परीक्षणों में नारक्कल के 0.1 हे ताल में 292 नरम कर्कटों का पालन किया था. इसका परिणाम प्रोत्साहजनक देखा जाता है.

विपिंजम में 1.2 टी एफ आर पी टैंकों में *पानिलुरस होमारस* को स्थूल बनाने केलिए किये गये परीक्षणों के परिणाम यह है कि 25 ग्रा के एक महाचिंगट ने 1.5 वर्ष में 600 ग्रा भार प्राप्त किया.

खाद्य शुक्तियों पर कुल 21 अंडजनन परीक्षण चलाये गये थे और उत्पादित स्पाटों को पालन केलिए उपयोग किया था. स्फुटनशाला में उत्पादित स्पाटों सहित 640 रज्जुओं को नर्सरी में स्थानांतरित किया था. नर्सरी में 25 मि मी आयाम में शुक्तियों सहित 800 रज्जुओं को फार्म में स्थानांतरित किया था.

टूटिकोरिन स्फुटनशाला की मुक्ता शुक्तियों से 7.72 लाख स्पाटों का उत्पादन हुआ था और उनको सी एम एफ आर आइ के विभिन्न अनुसंधान केन्द्रों को और उद्यमकर्ताओं को वितरण किया था.

विल्लोरिट्टा साइप्रिनोइड्स का ब्रूड स्टॉक अनुरक्षण 10 से 34 पी पी टी तक की लवणता पर किया था और अधिकतम अतिजीवितता 15 पी पी टी में देखा गया. अप्रैल में 30% सीपियाँ परिपक्व की अवस्था में थी. 10% प्रौढावस्था में और बाकी अंडरिक्त अवस्था में थी.

सेपियोट्यूथिस लेस्सोनियाना के अंडों को एफ आर पी टैंकों में अनुरक्षित किया था और जिसके परिणामस्वरूप 458 हैचलिंग प्राप्त हुये थे.

मद्रास में उपतट मुक्ता संवर्धन कार्यक्रम में 3 मि मी और 4 मि मी केन्द्रकों का इस्तेमाल करके 1700 शुक्तियों में केन्द्रक प्रतिरोपण किया गया. इन में से कुल 272 मोती प्राप्त हुये थे.

सीपियों के प्रेरित अंडजनन में *मेरिट्रिक्स मेरिट्रिक्स* के 50,000 और *एम. कास्टा* के 13,000 बीजों का उत्पादन हुआ था और केजों में उनका पालन हो गया है.

कालिकट में हाल ही में निर्मित स्फुटनशाला में तापीय उद्दीपन के ज़रिए हरित शंबुओं के प्रेरित प्रजनन में लगभग 5-6 लाख डिंभकों का उत्पादन हुआ था जिनमें 1.28 लाख स्पाट अवस्था तक जीवित रहे जिनका आगे 45 दिनांक केलिए 10-15 मि मी आयाम प्राप्त करने तक पालन किया जा सका.

समुद्री फिन फिश संवर्धन में, कलवा के (एपिनेफेलस जाति) बीजों का संग्रहण टूटिकोरिन से दूर स्थित तलों से किया था. इस प्रकार संग्रहित बीजों को नर्सरी में पालन करके बढती का निरीक्षण किया था, इसके अतिरिक्त टूटिकोरिन में मिट्टी से निर्मित तालों में ब्रूड स्टॉक विकास पर परीक्षण भी चलाया जाता है.

टूटिकोरिन में मई 1996 के दौरान संग्रहित 530-850 मि मी आयाम के नमूनों को जीवित अवस्था में 100% अतिजीवितता के साथ मंडपम को परिवहित किया था. कोचीन में भी ब्रूड स्टॉक विकास पर परीक्षण चलाया और 120-242 मि मी आयम के *ई. टॉविना* किशोरों को टूटिकोरिन को भेज दिया जिन्हें वहाँ एफ आर पी टैंकों में स्टॉक किया था. इनकी औसत माहिक बढती 130-160 ग्रा थी.

द्विकपाटी संवर्धन प्रौद्योगिकी के उन्नयन, स्थान निर्णय निरीक्षण और स्थानांतरण

गुणतायुक्त मोती पाने के उद्देश्य से मुक्ता शुक्तियों पर ऊतक से इन्हीं जातियों पर किये गये ग्राफ्टिंग परीक्षण से गुणतायुक्त मोतियों का उत्पादन हुआ.

उद्यमियों को मुक्ता शुक्ति बीजों की आपूर्ति की थी और संवर्धन क्षेत्रों का निरीक्षण करके पालन केलिए सलाह दिये थे.

केरल में कई कृषकों ने खाद्य शुक्ति संवर्धन तकनोलजी अपनाकर 62 से 438 कि ग्रा तक शुक्ति मांस का उत्पादन किया और 3,000 से 19,700 रु/- तक कमाया. धर्मडम ज्वारनदमुख में शंबु संवर्धन निदर्शन के सिलसिले में एक रैक की स्थापना दिसंबर महीने में की थी. पाँच महीने की अवधि में लगभग 1300 कि. ग्रा शंबु प्राप्त हुआ जिसका औसत उत्पादन प्रति मीटर रस्सी केलिए 12 कि. ग्रा था.

केरल सरकार ने 4 जिलाओं में खाद्य शुक्ति कृषि के कार्यान्वयन का अनुमोदन किया. 125 स्त्रियों और कृषकों के 15 दल बी एफ एफ डी ए की आर्थिक सहायता से इस प्रौद्योगिकी का कार्यान्वयन करेंगे. इसी प्रकार 67 स्त्रियों ने पाडन्ना में डी डब्लियू सी आर ए/ आइ आर डी पी कार्यक्रम के अधीन 800 वर्ग मी कृषि क्षेत्र में शंबु संवर्धन प्रारंभ किया है.

संस्थान की प्रौद्योगिकी और सहायता से पाडन्ना के एक कृषक ने 5 एकड़ के कृषि क्षेत्र से 2.5 टन शंबुओं का उत्पादन किया.

समुद्री संवर्धन प्रौद्योगिकियों का सुधार

पोषण: फंगाइ का उपयोग करके सूखे कसावा टुकडों को उबालने पर प्रोटीन में 9.2% बढती देखी गई. इसी प्रकार सूखे काजू फल का प्रोटीन में भी 8.64% की बढती दिखायी पडी. इन संपुष्ट वस्तुओं को *पेनिअस इंडिकस* पश्चडिंभकों के खिलाने के खाद्य में जोड दिया जाता है. मड कर्कटों ने 5 मि मी की गुटिकाओं को अधिक स्वीकार करते हुए देखा. *पी. सेमिसुलकाटस* को आहार में 35% प्रोटीन की आवश्यकता दिखायी पडी. चिंगटों के खाद्य में सोयाबीन आटा जोडने पर उच्च पचनीयता और 30% बढती दिखायी जबकि मैंटिस चिंगट जोडने पर बढती 20% थी.

शरीर क्रियाविज्ञान: 45 दिनों केलिए विविध लवणता में रखे गये खाद्य और सीपियों ने व्यक्त किया कि *क्रास्सोस्ट्रिआ माड्रासेनसिस* 85% की उच्च

अतिजीवितता दर 20 और 25 पी पी टी में प्राप्त किया जा सकता है. *मेरिट्रिक्स कास्टा* में 75% की उच्च अतिजीवितता और 7.18% की उच्च भार प्राप्ति 20 पी पी टी पर थी.

रोग विज्ञान : *पी. मोनोडोन* में वाइट स्पोट सिन्ड्रोम रोग पर किये हिस्टोपतोलोजिकल अध्ययन ने मीसोडेर्मल और एपिडेर्मल कोशों में इन्ट्रान्युक्लियर इनक्लूपन बोडीस दिखाया. पहली वार *पी. मोनोडोन* के हेपाटोपानक्रियास के इन्टर और इन्ट्रा ट्यूबुलर स्थान में एक प्रोटोसोन दिखाया पडा है.

दो मछली रोगजनक *विब्रियो पाराहीमोलिटिकस* और *वी. हारवेय* का संवर्धन किया और इनमें से केन्द्रक डी एन ए और प्लैज़मिड डी एन ए के पृथक्करण केलिए प्रोटोकोलम का मानकीकरण किया.

आनुवंशिकी : *रास्ट्रेलिगर कानागुर्टा* और *सारडेनिल्ला लोंगिसेप्स* पर किये गये अध्ययन पहली जाति के मसिल प्रोटीन और दोनों के एम टी डी एन ए अंतराजातीय आनुवंशिक परिवर्तिता के मूल्यांकन केलिए शक्य आनुवंशिक सूचक है.

मात्स्यिकी आर्थिक अध्ययन

कोचीन में रोज़ प्रचालन में लगे हुए आनाय का औसत प्रचालन लागत प्रति ट्रिप 3500/- रु और कई दिनों में प्रचालित आनाय केलिए 7700/- रु आकलित किया था. इंधन और मज़दूर मुख्य प्रचालन खर्च थे. एक दिवस के प्रचालन में प्रति ट्रिप औसत सकल आय 6000/रु और बहुदिवसीय मत्स्यन एकक का औसत सकल आय प्रति ट्रिप 13,200/- रु आकलित किया गया.

प्रौद्योगिकियों का स्थानांतरण

विस्तार कार्यकलाप कण्डकडव, वल्प्पु, और नायरम्बलम तक विस्तृत किये थे. 150 एकडों के क्षेत्र में 90 कृषकों को शामिल करके समूह कृषि कार्यक्रम भी विस्तृत किया था. *महिमा* खाद्य उत्पादन की तैयारी में केरल के तीन महिला समूहों को प्रशिक्षण दिया था. कई मछुए-उद्योग- संस्था सम्मेलनों का प्रबंधन किये थे और समुदाय केलिए गुणप्रद कई चर्चायें चलाई और अनुकूल सहायता भी प्रदान की गयी थी.

माँगलूर में मड कर्कट संवर्धन का निदर्शन किया गया और 800 वर्ग मी क्षेत्र से 500 कि. ग्रा के जल कर्कटों से 349 कि. ग्रा *एस. टानक्युवारिका* प्राप्त हुआ था. निवल आय 36,000/- रु था. विषिंजम के कृषक उत्पादन बढने केलिए कृत्रिम रीफों के उपयोग में बहुत उत्सुक थे. मंडपम में खुले समुद्र शंवु संवर्धन कार्यक्रम का सफल निदर्शन हुआ था.

प्रशिक्षण और शैक्षणिक कार्य

संस्थान में एम. एफ. एस सी और पी एच. डी कार्यक्रमों का आयोजन जारी रहा. 9 छात्रों ने एम. एफ. एस सी उपाधि प्राप्त की और तीन छात्रों को पी एच. डी उपाधि दे दी गई. इसके अतिरिक्त तीन छात्रों ने अपने थीसिस पेश किये गये है.

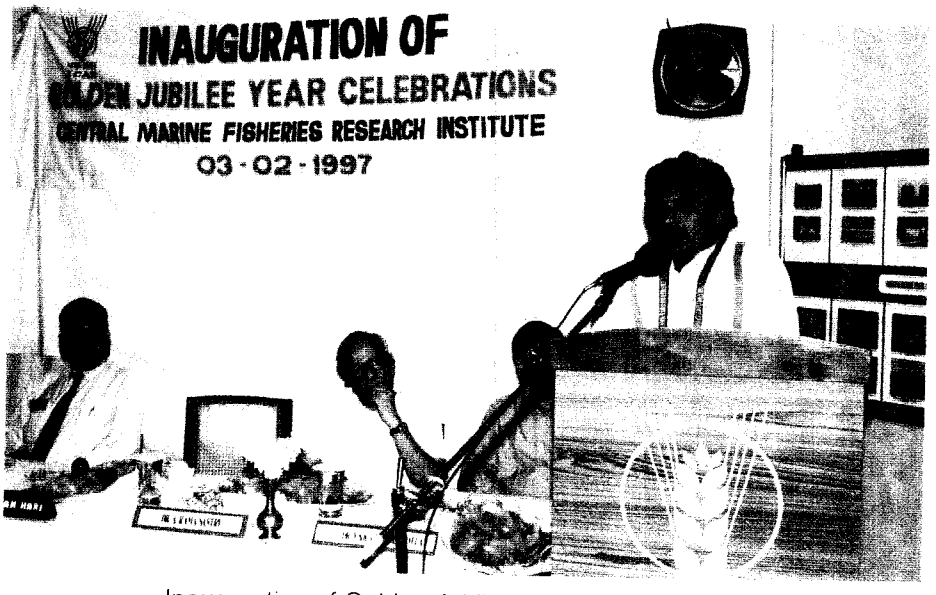
प्रशिक्षक प्रशिक्षण केन्द्र के समुद्री संवर्धन के विभिन्न क्षेत्रों और मात्स्यिकी के संग्रहणोत्तर प्रौद्योगिकी पर 9 प्रशिक्षण कोर्स चलाये. विविध समुद्रवर्ती राज्यों द्वारा प्रायोजित 66 उम्मीदवारों को इनमें प्रशिक्षित किया गया.

संस्थान के कृषि विज्ञान केन्द्र (के वी के) ने विविध विषयों पर 32 कोर्स चलाये ओर 802 व्यक्तियों को इसमें प्रशिक्षित किया गया.

Dr. P.V. Dehadrai DDG (FY), ICAR speaking at the conference of Directors of Fisheries Research Institutes held at CMFRI

Directors of Fisheries Research Institutes of ICAR at the ICAR Fisheries Division Meeting at CMFRI Cochin

Inauguration of Golden Jubilee Celebrations of the Institute at Madras Research Centre



Inauguration of Golden Jubilee Celebrations of the Institute at Visakhapatnam Research Centre by Shri Subbam Hari, Hon'ble Mayor, Visakhapatnam

CMFRI stall at the Karvali Festival at Karwar.

***परामर्श और विज्ञान विस्तार सहायता*. 1996-97 के दौरान हस्ताक्षर की गयी हस्ताक्षर किए जाने वाले करार**

क्र.सं.	उद्यमकर्ता का नाम	स्थान/कार्यकलाप	राशि
1.	मेसेर्स एन.सी.सी. ब्लूवाटर प्रोडक्टस लिमिटेड	चन्दनडा (आ.प्र) मुक्ता कृषि	84,000
2.	मेसेर्स बालाजी बयो-टेक लिमिटेड, नेल्लूर	तुपिलिपालेम मुक्ता कृषि	1,66,250
3.	मेसेर्स अक्वा प्राइम इन्टर नैशनल (इन्डिया) लिमिटेड	नेल्लूर मुक्ता कृषि	2,01,350
4.	मेसेर्स जेम होलिडे रिसोर्टस लिमिटेड	मद्रास मुक्ता कृषि	4,30,750
5.	मेसेर्स स्टेरलिंग श्रिम्पेक्स (प्राइवेट) लिमिटेड	चिराला (आ.प्र) मुक्ता कृषि	
6.	मोसेर्स कलिंगा अक्वटिक्स लिमिटेड	भुवनेश्वर (उडीसा) कर्कट पालन	
7.	मेसेर्स पिंक गोल्ड ब्रिटिश एक्सपोर्ट लिमिटेड	रायगड (महाराष्ट्र) कर्कट पालन	1,94,000
8.	मेसेर्स माँगलूर रिफाइनेरिज़ व पेट्रोकेमिकलस	माँगलूर प्रदूषण मोनिटरिंग	3,60,000
9.	मेसेर्स कुडेमुख अयर्न ओर कंपनि लिमिटेड (के आइ ओ सी एल)	माँगलूर प्रदूषण मोनिटरिंग	3,80,000
10.	मेसेर्स मास्टर पेर्ल्स लिमिटेड	हैदराबाद मुक्ता कृषि	6,71,250

अनुसंधान परिणामों का प्रकाशन

पिछले वर्षों की तरह संस्थान द्वारा वैज्ञानिक लेखों का प्रकाशन इस साल में भी जारी रखा और निम्नलिखित प्रकाशन निकाले गये.

1. इन्डियन जेर्नल ऑफ फिशरीज़ खडं 43 सं. 1-3
2. सी एम एफ आर आइ विशेष प्रकाशन सं. 65
3. समुद्री मात्स्यिकी सूचना सेवा सं. 140-145
4. सी एम एफ आर आइ न्यूज़लेटर सं. 68-69, 70-71
5. सी एम एफ आर आइ वार्षिक रिपोर्ट 1995-96
6. अनुसंधान मुख्य अंश 1995-96
7. सी एम एफ आर आइ विवरणिका (पुनर्मुद्रण)
8. विज़न -2020, सी एम एफ आर आइ पेर्सपेक्टीव प्लान

RESEARCH PAPERS PUBLISHED

BENSAM, P. 1996. Early juvenile stages of three jew fishes from the Southwest coast of India. *Indian. J. Fish.*, 41(1): 9-14.

BENSAM, P., V.N. BANDE, S. SIVAKAMI, K.V. SOMASEKHARAN NAIR, N. GOPINATHA MENON, GRACE MATHEW, P. DEVADOSS, P. NAMMALWAR, P.U. ZACHARIA, M. FEROZ KHAN, P. JAYASANKAR, G. MOHANRAJ, P. LIVINGSTON, V. GANDHI, A. RAJU, S. SRINIVASARANGAN, V. RENGASWAMI AND S.G. R 1996. Demersal finfish resources in certain areas of the EEZ of southwest and southeast coast of India. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 375-385.

BENSAM, P., K.V. SOMASEKHARAN NAIR, A. NANDAKUMAR, M.S. RAJAGOPALAN AND J. NARAYANASWAMY 1996. Hydrographic features off North east coast and Andaman-Nicobar Islands in relation to demersal finfish resources. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 419-428.

BENSAM, P. 1997. Occurrence of milk fish, *Chanos chanos* (Forskal) post larvae in the continental slope Northwest off Cochin, as collected by FORV Sagar Sampada. *Indian J. Fish.*, 43(4): 417-421.

CHAKRABORTY, S.K. 1996. Growth, mortality and yield per recruit of bearded croaker *Johnius dussumieri* (Val.) from Mumbai waters. *Indian J. Fish.*, 44(1): 45-49.

CHAKRABORTY, S.K. AND KUBER VIDYASAGAR 1996. Growth, mortality and stock assessment of two perches moontail bull's eye *Priacanthus hamrur* (Perciformes/Priacanthidae) and thornycheck grouper *Epinephelus diacanthus* (Perciformes/ Serranidae) from Bombay waters. *Indian J. Mar. Sci.*, 25(4): 312-315.

CHAKRABORTY, S.K. 1996. Stock assessment of big eye croaker *Pennahia macrophthalmus* (Bleeker) (Pisces/ Perciformes / Sciaenidae) from Bombay waters. *Indian J. Mar. Sci.*, 25(4): 316-319.

CHAKRABORTY, S.K., V.D. DESHMUKH, M.Z. KHAN, KUBER VIDYASAGAR AND S.G. RAJE 1997. Estimates of growth, mortality, recruitment pattern and maximum sustainable yield of important 'fishery resources of Maharashtra coast. *Indian J. Mar. Sci.*, 26(1): 53-56.

DEVADOSS, P. AND HAMEED BATCHA 1997. Sex change in hound shark along Madras coast. *Mar. Fish. Infor. Serv. T&E Ser.*, 146: 9-10.

DEVARAJ, M., R. PAUL RAJ, E. VIVEKANANDAN, K. BALAN, R. SATHIADHAS AND M. SRINATH 1996. Coastal Fisheries and Aquaculture Management in the East Coast of India. *Mar. Fish. Infor. Serv. T&E Ser.*, 141: 1-9.

DEVARAJ, M. 1997. Indian Marine Fisheries Scenario towards the beginning of 21st century. *Souvenior of the 11th Indian Seafood Trade Fair*, Kochi, February 1997, 4 pp.

DIWAN, A.D. AND C. SUSEELAN 1997. Need for professional manpower development to augment Indian marine shrimp industry. *Proc. National Seminar in Fisheries Education*, CIFE, Mumbai, 23-24 May 1996 : 250-253.

FEROZ KHAN, M., P.U. ZACHARIA, K. NANDAKUMARAN, S. MOHAN, M.R. ARPUTHARAJ, D. NAGARAJA AND P. RAMAKRISHNAN 1996. Catch, abundance and some aspects of the biology of deep sea fish in the southeastern Arabian Sea. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 331-346.

GOSWAMI, P.K. AND M. DEVARAJ 1996. Estimated mortalities and potential yield of freshwater shark (*Wallago attu*) from the 'Dhir beel' (riverine floodplain lake) ecosystem of the Brahmaputra basin, Assam, India. *Indian J. Fish.*, 43 (2): 127-136.

GRACE MATHEW, P. DEVADOSS, E. VIVEKANANDAN, M. FEROZ KHAN AND P.U. ZACHARIA 1996. Distribution and abundance of elasmobranchs in the Indian EEZ. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada*: 285-293.

GRACE MATHEW, G. GOPAKUMAR, S. LAZARUS, S.K. CHAKRABORTY, P. KALADHARAN, M. FEROZ KHAN, P. JAYASANKAR AND K.M. VENUGOPALAN 1996. Studies on perch resources of the shelf waters and beyond in the EEZ of India, based on trawling survey by FORV Sagar Sampada. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 387-397

IRENE FERNANDES AND M. DEVARAJ 1996. Dynamics of the Bombay duck (*Harpodon nehereus*) stock along the northwest coast of India. *Indian J. Fish.*, 43(1): 1-11.

IRENE FERNANDES AND M. DEVARAJ 1996. Dynamics of the gold-spotted grenadier anchovy (*Coilia dussumieri*) stock along the northwest coast of India. *Indian J. Fish.*, 43(1): 27-38.

JACOB JERALD JOEL AND I.P. EBENEZER 1996. Present status of trawl fishery at Colachel. *Mar. Fish. Infor. Serv. T&E Ser.*, 141: 10-17.

JACOB JERALD JOEL, I.P. EBENEZER, PAUL SIGAMONY AND A. PROSPER 1996. On the stranding of a young fin-whale at Kanyakumari. *Mar. Fish. Infor. Serv. T&E Ser.*, 141: 18.

JAMES, D.B. 1996. Animal associations in echinoderms. *J. mar. biol. Ass. India*, 37: 272-276.

JAMES, D.B. 1997. Seacucumber hatchery and culture prospects. *National Aquaculture Week* : 6 pp.

JAYAPRAKASH, A.A., P. NAMMALWAR, S. KRISHNA PILLAI AND M.N. ELAYATHU 1995. Incidental by-catch of dolphins at Fisheries Harbour, Cochin with a note on their conservation and management in India. *J. mar. biol. Ass. India.*, 37 (1&2): 126-133.

JAYASANKAR, P. 1995. Population dynamics of big eye croaker *Pennahia macrophthalmus* and blotched croaker *Nibea maculata* (Pisces/ Perciformes/Sciaenidae) in the trawling grounds off Rameswaram island, east coast of India. *Indian J. Mar. Sci.* 24: 153-157.

JAYASANKAR, P. 1997. DNA fingerprinting fosters genetic research in fisheries and aquaculture. *Fishing Chimes* 17(2): 11-15.

JAYASANKAR, P. AND K. DHARMALINGAM 1997. Potential application of RAPD and RAHM markers in genome analysis of scombroid fishes. *Curr. Sci.*, 72(6): 383-390.

KALADHARAN, P. AND S. KANDAN 1996. Primary production of Seaweeds in the

lagoon of Minicoy atoll of Laccadive Archipelago. *Seaweed Res. Utiln.*, 19(1&2): 25-28.

KALADHARAN, P., V.K. PILLAI AND S.V. ALAVANDI 1996. Abatement of Mercury pollution in aquatic systems: A biotechnological approach. *Fishing Chimes*, July 1996, 35-36.

KALIAPERUMAL, N., S. KALIMUTHU, K. MUNIYANDI, J.R. RAMALINGAM, S. KRISHNA PILLAI, V.S.K. CHENNUBHOTLA, M.S. RAJAGOPALAN, P.V. SUBBA RAO, K. RAMA RAO, P.C. THOMAS, S.H. ZAIDI AND K. SUBBARAMAIAH 1996. Distribution of marine algae and sea grasses of Valinokkam - Kilakkarai, Tamil Nadu coast, *Seaweed Res. Utiln.*, 18 (1&2): 73-82.

KASIM, H.M., K.M.S. AMEER HAMSA, T.S. BALASUBRAMANIAN AND S. RAJAPACKIAM 1996. Fishery of full beaks and half beaks, with special reference on the growth, mortality and stock assessment of *Albennes hians* (Valenciennes) along the Tuticorin Coast, Gulf of Mannar. *Indian J. Fish.*, 43(1): 51-59.

KRIPA, V., K.P. NAIR, KUBER VIDYASAGAR, G. SYDA RAO, A.P. LIPTON K.K. APPUKUTTAN, P.V. SREENIVASAN, M.E. RAJAPANDIAN, P. NATARAJAN, K. RAMADOSS, N. BURAYYA, K.T. THOMAS, P. ACHAYYA, M.M. BHASKARAN AND MATHEW JOSEPH 1996. Cephalopod Resources in Southeast and Northeast coasts of India and Andaman-Nicobar waters. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 445-451.

KRIPA, V. AND G. GOPAKUMAR 1996. Utilization of clam meat as feed in the shrimp farms of Kerala. *Seafood Export Journal*, 27(5): 7-13.

KRISHNA SRINATH 1996. Adoption of shrimp culture practices by farmers. *Seafood Export Journal*, 27(10): 9-12.

MAHESWARUDU, G., E.V. RADHAKRISHNAN, N.N. PILLAI, S. MOHAN, M.R. ARPUTHARAJ, A. RAMAKRISHNAN AND A. VAIRAMANI 1996. Repetitive spawning of *Penaeus indicus* without eyestalk ablation, hatching rate and growth upto juveniles. *Fishing Chimes*, 16(3): 21-23.

MATHEW, K.J., K.N. KURUP, T.S. NAOMI, GEETHA ANTONY AND K. SOLOMON 1996. Zooplankton abundance in the continental shelf waters of northeast coast of India. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 257-269.

MENON, N.G. 1996. Impact of bottom trawling on exploited resources. *In: Marine Biodiversity, Conservation and Management*, CMFRI, Cochin : 97-102.

MENON, N.G., N.G.K. PILLAI, R. REGHU AND K. BALACHANDRAN 1996. Distribution and abundance of the genus *Vinciguerria* (Gonostomatidae) in the DSL of Indian EEZ with a note on the biology of *Vinciguerroa nimbaria*. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada*:, 271-284.

MENON, N.G., N.G.K. PILLAI, S. LAZARUS AND P. NAMMALWAR 1996. Finfish resources in the north eastern region in the Indian EEZ. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 295-304.

MENON, N.G., K. BALACHANDRAN, S.G. RAJE, P.U. ZACHARIA, M. FEROZ KHAN, Y. APPANNA SASTRY AND P. JAYASANKAR 1996. Catfish resources in the Indian shelf waters. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 305-314.

MOHAMED, K.S. 1996. Advances in marine molluscan culture. *In: Refresher course on Advanced techniques in Aquaculture*, 6-7th February, 1996 sponsored by Dept. of Fisheries, Govt. of Karnataka and College of Fisheries, Mangalore : 77-81.

MOHAMED, K.S., P. ROHIT, G.S. BHAT, Y. MUNIYAPPA AND R.A. NAIK 1996. Shoaling of *Metapenaeus dobsoni* in the inshore waters of Malpe. *Mar. Fish. Infor. Serv. T&E Ser.*, 142: 5-8.

MOHAMED, K.S. AND D. NAGARAJA 1997. Cephalopod fisheries of Karnataka State - An overview. *Fishing Chimes* 16(11): 33-35.

MOHAPATRA, B.C. AND K. RENGARAJAN 1996. Copper, zinc and lead accumulation by *Eichhornia crassipes* (Mart.) Solms in static laboratory experiments. *J. Aqua.*, 4: 69-76.

MOHAPATRA, B.C. AND K. RENGARAJAN 1996. Static bioassay with *Liza parsia* exposed to copper sulphate, zinc sulphate and lead nitrate. *Fishery Technology*, 33(2): 127-129.

MOLLY VARGHESE, K.J. MATHEW, T.S. NAOMI, GEETHA ANTONY AND K. SOLAMAN 1996. Quantitative abundance of amphipods around Andaman-Nicobar Islands. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 229-238.

NAIR, K.V.S., R. REGHU, K. BALACHANDRAN, N.G. MENON, S.K. CHAKRABORTY, P.U. ZACHARIA, E. VIVEKANANDAN, G. MOHANRAJ AND V.S. RENGASWAMY 1996. Studies on the threadfin bream and lizardfish resources in the shelf waters of Indian EEZ. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 363-374.

NAOMI, T.S., K.J. MATHEW, GEETHA ANTONY, T.V. SATHIANANDAN AND P.P. PAVITHRAN 1996. Distribution and abundance of cladocerans in the eastern Arabian Sea. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 149-162.

NAMMALWAR, P., R. MARICHAMY, G. MOHANRAJ, V.S. RENGASWAMY, A. RAJAN AND V. GANDHI 1996. A review of the systems for culture of marine finfishes in India. *Proc. of the Nat. Symp. on Aquaculture for 2000 A.D.* : 231-244.

NASSER, A.K.V. AND A. NOBLE 1995. Fishery of live *Scylla serrata* at Azhicode in Kerala : Economics and implications. *J. Mar. biol. Ass. India* 37(1&2): 102-108.

PANDEY, A.K., K.C. GEORGE AND M. PEER MOHAMED 1996. Histopathological alterations induced in the liver of an estuarine mullet *Liza parsia* by mercuric chloride and DDT. *Indian J. Fish.*, 43(3): 277-284.

PANDEY, A.K., K.C. GEORGE AND M. PEER MOHAMED 1996. Histopathological changes induced in the gill of an estuarine mullet *Liza parsia*. *Indian J. Fish.*, 43(3): 285-291.

PAUL RAJ, R., M. RAJAGOPLAN, M. VIJAYAKUMARAN, G.S. DANIEL SELVARAJ, E. VIVEKANANDAN, R. SATHIADHAS, R. NARAYANAKUMAR, P. KALADHARAN, A. NANDAKUMAR, R. THANGAVELU, L. JAYASANKARAN, L.R. KHAMBADKAR AND A. AHMED KAMAL BHASHA 1997. Environmental Impact Assessment in the shrimp farming areas of Nagapattinam Quaid-E.Milleth District, Tamil Nadu, *Mar. Fish. Infor. Serv. T&E Ser.*, 147: 1-9.

PEER MOHAMED, M. AND M. DEVARAJ 1997. Transportation of live finfishes and shellfishes. *CMFRI Spl. Publ.*, 66: 43 pp.

PILLAI, N.G.K., P.P. PILLAI AND K.P. SAID KOYA 1996. Status report on the tuna fishery in India with particular reference to longtail tuna, *Thunnus tonggol*. *Proc. 6th Expert Consultation on Indian Ocean Tunas, IPTP* Collective Volume No. 9: 6-8.

PILLAI, N.G.K., P.P. PILLAI, K.P. SAID KOYA AND T.V.SATHIANANDAN 1996. Assessment of the stock of Kingseer *Scomberomorus commerson* (Lac.) along the west coast of India. *Proc. 6th Expert Consultation on Indian Ocean Tunas, IPTP* Collective Volume No. 9 : 299-311.

PILLAI, N.G.K., R. THIAGARAJAN AND A. RAJU 1996. Finfish resources around Andaman and Nicobar Islands. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 399-404.

PILLAI, S. KRISHNA 1995. Observations on hydrological features of marine fish culture pond waters and the adjacent inshore waters of Palk Bay near Mandapam during 1985-86. *Sci. & Cul.* 61: 195-197.

PILLAI, S. KRISHNA, M. BADRUDEEN AND M. BOSE 1995. On a leatherback turtle, *Dermochelys coriacea*, landed at Rameswaram. *Mar. Fish. Infor. Serv. T&E Ser.*, 140: 11.

PILLAI, S. KRISHNA AND C. KASINATHAN 1995. Movement of a large shoal of *Hilsa kelee* from Palk Bay to Gulf of Mannar. *Mar. Fish. Infor. Serv. T&E Ser.*, 140: 8-9.

PILLAI, S. KRISHNA 1996. Report on juvenile whale shark *Rhiniodon typus* (Smith) caught in a trawler off Kanyakumari. *Sci. & Cul.*, 62: 9-10.

PILLAI, S. KRISHNA AND A.P. LIPTON 1996. Dolphin killed by the propeller of a trawler. *Mar. Fish. Infor. Serv. T&E Ser.*, 141: 18.

PILLAI, S. KRISHNA AND M. BADRUDEEN 1996. Report on a whale shark, *Rhincodon typus* (Smith) caught in shore-seine from Palk Bay. *Mar. Fish. Infor. Serv. T&E Ser.*, 142: 15-16.

PILLAI, S. KRISHNA AND JACOB JERALD JOEL 1996. Report on juveniles of whale shark landed along the southern part of west coast of India. *Mar. Fish. Infor. Serv. T&E Ser.*, 143: 27.

PILLAI, S. KRISHNA 1997. On the nesting site and hatchings of olive ridley turtle observed at Mullur near Vizhinjam, southwest coast of India. *Mar. Fish. Infor. Serv. T&E Ser.*, 146: 11.

PRABHAKARAN NAIR, K., M.M. MEIYAPPAN, R. SARVESAN, KUBER VIDYASAGAR, G. SYDA RAO, K. SUNILKUMAR MOHAMED, P.K. ASOKAN, A.P. LIPTON, K. RAMADOSS, V.G. SURENDRANATHAN, D. NAGARAJA AND K. JAYABALAN 1996. Oceanic squids, their distribution, abundance and potential in the EEZ of India and contiguous seas. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 437-444.

PRATHIBHA ROHIT, P.P. PILLAI AND ALLI C. GUPTA 1996. Mackerel fishery during the monsoon period by indigenous gears along the south Kanara coast. *Indian J. Fish.*, 43(1): 45-50.

RADHAKRISHNAN NAIR, P.N., ALEXANDER KURIAN, C. MUTHIAH, S. LAZARUS, R. THIAGARAJAN, M. ZAFFAR KHAN AND

PRATHIBHA ROHIT 1996. Occurrence of ribbonfish in the Indian EEZ. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* :429-436.

RADHAKRISHNAN, E.V. AND M. VIJAYAKUMARAN 1996. Prospects for spiny lobster culture in India. *Fisheries World*, July 1996 : 11(3): 22-28.

RAJAGOPALAN, M., E. VIVEKANANDAN, S. KRISHNA PILLAI, M. SRINATH AND A. BASTIN FERNANDO 1996. Incidental catch of sea turtles of India. *Mar. Fish. Infor. Serv. T&E Ser.*, 143: 8-17.

RAJE, S.G. 1996. Some observations on the biology of *Nemipterus mesoprion* (Bleeker) from Veraval (Gujarat). *Indian J. Fish.*, 43(2): 163-170.

RAJE, S.G. 1997. On some aspects of biology of the mackerel scad *Decapterus russelli* (Ruppell). *Indian J. Fish.*, 44(1): 97-99.

RAMARAO, K., T. SUBA RAO, K. MAL, K. SUBBARAMAIAH, N. KALIAPERUMAL, S. KALIMUTHU, K. MUNIYANDI, J.R. RAMALINGAM, S. KRISHNA PILLAI AND V.S.K. CHENNUBHOTLA 1996. Distribution of seaweeds off Alantalai-Manapad and Vembar-Nallathanni Tivu in Tamil Nadu. *Phykos*, 35 (1&2): 163-170.

RAO, G. SUDHAKARA, T.V. SUBRAMANIAN, M. RAJAMANI. P.E. SAMPSON MANICKAM AND G. MAHESWARUDU 1995. Population dynamics of *Penaeus* spp. on the east coast of India. *Indian J. Fish.*, 40 : 1-19.

RAO, G. SUDHAKARA 1997. Prawn farming in Andhra Pradesh - A retrospect. *Mar. Fish. Infor. Serv, T&E Ser.*, 146: 1-5.

REGHU, R., K. BALACHANDRAN, N.G. MENON, E. VIVEKANANDAN, S.K. CHAKRABORTY AND P. DEVADOSS 1996. Distribution, abundance and biology of Unicorn cod, *Bregmaceros mcclellandi* in the Deep Scattering Layers of Indian EEZ. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 411-418.

REUBEN, S., K. VIJAYAKUMARAN AND P. ACHAYYA 1996. Growth, maturity, mortality and exploitation of *Ariomma indica* (Day) from Andhra - Orissa coast. *Indian J. Fish.*, 43(1): 39-44.

SAID KOYA, K.P. AND P. KALADHARAN 1997. Trichodesmium bloom and Mortality of *Canthigaster margaritatus* in the Lakshadweep Sea. *Mar. Fish. Infor. Serv. T&E Ser.*, 147: 14 p.

SATHIADHAS, R. AND R. NARAYANAKUMAR 1994. Price policy and fish marketing system in India, *Biology Education*, 11 (4) : 225-241.

SATHIADHAS, R. 1996. Economic evaluation of marine fisheries in India for sustainable production and coastal zone development, NAGA, the *ICLARM Quarterly*, July 1996 : 54-56.

SATHIADHAS, R., R. REGHU AND V.K. SURESH 1996. Economic evaluation of composite culture practices of crab fattening and fish, shrimp farming in Kerala, *Fishing Chimes*. 16 (4): 31-34.

SELVARAJ, G.S.D., M.S. RAJAGOPALAN AND R. ANILKUMAR 1996. Dial variations in temperature, salinity and dissolved oxygen from the neritic waters off Cochin during April (peak summer). *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 75-83.

SELVARAJ, G.S.D. AND V. SRINIVASAN 1996. Some observations on primary production and plankton biomass along the continental shelf and slope off the northeast coast of India during January 1989. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 103-113.

SELVARAJ, G.S.D., K.J. MATHEW AND MOLLY VARGHESE 1996. Diurnal variations in the vertical distribution and abundance of zooplankton in the continental shelf waters off Cochin during April 1991. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 115-125.

SIVAKAMI, S., T.V. SATHYANANDAN AND P.K. SEETHA 1995. On the carangid fishery resources off Cochin with a note on the biology *Decapterus russelli*. *Indian J. Fish.*, 41(3): 33-42.

SIVAKAMI, S. 1996. Fishery and Biology of the carangid fish *Megalapsis cordyla* (Linnaeus) off Cochin. *J. mar. biol. Ass. India,* 37(1&2): 237-248.

SIVAKAMI, S., R. MARICHAMY, P. LIVINGSTON, G. GOPAKUMAR, R. THIAGARAJAN, E. VIVEKANANDAN, KUBER VIDYASAGAR, G.S. DANIEL SELVARAJ, S. MUTHUSAMY, N.G.K. PILLAI AND M. ZAFAR KHAN 1996. Distribution of finfish resources along southeast coast of India in relation to certain environmental parameters. *Proc. Second Workshop Scient. Result. FORV Sagar Sampada* : 315-331.

SIVAKAMI, S., P.N. RADHAKRISHNAN NAIR, A.A. JAYAPRAKASH, MOHAMMAD KASIM, T.M. YOHANNAN, M. SIVADAS, K.P. SAID KOYA AND P.K. SEETHA 1996. Distribution and abundance of carangid resources along the EEZ of India. *Proc. Second Workshop Scient. Resul. FORV Sagar Sampada* : 347-361.

SUKUMARAN, K.K. AND B. NEELAKANTAN 1996. Mortality and stock assessment of two marine portunid crabs, *Portunus (Portunus) sanguinolentus* (Herbst) and *Portunus (Portunus) pelagicus* (Linnaeus) along the southwest coast of India. *Indian J. Fish.*, 43(3): 225-240.

SUKUMARAN, K.K. AND B. NEELAKANTAN 1996. Marine crab fishery of Karnataka. *Seafood Exp. J.*, 27(12): 1-14.

SUKUMARAN, K.K. AND B. NEELAKANTAN 1997. Food and feeding of *Portunus(Portunus) sanguinolentus* (Herbst) and *Portunus (Portunus) pelagicus* (Linnaeus) (Brachyura: Portunidae) along Karnataka coast. *Indian J. Mar. Sci.*, 26(1): 35-38.

SUKUMARAN, K.K. AND B. NEELAKANTAN 1997. Length-weight relationship in two marine portunid crabs, *Portunus (Portunus) sanguinolentus* (Herbst) and *Portunus (Portunus) pelagicus* (Linnaeus) from the Karnataka coast. *Indian J. Mar. Sci.*, 26(1): 39-42.

SUKUMARAN, K.K. AND B. NEELAKANTAN 1997. Sex ratio, fecundity and reproductive potential in two marine portunid crabs, *Portunus (Portunus) sanguinolentus* (Herbst) and *Portunus (Portunus) pelagicus* (Linnaeus) along the Karnataka coast. *Indian J. Mar. Sci.*, 26(1): 43-48.

SUKUMARAN, K.K., B. SHREEDHARA AND Y. MUNIYAPPA 1997. The portunid crab, *Charybdis (Charybdis) feriatus* - an emerging fishery resource of Mangalore coast. *Mar. Fish. Infor. Serv. T&E Ser.*, 146: 5-7.

SYDA RAO, G. AND M. DEVARAJ 1996. Prospects for large scale onshore marine pearl culture along the Indian Coasts. *Mar. Fish. Infor. Serv. T&E Ser.*, 143: 1-7.

SYDA RAO, G. AND K.R. SOMAYAJULU 1996. Resource characteristics of exploited bivalves and gastropods of Kakinada Bay with a note on stock assessment. *Mar. Fish. Infor. Serv. T&E Ser.*, 144: 13-19.

THATAYYA CH. E. 1996. Landing of whale shark *Rhiniodon typus* at the Kakinada coast. *Mar. Fish. Infor. Serv. T&E Ser.*, 143: 27.

THOMAS, P.A. 1996. An appraisal of the biological and biochemical diversity in sponges. *Mar. Fish. Infor. Serv. T&E Ser.*, 142: 1-5.

VASUDEVAPPA, C. AND C. SUSEELAN 1996. Size count and meat recovery relationships in the penaeid prawn *Metapenaeus dobsoni*. *Fishing Chimes*, 15(7): 39-40.

VASUDEVAPPA, C. AND C. SUSEELAN 1996. Maturation and spawning of the penaeid prawn *Metapenaeus dobsoni* (Miers) in brackishwater environment. *Proc. Natl. Symp. on Aquaculture for 2000 AD*, Nov. 1994, Dept. National Resources, Madurai Kamaraj University, Madurai, India: 66-76.

VELAYUDHAN, T.S., A. CHELLAM, S. DHARMARAJ, A.C.C. VICTOR AND H. MOHAMMED KASIM 1996. Comparison of growth and shell attributes of four generation of pearl oyster *Pinctada fucata* (Gould) produced in the hatchery. *Indian J. Fish.*, 43(1) : 69-77.

VERMA, N.K., P.C. THOMAS AND M.K. GEORGE 1996. Biochemical genetic profile of Indian mackerel *Rastrelliger kanagurta* of mud bank and post mud bank periods. *Mar. Fish. Infor. Serv. T&E Ser.*, 142: 9-10.

VIJAYAKUMARAN, K. 1996. Book Review - Stock Assessment in Inland Fisheries. I.G. Cowx (Ed.), Fishing News Books, Osney Mead, Oxford, U.K., 1996. *Fishing Chimes*, 16(6): 20-21.

VIJAYAN, K.K., K.S. MOHAMED AND A.D. DIWAN 1997. Studies on moult staging, moulting duration and moulting behaviour in Indian white shrimp *Penaeus indicus* Milne Edwards (Decapoda : Penaeidae). *J. Aqua. Trop.*, 12(1): 53-64.

VIVEKANANDAN, E. 1996. Madras Fisheries Harbour - A status report for 1995. *Mar. Fish. Infor. Serv. T&E Ser.*, 143: 19-23.

ZACHARIA, P.U., K.S. MOHAMED, C. PURANDHARA, H.S. MAHADEVASWAMY, A.C. GUPTA, D. NAGARAJA AND U.S. BHAT 1996. A bio-economic evaluation of the dual-fleet trawl fishery of Mangalore and Malpe. *Mar. Fish. Infor. Serv. T&E Ser.* 144: 1-12.

MEETINGS, CONFERENCES, SYMPOSIA, WORKSHOPS ATTENDED

Name & Designation	Meeting/Symposium/ Workshop etc.	Date/s
Dr.M.Devaraj Director	Discussion with Deputy Director General (F) for finalization of World Bank National Agricultural Technology Project (NATP) at ICAR Headquarters, New Delhi	22 April 1996
	Second meeting of the Committee on Marine Living Resources, Drugs and Chemicals at Indian Institute of Chemical Technology, Hyderabad	13-14 May 1996
	Finalisation of IX Plan programme document of DOD and to participate in the discussion as a member of the High level Committee for implementing the recommendation of the Johl's Committee report at NAARM, Hyderabad	16-17 May 1996
	Inauguration of Summer Institute on Recent developments in Mariculture of molluscs at Tuticorin	20 May 1996
	Second meeting of Evaluation Committee for Fishery Survey of India at Mumbai	7 June 1996
	Meeting of ICAR Project Screening Committee of the Scientific Panel for Fisheries at New Delhi	2-3 July 1996
	Preliminary meeting on State Fisheries Research Council at Commissionerate of Fisheries, Madras	24 July 1996
	13th Task Force meeting on aquaculture and marine biotechnology of Department of Biotechnology at New Delhi	6-7 August 1996
	Standing Committee on Parliament on Science & Technology, meeting of the Department of Ocean Development at New Delhi	8-9 August 1996
	Symposium on 'Fish genetics and Biodiversity Conservation for sustainable Fisheries development'. National Bureau of Fish Genetic Resources at Lucknow	27 September 1996
	Review meeting of the Perspective Plan of CMFRI at ICAR, New Delhi	11 October 1996
	Scientific colloquium for identifying collaborative projects for the mutual benefit of India and Australia at New Delhi	30 October 1996 to 2 November 1997
	Attended the Fourth Asian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Cochin	24-28 November 1997

Trainees attending the computer training programme organised by the TTC of CMFRI, at Cochin

The CMFRI Stall at the *Pooram* Festival at Trichur

Shri K. Jayaprakash Hegde
Hon'ble Minister for
Fisheries and ports,
Govt of Karnataka
speaking on the occasion
of the opensea mussel
harvest of CMFRI at
Byndoor, Karnataka.

Dr. E. G. Silas former
V.C of KAU and former
Director CMFRI
speaking at the function
of mussel harvest at
Dharmadam

CMFRI stall at the
Food Security
Expo 1996
organised jointly
by Rotary Club
of Madras East
and
M.S. Swaminathan
Research
Foundation
at Madras

Name & Designation	Meeting/Symposium/ Workshop etc.	Date/s
	National Committee meeting on the amendment of CRZ Notification at Thiruvananthapuram	20-21 January 199
	Meeting of task force on Aquaculture and Marine Biotechnology of the Department of Biotechnology at New Delhi	22 January 1997
	Interdisciplinary workshop on Biostatistics to deliver inaugural address on the topic 'Fish stock Assessment' at Manonmanian Sundaranar University	26 March 1997
Dr. V.N. Pillai Head, FEMD	NATP meetings at ICAR, New Delhi	22-24 April 1996
	Workshop on Remote Sensing and its applications at CWRDM, Calicut	23-26 May 1996
	ISRO Working group meeting on OCEANSAT at ISRO HQ, Bangalore	28-30 May 1996
	GOOS meeting at NIO, Goa	18-20 July 1996
	IRS P3 meeting at SAC, Ahmedabad	29 July 1996 to to 2 August 1996
	MARSIS - Validation meetings at CMFRI, Calicut	21-23 August 1996
	Indo-US International Symposium on Remote Sensing at IIT, Bombay	5-10 October 1996
	GOOS/IOCINDIO meetings at NIO, Goa	17-23 November 1996
	Planning Board meeting at Trivandrum	31 December 1996 to 1 January 1997
	MARSIS meetings and discussions at NRSA, Hyderabad	16-21 February 1997
	Board of Examiners meeting at Calicut	27-28 February 1997
Dr. V. Sriramachandra Murty, Head, DFD	Meeting of the Project Management Committee for establishment of oceanarium at Goa, held at Dept. of Ocean Development, New Delhi	10 July 1996
	Review meeting of the Perspective Plan of CMFRI at ICAR, New Delhi	11 October 1996
	Fourth Indian Fisheries Forum; chaired the Technical Session on ornamental fish organised by Asian Fisheries Society, Indian Branch at Cochin	24-28 November 1996
	Nansen International Workshop on integrated coastal ecosystem studies; School of Marine Sciences, CUSAT, Cochin	25-27 February 1997

Name & Designation	Meeting/Symposium/ Workshop etc.	Date/s
Dr.G.Sudhakara Rao Head, CFD	Nansen International Workshop on integrated coastal ecosystem studies; School of Marine Sciences, CUSAT, Cochin	25-27 February 1997
Dr.N.G.K. Pillai Head, PFD	Seminar on shrimp diseases prevention and control — organised by MPEDA, Cochin & ADAK, Kerala	10 April 1996
	Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Cochin	24-28 November 1996
	Nansen International Workshop on Integrated Coastal Ecosystem studies; School of Marine Sciences, CUSAT, Cochin	25-27 February 1997
Dr. K.K.Appukuttan Head, MFD	Seminar on shrimp farming - disease and remedy - organised jointly by MPEDA, ADAK and BFFDA at Cochin and presented a paper	10 April 1996
	Gulf Malayalee meeting organised by Indo-Arab Confederation and Kerala State Inland Fish Farmers Association, at Kollam and gave a talk on possibilities of oyster and mussel farming in Kerala	23 October 1996
	Fourth Indian Fisheries Forum organised by Asian Fisheries Forum, Indian Branch at Cochin	24-28 November 1996
	Inaugurated the Oyster Farming Training organised by the Kerala State Inland Fish Farmers Association, Kollam funded by MPEDA	2 December 1996
	Meeting to discuss and formulate policies for 'Janakeeya Matsyakrishi' organised by Kerala State Government at Trivandrum under the Chairmanship of Hon'ble Minister of Fisheries	4 January 1997
	Gave special lecture on Recent Advances in Molluscan Aquaculture in India at Mangalore	12 February 1997
	Meeting at Kollam organised by Kerala State Fisheries Department on the occasion of inauguration of District level training programme on aquaculture for farmers in connection with 'Janakeeya Matsyakrishi' a scheme launched by the Govt. of Kerala - Presided over the function	28 February 1997
	Meeting at Kollam organised by the Kerala State Inland Fish Farmers Association in connection with inauguration of oyster farming training at Kollam funded by State Small-scale Industries Department - presided over the function	20 March 1997
	Nansen International Workshop on Integrated Coastal Ecosystem Studies; School of Marine Sciences, CUSAT	25-27 February 1997

Name & Designation	Meeting/Symposium/ Workshop etc.	Date/s
Dr.V.K. Pillai Sr. Scientist	Zonal Workshop of KVK/TTC's organised by Dy. Director General (Extn), ICAR at Madurai	30 November 1996 to 2 December 1996
	Seminar on Urban Solid Waste disposal in Cochin organised by the Institution of Engineers (India) Cochin Centre, at Cochin	22 February 1997
	Seminar on 'Integrated Prawn Farming in Pokkali fields' organised by the Department of Fisheries, Govt. of Kerala at Cochin	6 February 1997
	Nansen International Workshop on Integrated Coastal Ecosystem Studies jointly organised by CUSAT, Cochin, Centre for Earth Science Studies, Trivandrum and Nansen Environmental and Remote Sensing Centre, Norway at Cochin	25-27 February 1997
	International symposium on Aquaculture - Environment Interaction organised by Asian Fisheries Society (Indian Forum) at Cochin	27 November 1996
Dr. C. Suseelan Sr. Scientist	Southern Regional Workshop on "Traditional Food Products and Technologies" at Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University) at Coimbatore	31 July 1996
	Fourth Indian Fisheries Forum organised by Asian Fisherie Society, Indian Branch at Cochin	24-28 November 1996
	20th meeting of Academic Council of CIFE (Deemed University) at CIFE, Mumbai	20 September 1996
Dr. Krishna Srinath Sr. Scientist	Attended meeting convened by the Fisheries Minister regarding Janakeeya Matsya Krishi, at Dept. of Fisheries, Trivandrum	4 January 1997
	Delivered a lecture on experiments and experiences in rural development officials, Institute of Management of Government at Cochin	30 January 1997
	Seminar on prawn farming in pokkali fields organised by the Kerala State Fisheries Department at Cochin	6 February 1997
	The All India Radio Rural Programme Advisory Committee Meeting at All India Radio, Trichur	4 March 1997
Dr. N.Sridhar Scientist (SS)	The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Kochi	24-28 November 1996
Dr.(Mrs) Manpal Sridhar, Scientist(SS)	The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Kochi	24-28 November 1996
Dr.P.Kaladharan Scientist(SS)	The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Kochi	24-28 November 1996

Name & Designation	Meeting/Symposium/ Workshop etc.	Date/s
Shri A.N.Mohanan Technical Officer	Gave a talk on "Training facilities to impart scientific prawn farming" in Malayalam and broadcast over all India Radio, Trichur	23 March 1997
Dr.V.S.K. Chennubhotla Principal Scientist	The expert meeting on "Introduction of exotic aquatic species in Indian waters" at NBFGR, Lucknow	15 April 1996
	Delivered a lecture on "Seaweed culture" for the benefit of bank officers at SBIRD, Hyderabad	. 25 June 1996
	The meeting organised by the Institute of Development and Planning Studies on "Coastal Aquaculture in Visakhapatnam District" at Visakhapatnam	23 August 1996
	The meeting organised by the Andhra Pradesh State Fisheries Department on "Preventive measures on jelly fish attack" at Visakha-patnam	30 September 1996
	Delivered a lecture on "Seaweed culture" at a refresher course programme of the Academic Staff College, Andhra University, Visakhapatnam	13 November 1996
	Gave a talk on "Mariculture Potentials of Andhra Pradesh coast" All India Radio, Visakhapatnam	26 November 1996
	Gave a lecture on "Aquaculture and its econo-mics" at the workshop for officers of Anticorrup-tion Bureau at Visakhapatnam	10 December 1996
	Chaired the session on "Seaweed Culture Tech-nology" in connection with the Aquaculture Week organised by the Aquaculture Foundation of India at Mandapam Camp	5 February 1997
	Chaired the session on Marine Algae at the National Symposium on Marine Algae and delivered a special invitation lecture at Andhra University, Visakhapatnam	. 6 March 1997
	The National Symposium on "Coastal Zone Management of Andhra Pradesh" organised by the Indian Meteorological Society at visakhapatnam and presented a paper	25-26 March 1997
Dr. V.S.K. Chennubhotla, Principal Scientist & Dr.G.Syda Rao, Sr. Scientist	Delivered lectures on "Seaweed culture" and "Pearl oyster culture" respectively, at an entre-preneur meeting organised by the State Bank Institute of Rural Development at Visakhapatnam	25 May 1996
Dr. V.S.K. Chennubhotla, Principal Scientist & Dr. G.Syda Rao, Sr. Scientist	The counselling session for Seaweed culture and onshore pearl culture respectively in connection with the Aquaculture Week organised by the Aquaculture Foundation of India at Vijayawada	26 January 1997

Name & Designation	Meeting/Symposium/ Workshop etc.	Date/s
Dr. V.S.K. Chennubhotla, Dr. G.Syda Rao, Shri K.M.S.Ameer Hamsa, Shri K. Vijayakumaran and Ms. Shoba Viswanathan	The inaugural session of the Workshop on "Wood for Marine Structure and Craft" organised by the Institute of Wood Science and Technology, Bangalore at Visakhapatnam	10 February 1997
Dr. V.S.K. Chennubhotla, Principal Scientist and Dr. G. Syda Rao, Sr. Scientist	The inaugural function of the "International Seminar on Mangrove Ecosystems" organised by the Dept. of Zoology, Andhra University at Hotel Taj Residency, Visakhapatnam	26 March 1997
Dr. K. Satyanarayana Rao, Principal Scientist	Gave a lecture on "Molluscan Culture" at a refresher course programme of the Academic Staff College, Andhra University at Visakhapatnam	15 November 1996
Shri K. Vijayakumaran, Scientist (SS)	Delivered a lecture on "Turtle conservation and the US embargo on shrimp imports" at the meeting of the Forum of Fisheries Professionals at Visakhapatnam	12 June 1996
	Participated as a panel member in thel Discussion on Deep-Sea Fishing Policy organised by the Forum of Fisheries Professionals at Visakhapatnam	17 July 1996
	Participated in the Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch and presented a paper.	24-28 November 1997
Dr.K.K.Sukumaran, Sr. Scientist	The Fourth Indian Fisheries Forum organised by Asian Fisheries, Society, Indian Branch at Kochi	24-28 November 1996
Dr. C. Muthiah, Sr. Scientist & Dr.P.K.Krishnakumar, Scientist (SS)	The National Seminar on Coastal Zone Environment Management : An appraisal of the Contemporary Research and Development organised by the Mangalore University, Mangalore and presented a paper .	12-14 February 1997
Shri M. Sivadas Scientist (SS)	The Summer Institute on molluscan mariculture organised by CMFRI, at Tuticorin.	May-June 1996
	The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch, at Kochi	24-28 November 1996
Dr. A.K.V. Nasser Scientist	The National Seminar on Recent Advances in Biological Oceanography at NIO, Goa	29 May 1996
	The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch, at Kochi	24-28 November 1996
Shri P.P. Manojkumar Scientist	Consultative Group Meeting of FSI at Porbandar	29 May 1996

Name & Designation	Meeting/Symposium/ Workshop etc.	Date/s
Dr.B.Manojkumar, Shri P.P. Manojkumar, and Shri A.P. Dinesh Babu, Scientists	Workshop on Fishery Resources Potential and Scope for Deepsea fishing off Gujarat at Fisheries Survey of India, Porbander, Veraval	23 October 1996
Dr. K.K. Joshi and Shri A.P. Dinesh Babu, Scientists	Ninth Five Year Plan meeting of Gujarat State Fisheries at Gandhinagar	4 October 1996
Dr. V.V. Singh, Scientist (SS)	Consultative Group meeting at FSI, Bombay	15 May 1996
	National Seminar on Fisheries Education at CIFE, Bombay	23-24 May 1996
	National Seminar on Recent Advances in Biological Oceanography at NIO, Goa	29-31 May 1996
	Pre-Vocational Workshop for Agricultural Courses (Aquaculture) at Central Institute of Vocational Education, Bhopal	16 June 1996 to 20 September 1996
Dr.P.V.Sreenivasan and Shri R.Sarvesan Sr.Scientists	Summer Institute on Recent Advances in Molluscan Culture as Faculty Members at Tuticorin	May 1996
Dr.R. Paul Raj and Dr. E.Vivekanandan, Sr. Scientists	Meeting of the *Adhoc* Board of Studies in M.Sc. Aquacutlure at the University of Madras at Madras	25 July 1996
Dr. R.Paul Raj Sr. Scientist	National Seminar on Corporate and Industry Competitiveness - Sector : Marine Products Organised by the Administrative Staff College of India, Hyderabad at Connemara Hotel, Madras	26 July 1996 |
	Commemoration Day programme relating to the JRD Tata Biotechnology Centre organised by M.S.Swaminathan Research Foundation at Madras	29 July 1996
	Meeting on the coastal zone management plan for Tamil Nadu organised by the Town and Country Planning Dept., Govt. of Tamil Nadu at Madras	January 1997
	National Aquacutlure Week and presented a paper in the Workshop sponsored by Dept. of Biotechnology, Govt. of India at Vijayawada	24-26 January 1997
	National Aquaculture Week at Madras and presented a paper	31 January 1997 to 1 February 1997
	Seminar on "Ways and Means of operationalizing fisheries management at the Bay of Bengal Programme of FAO at Madras	18 February 1997
Dr.R.Paul Raj and Dr. M. Rajagopalan Sr. Scientists	Workshop on 'Biodiversity, Conservation, Prioritisation programme - Coastal Areas at the M.S. Swaminathan Research Foundation at Madras	18 November 1996

Name & Designation	Meeting/Symposium/ Workshop etc.	Date/s
	Workshop on National Agriculture Technology Project : Planning (NATP) at TNUVAS, Madras	29-30 November 1996
Dr.M.Rajagopalan, Sr. Scientist	National Seminar on livestock industry for self gainful employment organised by ISAPM at TNUVAS, Madras	September 1996
	Northern Indian Ocean Sea Turtle Workshop at Bhubaneswar	13-18 January 1997
Dr. P. Nammalwar Sr. Scientist	Regional Seminar on Conservation of Coral Reefs in Gulf of Mannar region at Tuticorin	21-22 Sept. 1996
	National Aquaculture Week and presented papers at Madras & Tuticorin	January and February 1997
	International Workshop cum Seminar on Bioethics and presented a paper organised by the Dept. of Zoology, University of Madras at Madras	16-19 January 1997
Dr. M.Vijayakumaran, Sr. Scientist	Fifth International Conference and Workshop on Lobster Biology and Management and made 3 oral presentations at Queenstown, New Zealand	9-14.February 1997
Shri K.Dorairaj Principal Scientist	Organisation Committee Meeting on National Aquaculture Week at Aquaculture Foundation of India at Madras	5 November 1996
	Workshop on Coastal Regulation Zone of Tamil Nadu Coast at Anna University, Madras	29 January 1997
	Meeting on Working Group of Fisheries for the formulation of IX Five Year Plan at State Planning Commission at Madras	30 January 1997
	Seminars of the National Aquaculture Week conducted by the Aquaculture Foundation of of India and presented papers at Vijayawada and Tuticorin	Janauary and February 1997
Shri K.Dorairaj Principal Scientist and Dr. P. Nammalwar Sr. Scientist	Participated in the meeting on "Development of GIS Based Information System for critical habitats in the coastal and marine areas in India" sponsored by Dept. of Ocean Development, New Delhi at Institute of Ocean Management, Madras	30 December 1996
Dr. E.Vivekanandan and Dr.M.Rajagopalan, Sr. Scientists	Participated in the National Aquaculture Week at Madras, Mandapam Camp & Tuticorin	January & February 1997
Shri R.Marichamy Principal Scientist	Delivered a guest lecture at St.Joseph's College on Resources of Marine Cultivable Organisms at Trichy	February 1997
Dr. D.B. James Sr. Scientist	Gave felicitation address at the Inauguration of B.Sc. Zoology with industrial fish and fisheries vocational course at Kamaraj College, Tuticorin	11 September 1996

Name & Designation	Meeting/Symposium/ Workshop etc.	Date/s
	Delivered inaugural address at Regional Seminar on Conservation of Coral Reefs in the Gulf of Mannar, organised by the P.G. Department of Zoology at Kamaraj College,	20 September 1996
	Tuticorin Seminar on Sustainable environment organised by Madurai Kamaraj University, Madurai at Tuticorin	28 September 1996
	Gave guest lecture on World Food Day Theme 'Fighting Hunger and Malnutrition' organised by Fisheries College & Research Institute at Tuticorin	16 October 1996
	The Fourth Indian Fisheries Forum School of Marine Sciences, CUSAT, Cochin and presented a paper	24-28 November 1996
	The National Conference on Aquaculture organised by the Centre of Aquaculture Research and Extension, Department of Zoology, St.Xavier's College and presented a paper at Palalyamkottai	18 December 1996
	The National Aquaculture Week workshop organised by the Aquaculture Foundation of India at Tuticorin	7 February 1997
Shri S.Dharmaraj Sr. Scientist	Served as a Faculty Member in the Summer Institute on Recent Developments in mariculture of molluscs at Tuticorin	20 May 1996 to 8 June 1996
	Delivered lecture on Culture of commercially important molluscs in the Seminar conducted by St. Mary's College at Tuticorin	24 February 1997
	The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian branch at Cochin and presented two research papers	24-28 November 1996
	Participated and delivered lecture on Marine Pearl culture hatchery at the National Aquaculture Week at Tuticorin	February 1997
Shri S.Dharmaraj and Shri A. Chellam Sr.Scientists	14th Task Force Meeting of DBT at New Delhi	22 January 1997
Shri M. Feroz Khan, Scientist	Delivered a talk on "What Oceanic Wealth" and broadcast through All India Radio, Calicut	5 July 1996
Shri G.Subbaraju Principal Scientist	Workshop on "Problems and prospects in implementation of post harvest activities at Kakinada	16 October 1996
Dr.P.A. Thomas and Shri G.P.K. Achary, Senior Scientists	Meeting of the Task Force on Fisheries Research, Education and Training; State Planning Board, Govt. of Kerala for formulating 9th Plan proposals at Trivandrum	15 November 1996

Name & Designation	Meeting/Symposium/ Workshop etc.	Date/s
	Meeting of the Task Force on Aquaculture; State Planning Board, Govt. of Kerala for formulating 9th Plan proposals at Trivandrum	18 November 1996
	Meeting on Programme for Janakeeya Matsya Krishi, sponsored by Govt. of Kerala, Trivandrum	4 January 1997
Dr. P.A.Thomas, Shri K.Prabhakaran Nair, Senior Scientists and Shri K.K.Philipose, Scientist (SS)	Second Executive Committee of the Centre for Development and Transfer of Mariculture Technologies (CDTMT), Vizhinjam, Trivandrum	24 December 1996
Shri K.K.Philipose Scientist (SS)	The Executive Committee Meeting of Kerala Fisheries Society at Trivandrum	27 March 1996
	Inaugural function of the Lobster Fattening Programme started by M/s A.R. Rahman at Vizhinjam	28 June 1996
	Meeting on Artificial Reef Programme, organised by Secretary, Dept. of Fisheries, Govt. of Kerala, Trivandrum	19 August 1996
	Workshop on "Coastal Zone Management" at Trivandrum	12 September 1996
	Gave a talk on "Role of Poovar Artificial Reefs in the Regeneration of Depleted Marine Resources" at Loyola Social Service, Poovar	31 January 1997
	Policy Planning Meeting on Artificial Reefs at Loyola Social Service, Poovar	31 January 1997
	Executive Committee Meeting of the Kerala Fisheries Society at Trivandrum	1 March 1997
G. Maheswarudu Scientist	National Aquaculture week 1997 organised by Aquaculture Foundation of India at Mandapam	February 1997
Josileen Jose Scientist	National Aquaculture week 1997 organised by Aquaculture Foundation of India at Mandapam	February 1997

VISITORS

COCHIN

Shri T.K. Ramakrishnan, Hon'ble Minister for Fisheries & Culture, Govt. of Kerala

Shri G.S. Sahni, IAS, Joint Secretary, Department of Agricultural Research & Education & Secretary, ICAR, New Delhi

Shri Bharat Bhushan, IAS, Director, Ministry of Commerce

Dr. N.K. Tyagi, Director, C.S.S.R.I., Karnal

Dr. M. Aslam, Director, DARE, New Delhi

Dr. K.V. Devaraj, former Vice Chancellor, UAS, Bangalore

Dr. Hassani Kongkeo, Co-ordinator, Network of Aquaculture Centres in Asia Pacific, Bangkok

Dr. M.V. Gupta, Director, International Relations, ICLARM, Manila, Philippines

Dr. Emmanuel O. ITA, Asst. Director, National Institute for Freshwater Fisheries Research, Nigeria

Dr. Agnes M. Ajaria, Asst. Director (Extension), National Institute for Oceanography and Marine Research, Nigeria

Dr. Bernard Ezenwa, Asst. Director (Aquaculture), National Institute for Oceanography and Marine Research, Nigeria

Dr. M. Ather Ali, Biol. Udem. CP 6128, Montreal, Canada

Dr. Meryl J. Williams, Director General, International Center for Living Aquatic Resources Management, Philippines

Dr. Martin Kumar, Sr. Scientist, South Australia Research and Development Institute, South Australia

Shri C.K. Neelakanta Raj, Secretary, Dept. of Animal Husbandry and Fisheries, Govt. of Karnataka, Bangalore

Shri S.K. Mathur, Ambassador of India to Federal Republic of Yugoslavia

Dr. Purwito Marto Subroto, Fishery Resources Officer, FAO, Rome

Dr. H. Hasserth Zadick Sakafi, Director, Oman Fisheries Research Centre

Dr. S.C. Pathak, Deputy General Manager, NABARD, Bombay

Dr. Bernard Robert Smith, Co-ordinator, ACIAR, Australia

Dr. K. Alagarswami, Director, CIBA, Madras

Dr. S. Ayyappan, Director, CIFA, Bhubaneswar

Dr. Y.S. Yadava, Fisheries Development Commissioner, Govt. of India, New Delhi

Dr. P.V. Dehadrai, Deputy Director General (Fisheries), ICAR, New Delhi

Dr. R.S. Paroda, Director General, ICAR and Secretary, DARE, New Delhi

Dr. A.K. Bandyopadhyay, Director, CARI, Port Blair

VERAVAL

Shri P.K. Valera, Commissioner of Fisheries, Govt. of Gujarat, Gandhinagar

Shri N.G. Akolkar, Lecturer, College of Fisheries, Veraval

Shri V.S. Somavanshi, Director General, Fishery Survey of India, Mumbai

Mrs. Poonam Prakash, Asstt. Professor, College of Fisheries, Dhouli, Bihar

Shri Jayadeva Prasad, Operations Manager, Hindustan Lever Ltd., Chorwad, Taluka, Veraval

Dr. Srinivas Jahageerlan, Scientist, CIFE, Mumbai

Dr. S. Shanmugham Principal Scientist, NAARM, Hyderabad

Ms. Fahmeeda Hanfee, Sr. Project Officer, W.W.F., New Delhi

Shri H.N. Upadhayay, Dy. Director (Statistics), Govt. of Gujarat, Gandhinar

BOMBAY

Dr. Kamarul Hassan and other professors along with group of students from B.N.N. College, Bhiwandi, Dist: Thane

Dr. A.D. Diwan, Dr. Moniuddin Iftekar, Scientists from CIFE, Mumbai

Dr. Mathili Rao and Dr. Snehalata A. Gaikwad, Reader and Research Guide in Zoology from Ramnarain Ruia College, Mutunga, Mumbai

Dr. K.A. Dongre, Dy. Director (Fisheries), Maharashtra State, Mumbai alongwith 12 Asstt. Fisheries Development Officers of the Fisheries Department

MANGALORE

Shri V.V. Sathypalan, Malabar Aqua Forum, Forum Manager, Manjeshwar

Shri Sreekanta Sarkar, College of Fisheries, Mangalore

Dr. V. Hariharan, Professor & Head of Dept., Fishery Oceanography, College of Fisheries, Mangalore

VIZHINJAM

Shri P. Arunkumar, V.I.P. Export, Thiruvananthapuram

Shri K. Reji Mathew, MPEDA, Vallarpadom, Kochi

Dr. G. Crowther, Dr. R. Wright and Dr. M. Joseph, Perth, Australia

Shri B. Afzal, Govt. V.H.S.S., Poovar

Dr. K. Kathiresan and Dr. K. Patterson, Annamalai University, Porto Novo

Dr. K. Larsen, Esperas, Norway

Dr. S. Jones, Director, Polio Home, Thiruvananthapuram

Dr. Meryl J. Williams, ICLARM, Philippines

Dr. M.V. Gupta, ICLARM, Philippines

Dr. Martin Kumar, SARDI. Aquatic Sciences, South Australia

Shri G.H. Manikfan, Director of Fisheries, Lakshadweep

Shri Eapan Zakariah, Vidyanagar, Kochi

Dr. V.A. Vijayan and Group of students, Dept. of Zoology, University of Mysore

Shri K.K. Bajpai, Secretary, ASRB, New Delhi

Dr. P.V. Dehadrai, DDG (Fy), ICAR, New Delhi

Dr. Y.S. Chauhan, Sr. Scientist, NIO, Goa

Shri S.K. Mathur, Deputy Secretary, Ministry of Environment, New Delhi

Dr. P.P. Kaimal, Director, SALS, M.G. University, Pathanamthitta

Dr. P.S. Parameswaran, Scientist, NIO, Goa

Dr. B. Victor, Dept. of Zoology, St. Xavier's College, Palayamkottai·

Dr. G. Sivaleela, ZSI, Port Blair

Dr. A.G. Ponniah, Director, NBFGR, Lucknow

Prof. D. Venkata Rao and Party, Dept. of Pharmaceutical Sciences, Andhra University, Visakhapatnam

Shri Ignacious Dominic and Shri P. Arunkumar, International Exports, Madurai

TUTICORIN

Dr. M.S. Swaminathan, Chairman, M.S. Swaminathan Research Foundation, Taramani, Madras

Rev. Canon Ken Peters, The Missions to Seamen, London, U.K.

Rev. Jason S. Dharmaraj, CSI Bishop in Tirunelveli, Tirunelveli

Shri K.K. Bajpai, Secretary, ASRB, New Delhi

Trainees from Staff Training Institute, Aquaculture Trainees Tamil Nadu Fisheries Dept., Tuticorin

Dr. R.P. Burman, Zoological Survey of India, Calcutta

Shri S.K. Singh, Dy. Commandant, Coast Guard, Tuticorin

Mr. William A. Cabill, Fort Selonga Farm, New York

Shri T.S. Sruthigirinathan, Audit Officer, AG's Office, Madras

KAKINADA

Shri N. Jaggaraju, Joint Director of Fisheries, A.P.

Smt. J. Suryakumari with students of A.M.G. College, Chilakaluripet

Shri J.V.S. Prasad, District Collector, East Godavari District, A.P.

Shri Bhavanisankar, Additional Director of Fisheries, A.P.

Shri M. Rajitha & students from College of Fishery Science Nellore (A.P.)

Shri Hans Andersen, Director, H. Andersen Consultancy, Switzerland

Shri Hans A. Fonnesbech, Atlas Industries A/S, Denmark

Shri O.P. Srivastava, Director, East Coast Boat Builders and Engineers Ltd., New Delhi

VISAKHAPATNAM

Mr. Ansen Ward, Fishery Technologist and Ms. Victoria Papadopulos, Senior Economic Research Officer, National Resource Institute, Chatham (Kent), U.K.

Dr. M. Sakthivel, President, Aquaculture Foundation of India, Madras

Shri G.S. Sahni, IAS, Secretary, ICAR and Joint Secretary, DARE, Ministry of Agriculture, Govt. of India

Dr. P.S.R. Anjaneyalu, Reader, Nagarjuna University with M.Sc. Aquaculture students

Dr. K. Radhakrishna, Former, ADG, ICAR

Shri O.P. Srivastava, Director, East Coast Boat Builders and Engineering Ltd., New Delhi; Mr. Hans Andersen, Director, H. Andersen Consultancy, Denmark and Mr. Hans Fonnesbeck, ATLAS, Denmark

CMFRI STAFF LIST AS ON 31.3.1997

(Not a gradation list)

Dr. M. Devaraj
Director

DIVISION WISE LIST OF SCIENTISTS / TECHNICAL STAFF

1. FISHERY ENVIRONMENT AND MANAGEMENT DIVISION

SCIENTIFIC

Dr.	V. Narayana Pillai -Head of Division	
Dr.	V.S.K. Chennubhotla	PS
Shri	G. Subbaraju	PS
Dr.	C.S.G. Pillai	PS
Dr.	P.A. Thomas	Sr. Sci.
Dr.	V. Kunjukrishna Pillai	Sr. Sci.
Dr.	C.P. Gopinathan	Sr. Sci.
Dr.	K.J. Mathew	Sr. Sci.
Dr.	K. Rengarajan	Sr. Sci.
Dr.	N. Kaliaperumal	Sr. Sci.
Dr.	M. Rajagopalan	Sr. Sci.
Dr.	(Mrs.) V. Chandrika	Sr. Sci.
Shri	S. Muthusamy	Sr. Sci.
Shri	S. Krishna Pillai	Sr. Sci.
Shri	R.N. Misra	Sr. Sci.
Shri	G.S. Daniel Selvaraj	Sr. Sci.
Shri	Pon Siraimeetan	Sr. Sci.
Smt.	Rany Mary George	Sr. Sci.
Shri	K.G. Girijavallabhan	Sr. Sci.
Smt.	T.S. Naomi	Sci.(SS)
Dr.	P. Kaladharan	Sci.(SS)
Dr.	P.K. Krishnakumar	Sci.(SS)
Smt.	Molly Varghese	Sci.(SS)
Dr.	Veerendra Veer Singh,	Sci.(SS)
Smt.	Reeta Jayasankar	Sci.(SS)
Shri	K. Vijayakumaran	Sci.(SS)
Smt.	S. Jasmine	Sci.(SS)
Miss	Asha	Sci.
Shri	Gulshad Mohamed	Sci.

TECHNICAL

Shri	M. Ayyappan Pillai	TO(T-5)
Shri	V.K. Balachandran	TO (T-5)
Smt.	K.S. Leelabhai	TO(T-5)
Smt.	Geetha Antony	TO(T-5)
Shri	R. Vasanthakumar	TO(T-5)
Shri	A. Nandakumar	TO (T-6)
Shri	N. Palaniswamy	STA (T-4)
Smt.	K.K. Valsala	TA(T-II-3)
Shri	L.R. Khambadkar	TA (T-II-3)
Shri	K. Solaman	JTA T-2
Smt.	P.M. Geetha	Museum Asstt. T-2
Shri	V.A. Kunhikoya	TA (T-II-3)
Shri	A. Anasukoya	FA T-1
Shri	S. Kalimuthu	TO T-5
Shri	C. Kasinathan	TO T-5
Dr.	K. Muniyandi	STA T-4
Shri	J.R. Ramalingam	TA T-II-3
Shri	K. Diwakar,	TA T-II-3
Shri	A. Palanichamy	FA T-1
Shri	L. Jayasankaran	TA T-II-3
Shri	A. Ahmed Kamal Basha	TA T-II-3
Shri	J.X. Rodrigo	STA T-4
Shri	M. Selvaraj	TA T-II-3
Shri	S. Rajapackiam	TA T-II-3
Shri	S. Natarajan	TO T-8
Shri	K. Chittibabu	STA T-4
Shri	B.S. Ramachandrudu	TO T-8
Shri	Vasam Shetty Abbulu	TO T-8
Shri	G. Subramanya Bhat	TA T-II-3
Shri	N.P. Kunhikrishnan	TO T-8
Shri	K.P. Viswanathan	TA T-II-3
Smt.	P. Swarnalatha	TA T-I-3
Shri	M.P. Sivadasan	TA T-I-3
Shri	C. Chandran	FA T-1
Shri	R. Anilkumar	FA T-1
Shri	Sujit. S.K.	FA T-1
Shri	Narayan G. Vaidya	JTA T-2

2. MOLLUSCAN FISHERIES DIVISION

SCIENTIFIC

Dr.	K.K. Appukuttan,	Head of Division
Dr.	K. Sathyanarayana Rao,	PS

Dr.	K.A. Narasimham	PS
Dr.	P.S. Kuriakose	PS
Dr.	A.C.C. Victor	Sr. Sci.
Dr.	Kuber Vidyasagar	Sr. Sci.
Dr.	G. Syda Rao	Sr. Sci.
Dr.	P.V. Sreenivasan	Sr. Sci.
Dr.	A.P. Lipton	Sr. Sci.
Dr.	N. Ramachandran	Sr. Sci.
Shri	D. Sivalingam	Sr. Sci.
Shri	P. Natarajan	Sr. Sci.
Shri	R. Sarvesan	Sr. Sci.
Shri	A. Chellam	Sr. Sci.
Shri	P. Muthiah	Sr. Sci.
Shri	G.P.K. Achari	Sr. Sci.
Shri	K. Prabhakaran Nair	Sr. Sci.
Shri	K. Ramadoss	Sr. Sci.
Shri	S. Dharmaraj	Sr. Sci.
Shri	M.M. Meiyyappan	Sr. Sci.
Shri	T.S. Velayudhan	Sr. Sci.
Smt.	V. Kripa	Sci.(SS)
Dr.	K. Sunilkumar Mohamed	Sci.(SS)
Shri	P.K. Asokan	Sci.(SS)
Smt.	Rani Palaniswamy	Sci.(SS)
Dr.	P.Laxmi Latha	Sci.
Shri	I. Jagadis	Sci.
Miss	Shoji Joseph	Sci.
Shri	Anil. M.K.	Sci.
Dr.	Krupesha Sharma	Sci.
Miss	Sujitha Thomas	Sci.
Shri	Boby Ignatius	Sci.
Smt.	Geetha Rani V. Mani	Sci.

TECHNICAL

Shri	N.P. Ramachandran	FA T-1
Shri	P.S. Alloycious	FA T-1
Shri	K. Jayabalan	JTA T-2
Shri	M. Rajkumar	FA T-1
Miss	G. Chitra	FA T-1
Dr.	R. Thangavelu	STA T-4
Shri	A. Deivendra Gandhi	STA T-4
Shri	G. Sreenivasan	TA T-II-3
Shri	P. Poovannan	TA T-II-3
Shri	C.T. Rajan	TO T-5
Shri	A.A.P. Mudaliar	TO T-5
Smt.	C.P. Suja	TA T-II-3
Shri	K. Srinivasan	TA T-II-3
Shri	A. Dasman Fernando, Skin Diver	T-I-3
Shri	F. Soosai V. Rayan,	-do-
Shri	N. Jesuraj,	-do-
Shri	P. Muthukrishnan	-do-
Shri	Sekar V. Rayer	-do-
Shri	K. Shanmughasundaram	JTA T-2
Shri	S.M. Sathakathullah	JTA T-2
Shri	R. Athipandian	JTA T-2
Shri	J. Padmanathan	FA T-1
Shri	U. Jeyaram	FA T-1
Shri	P. Jaiganesh	FA T-1
Shri	M. Prasada Rao	TA T-I-3
Shri	K. Ramasomayajulu	STA T-4
Shri	P. Achayya	JTA T-2
Shri	P. Villan	FA T-1
Shri	D. Nagaraja	TA T-II-3
Shri	G.D. Nataraja	FA T-1
Shri	Maruti S. Naik	TA T-I-3
Shri	V.G. Surendranathan	TA T-I-3
Shri	K. Ramakrishnan Nair,	TO T-5
Mrs.	P. Sreelatha	TO T-5
Shri	Joseph Andrews	STA T-4
Shri	K.T. Thomas	TA T-II-3

3. DEMERSAL FISHERIES DIVISION

SCIENTIFIC

Dr.	V. Sriramachandra Murty,	Head of Division
Dr.	P. Bensam	PS
Shri	R. Marichamy	PS
Dr.	P. Devadoss	Sr. Sci.
Dr.	P. Nammalwar	Sr. Sci.
Dr.	(Mrs.) S. Sivakami	Sr. Sci.
Dr.	S. Lazarus	Sr. Sci. (on deputation)
Dr.	E. Vivekanandan	Sr. Sci.
Dr.	S.K. Chakraborty	Sr. Sci.
Shri	V.S. Rengaswamy	Sr. Sci.
Shri	G. Mohanraj	Sr. Sci.
Shri	K.M.S. Ameer Hamsa	Sr. Sci.
Shri	K.V. Somasekharan Nair	Sr. Sci.
Shri	P. Livingston	Sr. Sci.
Shri	V. Gandhi	Sr. Sci.
Shri	A. Raju	Sr. Sci.
Smt.	Grace Mathew	Sr. Sci.
Shri	S.G. Raje	Sci.(SS)
Shri	P.U. Zachariah	Sci.(SS)
Shri	M. Feroz Khan	Sci.(SS)
Dr.	K.K. Joshi	Sci.
Shri	P.P. Manoj Kumar	Sci.
Smt.	Rekha J. Nair	Sci.

TECHNICAL

Shri	K. Balachandran	STA T-4
Shri	J. Narayanaswamy	TA T-II-3
Shri	K.M. Venugopalan	JTA T-2
Smt	P.K. Seetha	JTA T-2
Shri	M. Badrudeen	TO T-5
Shri	S. Palanichamy	STA T-4
Shri	S. Mohan	TA T-II-3
Shri	N. Ramamoorthi, Museum	Asst. T-2
Shri	S.K. Balakumar	TO T-5
Shri	P. Ramadoss	TO T-5
Shri	D. Soundararajan	TA T-II-3
Shri	C.V. Seshagiri Rao	TO T-5
Shri	K. Narayana Rao	TA T-I-3
Shri	P. Ramalingam	TO T-5
Shri	M. Shriram	TO T-5
Shri	B.B. Chawan	TA T-II-3
Shri	Thakurdas	FA T-1
Shri	H.S.Mahadevaswamy	JTA T-2
Shri	V.M. Dhareswar	JTA T-2
Shri	K. Nandakumar	TO t-5
Shri	S.G. Vincent	TO T-5
Mrs.	T.A. Omana	TA T-I-3

4. PELAGIC FISHERIES DIVISION

SCIENTIFIC

Dr.	N.G.K. Pillai,	Head of Division
Dr.	P. Parameswaran Pillai,	PS
Shri	K. Dorairaj	PS
Dr.	Alexander Kurian	Sr. Sci.
Dr.	P.N. Radhakrishnan Nair,	Sr. Sci.
Dr.	H. Mohamed Kasim	Sr. Sci.
Shri	T.M. Yohannan	Sr. Sci.
Dr.	C. Muthiah	Sr. Sci.
Shri	A.A. Jayaprakash	Sr. Sci.
Shri	G. Gopakumar	Sr. Sci.
Shri	R. Thiagarajan	Sr. Sci.
Shri	Mohamed Zafar Khan,	Sr. Sci.
Shri	M. Sivadas	Sci.(SS)
Smt.	Pratibha Rohit	Sci.(SS)
Shri	K.P.Said Koya	Sci.(SS)
Dr.	A.K.V. Nasser	Sci.
Miss	Preetha.K	Sci.
Shri	B. Manoj Kumar	Sci.
Shri	E.M. Abdussamad	Sci.
Miss	U. Ganga	Sci.

TECHNICAL

Shri	M.N. Kesavan Elayathu	TA T-I-3
Shri	V.R. Arunachalam	JTA T-2
Shri	D. Prakasan	FA T-1
Smt.	K.V. Rema	FA T-1
Shri	A. Shanmughavel	FA T-1
Shri	C. Manimaran	TA t-I-3
Shri	T.S. Balasubramanian	TO T-5
Shri	G. Arumugham	TA T-I-3
Shri	M.V. Somaraju	TO T-5
Shri	M.S. Sumithrudu	JTA T-2
Shri	V. Mohana Rao	FA T-1
Shri	J.D. Sarang,	TA T-I-3
Shri	H.K. dhokia,	FA T-1
Shri	M.S. Zala,	TA T-I-3
Smt.	Alli C. Gupta	TA T-II-3
Smt.	Uma. S. Bhat	TA T-II-3
Shri	S. Kemparaju	TA T-II-3
Shri	G. Sampathkumar	FA T-1
Shri	N. Chennappa Gowda	TA T-I-3
Shri	K.K. Balasubramanian	TO T-5
Smt.	V.K. Janaki	TA T-I-3
Shri	M.M. Bhaskaran	JTA T-2
Shri	A.K. Velayudhan	TA T-I-3

5. CRUSTACEAN FISHERIES DIVISION

SCIENTIFIC

Dr.	G. Sudhakara Rao,	Head of Division
Dr.	N. Neelakanta Pillai	Sr. Sci.
Dr.	D.B. James	Sr. Sci.
Dr.	C. Suseelan	Sr. Sci.
Dr.	E.V. Radhakrishnan	Sr. Sci.
Dr.	V.S. Kakathi	Sr. Sci.
Dr.	M. Rajamani	Sr. Sci.
Dr.	(Mrs.) S. Lalithadevi	Sr. Sci.
Dr.	V.D. Deshmukh	Sr. Sci.
Dr.	V. Thangaraj Subramanian	Sr. Sci.
Shri	G. Nandakumar	Sr. Sci.
Dr.	(Mrs.) Mary K. Manissery	Sr. Sci.
Dr.	K.K. Sukumaran	Sr. Sci.
Shri	K.R. Manmadan Nair	Sr. Sci.
Shri	K.N. Rajan	Sr. Sci.
Shri	P.E. Sampson Manickam	Sr. Sci.
Dr.	A.Laxminarayana	Sr. Sci.
Shri	M. Aravindakshan	Sci.(SS)
Shri	K.K. Philipose	Sci.(SS)
Smt.	P.T. Sarada	Sci.(SS)

Dr.	G. Maheswarudu	Sci.(SS)
Miss	K.N. Saleela	Sci.
Smt.	Josileen Jose,	Sci.
Shri	A.P.Dinesh Babu	Sci.
Shri	Joe K. Kizhakudan	Sci.
Miss	Lakshmi Pillai	Sci.
Miss	Sobha Viswanathan	Sci.
Smt.	Miriam Paul	Sci.

TECHNICAL

Shri	K.N. Gopalakrishnan	TO T-5
Smt.	C. Nalini	TO T-5
Shri	K. Chellappan	TA T-I-3
Shri	P.K. Baby	JTA T-2
Shri	A. Ramakrishnan	TA T-I-3
Shri	A. Vairamani	FA T-1
Shri	M.R. Arputharaj	TA T-II-3
Shri	M. Mohamed Sultan	TO T-5
Shri	K.S. Krishnan	TO T-5
Shri	K. Shahul Hameed	TA T-I-3
Shri	P. Thirumilu	TA T-II-3
Shri	M. Manickaraja	TA T-I-3
Shri	J.B. Verma	TA T-I-3
Shri	P.V. Krishna Rao	TA T-I-3
Shri	K. Dhanaraju	STA T-4
Shri	A.D. Sawant	TA T-II-3
Shri	R. Dias Johny	TA T-II-3
Shri	B.P. Thumber	TA T-I-3
Shri	B. Sridhara	TA T-II-3
Shri	Y. Muniyappa	TA T-I-3
Shri	C.K. Dinesh	TA T-I-3
Smt.	K. Koumudi Menon	TO T-5
Smt.	S. Lakshmi	TO T-5
Shri	C. Unnikrishnan	JTA T-2
Shri	B. Raju	FA T-1

6. PHYSIOLOGY NUTRITION AND PATHOLOGY DIVISION

SCIENTIFIC

Dr.	M. Peer Mohamed	PS
Dr.	R. Paul Raj	Sr. Sci.
Dr.	M. Vijayakumaran	Sr. Sci.
Dr.	P.C. Thomas	Sr. Sci.
Dr.	M.K. George	Sr. Sci.
Shri	D.C.V. Easterson	Sr. Sci.
Dr.	K.C. George	Sr. Sci.
Dr.	D. Noble	Sr. Sci.
Shri	D. Kandasamy	Sr. Sci.
Dr.	N. Sridhar	Sci.(SS)
Dr.	(Mrs.) Manpal Sridhar	Sci.(SS)
Dr.	P. Jayasankar	Sci.(SS)
Shri	P. Vijayagopal	Sci.
Dr.	Mohan K. Zachariah	Sci.
Shri	N.K. Sanil,	Sci.
Smt.	K.S. Sobhana	Sci.
Dr.	Gaurav Rathore	Sci.
Smt.	Preetha Panikkar	Sci.

TECHNICAL

Shri	V. Suresh	TO T-5
Shri	A. Udayakumar	JTA T-2
Shri	S. Nandakumar Rao	FA T-1
Shri	N. Ratnaswamy	TO T-5

7. SOCIO-ECONOMIC EVALUATION AND TECHNOLOGY TRANSFER DIVISION

SCIENTIFIC

Dr.	R. Sathiadhas	Sr. Sci.
Shri	D.B.S. Sehara	Sr. sci.
Dr.	A. Reghunathan	Sr. Sci.
Dr.	(Mrs.) Krishna Srinath	Sr. Sci.
Shri	R. Narayana Kumar	Sci.
Smt.	Sheela Immanuel	Sci.
Shri	Jiju P. Alex	Sci.
Smt.	Arpita Sharma	Sci.

TECHNICAL

Shri	P. Raghavan	TO T-5
Shri	R. Reghu	TO T-5
Shri	K.L.K. Kesavan	Artist T-5
Shri	A. Kanakkan	STA T-4
Smt.	A. Kanagam	TA T-II-3
Shri	K. Chacko	Proj. Optr. T-I-3
Shri	K.K. Sankaran	Artist, T-II-3
Smt.	K.P. Salini	JTA T-2
Shri	N.K. Harshan	FA T-1
Shri	V.K. Suresh	JTA T-2
Shri	K.N. Pushkaran	JTA T-2
Smt.	T.N. Ananthalakshmi	JTA T-2
Shri	A. Bastian Fernando	TO T-7
Shri	A. Muniyandhi	Artist T-II-3

8. FISHERY RESOURCES ASSESSMENT DIVISION

SCIENTIFIC

Shri	K. Balan	Sr. Sci.
Shri	K. Narayana Kurup	Sr. Sci.
Shri	M. Srinath	Sr. Sci.
Dr.	K.S. Schariah	Sr. Sci.
Dr.	N. Gopinatha Menon	Sr. Sci.
Smt.	K. Vijayalakshmi	Sci.(SS)
Shri	T.V. Sathianandan	Sci.

TECHNICAL

Shri	P.K. Mahadevan Pillai	TO T-7
Shri	Varughese Philipose	TO T-7
Shri	V.Rejendran	TO T-7
Shri	G. Krishnan Kutty Nair	TO T-5
Smt.	V.P Annam	TO T-5
Shri	Varughese Jacob	TO T-5
Smt.	P.L. Ammini	STA T-4
Shri	C.J. Prasad	STA T-4
Shri	S. Hajanajeemudeen	STA T-4
Shri	V. Radhakrishnan Nair	STA T-4
Shri	V.A. Narayanankutty	TA T-II-3
Smt.	K. Ramani	TA T-II-3
Shri	Mathew Joseph	TA T-II-3
Shri	D. Pugazhendi	TA T-II-3
Smt.	P.T. Mani	PCO T-I-3
Shri	P.P. Pavithran	-do-
Shri	K.P. George	-do-
Shri	M.B. Seynudeen	-do-
Shri	K. Anandan	-do-
Smt.	M.R. Beena	-do-
Smt.	Lata L. Khambadkar	-do-
Shri	G. Subbaraman	-do-
Shri	K. Thulasidas	TO T-5
Shri	K.C. Pradeep Kumar,	JTA T-2
Shri	Thomas Kuruvila	-do-
Shri	S.B. Chandrangathan	TO T-5
Shri	M. Babu Philip	TO T-5
Shri	K. Sasidharan Pillai	JTA T-2
Shri	A.Y. Jacob	JTA T-2
Shri	K.G. Baby	-do-
Miss	Sindhu K. Augustine	FA T-1
Shri	K.C. Hezhakiel	FA T-1
Shri	A. Ganapathy	STA T-4
Shri	K. Muthiah	TA T-II-3
Shri	M. Bose	TA T-II-3
Shri	K. Sethuraman	JTA T-2
Shri	A. Gandhi	JTA T-2
Shri	N. Vaithinathan	TA T-I-3
Shri	P. Palani	TA T-I-3
Shri	A. Kumar	TA T-II-3
Shri	B. Thangaraj	FA T-1
Shri	R. Somu	TA T-I-3
Shri	V. Sivaswamy	TA T-II-3
Shri	H. Kather Batcha	TA T-II-3
Shri	S. Chandrasekhar	-do-
Shri	S. Seetharaman	-do-
Shri	V. Thanapathy	-do-
Shri	S. Subramani	-do-
Shri	S. Sankaralingam	-do-
Shri	V.S. Gopi	TA T-I-3
Shri	L. Chidambaram	TA T-II-3
Shri	G.C. Lakshmaiah	TO T-5
Shri	N. Boominathan	FA T-1
Shri	S. Manivasagam	TO T-5
Shri	A. Srinivasan	TA T-II-3
Shri	T. Dhandapani	TA T-I-3
Shri	M. Manivasagam	TA T-I-3
Shri	M. Radhakrishnan	TA T-I-3
Shri	S. Rajan	FA T-1
Shri	K.V.S. Seshagiri Rao	TO T-5
Shri	A. Hanumantha Rao	STA T-4
Shri	G. Sudhakar	FA T-1
Shri	R. Guruswamy	TO T-5
Shri	O.M.M.J. Habeeb Mohamed	TA T-II-3
Shri	M. Chellappa	TA T-I-3
Shri	R. Subramanian	TA T-I-3
Shri	I.P. Ebnezer,	TO T-5
Shri	A Prosper	TA T-I-3
Shri	P. Paulsigamony	JTA T-2
Shri	M. Chandrasekhar	TA T-I-3
Shri	Sailada Satya Rao	TA T-I-3
Shri	S. Chandrasekhar	JTA T-2
Shri	T. Nageswara Rao	JTA T-2
Shri	R.V.D. Prabhakar	FA T-1
Shri	Satchidananda Naik	FA T-1
Shri	N.P. Chandrakumar	JTA T-2
Shri	V. Achuta Rao	TA T-I-3
Shri	Sukhdev Bar	TA T-I-3
Shri	S. Hemasundara Rao	JTA T-2
Shri	Swapan Kumar Kar	FA T-1
Shri	Bijoy Krishna Burman	JTA T-2
Shri	Pulin Behari Day	TA T-I-3

Shri	Sapankumar Ghosh	TA T-II-3
Shri	Ellithathayya	TA T-I-3
Shri	P. Venkataramana	JTA T-2
Shri	N. Burayya	JTA T-2
Shri	Y.V.S. Suryanarayana	JTA T-2
Shri	P. Ananda Rao	TO T-5
Shri	T. Chandrasekhara Rao	TA T-II-3
Shri	K.B. Waghmare	TA T-II-3
Shri	C.J. Josekutty	TA T-I-3
Shri	S.D. Kamble	JTA T-2
Shri	B.G. Kamble	JTA T-2
Shri	Jayadev S. Hotagi	FA T-1
Shri	Suresh Krishna Rao Kamble	JTA T-2
Shri	Arun Y. Mestry	JTA T-2
Shri	S.V. Subba Rao	FA T-1
Shri	Baban N. Kaktar	TA T-I-3
Shri	D.D. Sawant	JTA T-2
Shri	Kishore Reghunath Mainkar	JTA T-2
Shri	Bharamu S. Melinmani	JTA T-2
Shri	D.G. Jadhav	JTA T-2
Shri	Ramesh B. Kamble	JTA T-2
Shri	Y.D. Savaria	TA T-II-3
Shri	Vanvi Jayanthilal Dayabhai	JTA T-2
Shri	Ladani Amruthlal Arjun Bhai	JTA T-2
Shri	Bharada Arjan Pancha Bhai	JTA T-2
Shri	Polara Jamnadas Premji	JTA T-2
Shri	Chudasama Ramji Raja	FA T-1
Shri	B.V. Makadia	JTA T-2
Shri	C. Purandara	JTA T-2
Shri	M. Chaniappa	FA T-1
Shri	V. Lingappa	FA T-1
Shri	Ganesh Bhatkal	JTA T-2
Shri	R. Appayya Naik	JTA T-2
Shri	C.G. Ulvekar	FA T-1
Shri	T.B. Harikantra	TA T-I-3
Shri	S. Satyanarayan V. Pai	JTA T-2
Shri	Udaya V. Arghekar	JTA T-2
Shri	K.C. Pandurangachar	JTA T-2
Shri	M.E. Durgekar	FA T-1
Shri	Prakash C. Shetty	JTA T-2
Shri	K. Soman	TO (T-5)
Shri	T. Girijavallabhan	TO T-5
Shri	C.K. Krishnan	TO T-5
Shri	K. Chandran	TA T-I-3
Shri	K.C. Purushothaman	JTA T-2
Shri	R. Bhaskaran Achari	TO T-5
Shri	Jacob Jerald Joel	TO T-5
Shri	T.G. Vijaya Warrier	TO T-5

LIBRARY & DOCUMENTATION SECTION

Smt.	S. Girijakumari	Lib. Asstt. T-II-3
Smt.	P. Geetha	Lib. Asstt. T-II-3
Smt.	P.Ammajee	Lib. Asstt. T-II-3
Shri	V. Mohan	Lib. Asstt. T-II-3
Smt.	Suvarna Mahesh	Jr. Lib. Asstt. T-2
Shri	V. Edwin Joseph	Sr. Lib. Asstt. T-4
Shri	V. Satyanesan	Jr. Lib. Asstt. T-2

TECHNICAL CELL

Shri	K. Ramadoss Gandhi	TA T-II-3
Shri	N. Viswanathan, Draughtsman	T-II-3

POST-GRADUATE PROGRAMME IN MARICULTURE

Shri	P.M. Aboobacker	TO T-5
Miss	G. Shylaja	TA T-II-3

HINDI TRANSLATORS

Smt.	E.K. Uma	Sr. Hindi Tr. T-4
Smt.	E. Sasikala	Hindi Tr. T-II-3
Miss	Omana. P.V.	-do-
Shri	Om Parkash Joshi	-do-

MOTOR DRIVERS

Shri	C.D. Davis	MD T-II-3
Shri	S. Yadayya	-do-
Shri	K.J. Mathew	-do-
Shri	M.N. Appukuttan Nair	MD T-II-3
Shri	C.S. Xavier	MD T-II-3
Shri	K.K. Soman	MD T-II-3
Shri	V.A.Surendran	MD T-1
Shri	A. Rajan	MD T-1
Shri	O. Muthukaruppan	MD T-II-3
Shri	A. Srinivasan	MD T-1
Shri	K.U. Raman	MD T-1
Shri	K. Ratnakumar	MD T-II-3
Shri	K. Pandi	MD T-II-3
Shri	M. Xavier Mohandas	MD T-II-3
Shri	S.K. Gurusamy	MD T-1
Shri	K. Muthuvel	MD T-1
Shri	P. Pasupathy Rao	MD T-2
Shri	S. Duraipandian	MD T-1
Shri	K. Dharma Rao	MD T-II-3

Shri K. Alagirisamy MD T-2
Shri P.S. Gadenkush MD T-II-3
Shri Shashikant R. Yadav MD T-1
Shri Govind Nath Chudasama MD T-I-3
Shri P. Narayana Naik MD T-1
Shri V. Varadaiah MD T-II-3
Shri P. Harshakumar MD T-1
Shri S. Ramachandran Nair MD T-II-3
Shri K.G. Radhakrishnan Nair MD T-1

WORKSHOP STAFF

Shri M. Krishnan Binder T-1
Shri P. Thankappan Refrigerator Mechanic T-1
Shri M. Asokan Painter-cum-Polisher-cum-Carpenter t-1
Shri R. Ponnaiah, Electrician T-2
Shri T.P. Haridasan Carpenter T-I-3

BOAT CREW (VMC)

Shri P.R. Leopold TO T-9 Skipper
Shri P.K. Velayudhan TO T-8 Mate
Shri B. Ramesh TO T-5 Bosun
Shri Nirmal Mathew -do-
Shri N.B. Gopalakrishna Menon TO T-5
Shri K.K. Prabhakaran Cook (Boat) T-I-3
Shri A.K. Unnikrishnan -do-
Shri M.A. Vincent Driver (Boat) T-I-3
Shri K.K. Bose -do- T—3
Shri K.P. Vijayan Deckhand T-I-3
Shri K.C. Devassy Deckhand T-2
Shri P.D. Chithambaran Oilman-cum-Deckhand
Shri K.S. Leon, Deckhand T-I-3
Shri M.K. Gopalakrishnan Deckhand T-I-3
Shri P.M. Hariharan Deckhand T-I-3
Shri T.K. Sudhakaran Bosun T-4
Shri Mohamed Jaffer Driver (Boat) T-I-3
Shri M. Rangan Cook(Boat) T-I-3
Shri M. Ibrahim Deckhand T-I-3
Shri P. Muniasamy. -do-
Shri R. Sekar -do-
Shri P.M.A. Muheedu, -do-
Shri S. Mohideen Meerasa Deckhand T-I-3
Shri U. Alagumalai Bosun T-4
Shri D. Padmanabhan Driver(Boat) T-I-3
Shri C. Manibal Deckhand T-I-3
Shri S. Ganesan Deckhand T-2
Shri Vali Mohamed Cook(Boat) T-I-3
Shri P. Feroz Khan TO T-5 Bosun
Shri D. Anandan Deckhand T-I-3
Shri S. Enasteen -do-
Shri R. Arockiasamy -do-
Shri E. Sivanandan Cook (Boat) T-I-3
Shri T.N. Sukumaran Bosun T-II-3
Shri H. Vasu Seran T-I-3
Shri M.P. Harikantra Serang T-1
Shri Thomas Teles TO T-5 Bosun
Shri K.C. Gopalan Cook T-I-3
Shri P. Hillary Deckhand T-I-3
Shri V.P. Benzeger -do-
Shri P. Bhaskaran Deckhand T-II-3
Shri T.R. Sreekumaran Oilman T-II-3

KRISHI VIGYAN KENDRA, NARAKKAL

Shri K. Asokakumaran Unnithan TO (Trng) T-8
Dr. P.K. Martin Thompson -do-
Shri A.N. Mohanan TO T-5
Shri P. Radhakrishnan TO T-5
Shri B. Sureshkumar Training Asstt. T-4
Shri P.J. Sebastian MD T-II-3

AUXILIARY STAFF

Shri C.N. Radhakrishna Pillai Halwai
Shri M.K. Subramanian Coupon Clerk
Shri P.M. Varughese Coffee/Tea maker
Shri P.V. George Bearer
Shri M.V. Devassykutty Bearer
Shri K.N. Purushan Wash Boy/Dish Cleaner

List of Ministerial and Supporting staff at Headquarters and Regional/Research Centres

HEADQUARTERS

Ministerial Staff

1.	Shri P. Bapaiah	Sr. Administrative Officer
2.	Shri A.V. Joseph	Sr. Finance & Accounts Officer
3.	Shri P.S. Sudersanan	Administrative Officer
4.	Shri K.U.K. Menon	Asstt. Fin. & Accounts Officer
5.	Shri P.A. Naik	Asstt. Adm. Officer
6.	Shri S. Subramanian	Asstt. Adm. Officer
7.	Smt. P.J. Sheela	Hindi Officer
8.	Shri K.S. Sreekumaran	Superintendent (A&A)
9.	Shri P.J. Davis	Superintendent
10.	Smt. T.K. Ponnamma	-do-
11.	Shri C. Balamamundinathan	-do-
12.	Shri A. Narayana Swamy	-do-
13.	Shri K. Nagarajan	-do-
14.	Shri C. Yohannan	-do-
15.	Smt. P.V. Mary	-do-
16.	Shri M.J. John	-do-
17.	Shri K.L.K.Padmanabhan	Assistant
18.	Shri K. Arumughan	-do-
19.	Shri N. Govindan	-do-
20.	Shri V.V. Lakshminarayanan	-do-
21.	Shri T.N.P. Kurup	-do-
22.	Shri V. Mohanan	-do-
23.	Smt. K. Vijayalakshmi	-do-
24.	Shri N. Gopinathan	-do-
25.	Smt. K.M. Annamma	-do-
26.	Smt. T. Madhavi	-do-
27.	Smt. M. Suseela	-do-
28.	Smt. Christina Joseph	Assistant
29.	Smt. M.O. Leela	-do-
30.	Miss M.A. Seetha	Senior Stenographer
31.	Shri K.M. Surendran	-do-
32.	Smt. Omana A.K	Stenographer
33.	Shri C.N. Chandrasekharan	-do-
34.	Shri C.G. Thomas	-do-
35.	Smt. N. Ambika	-do-
36.	Smt. N. Yesoda	-do-
37.	Smt. K.J. Malathidevi	-do-
38.	Smt. N.R. Lethadevi	-do-
39.	Smt. K.V. Sajitha	-do-
40.	Shri Chandrakesa Shenoi	-do-
41.	Shri K.N. Murali	Junior Stenographer
42.	Shri K. Faisal	-do-
43.	Smt. Lata Vijayakumar	-do-
44.	Shri V.P. Unnikrishnan	Senior Clerk
45.	Shri M.K. Abdulla	-do-
46.	Smt. K.C. Karthiayin	-do-
47.	Shri A.P. Balakrishnan	-do-
48.	Smt. P.K. Sreedevi	-do-
49.	Shri V. Chandrasekharan	-do-
50.	Smt. A. Ranjini	-do-
51.	Smt. Alice Valooran	-do-
52.	Smt. K.C. Girija	-do-
53.	Smt. M.M. Teresakutty	-do-
54.	Smt. K. Santha	-do-
55.	Shri Thomas Joy	-do-
56.	Smt. A.K. Kunjupennu	-do-
57.	Smt. V.K. Sobha	-do-
58.	Smt. V. Parukutty	-do-
59.	Shri P.V. Devassy	-do-
60.	Shri P.M. Bhaskaran	-do-
61.	Smt. N.S. Sarala	-do-
62.	Shri K. Sadanandan	-do-
63.	Smt. P.S. Sumathy	-do-
64.	Shri S.Erishikesan	-do-
65.	Smt. I.M. Baby Rajalakshmi	-do-
66.	Smt. G. Ambika	Junior Clerk
67.	Smt. N.K. Suseela	-do-
68.	Shri K. Baburajan	-do-
69.	Smt. M.G. Chandramathi	-do-
70.	Shri V. C. Subhash	-do-
71.	Smt. K.K. Kousallia	-do-
72.	Shri V.C. Antony	-do-
73.	Smt. V. Jayalakshmi	-do-
74.	Shri K.J. Mathew	-do-
75.	Shri C.K. Sivadas	-do-

76. Shri Tomy Prince M.J. -do-
(Place of posting at Narakkal)
77. Smt. N.G. Supriya -do-
78. Smt. P.K. Mary -do-
79. Smt. K. Balamani (Hindi Typist) -do-
80. Shri K. Ramadasan -do-
81. Miss N.M. Ponnamma -do-
82. Shri Augustus Julin Raj -do-
83. Shri K.M. Joseph -do-
84. Smt. Binny Cherian -do-
85. Smt. Gouri Hareendran -do-
86. Smt. Meera. K.N. -do-
87. Shri U. Purandara Shetty -do-
88. Shri Rishikesh Aandi -do-
89. Smt. D. Lalithambika Amma -do-
90. Shri P.P. Anil Kumar -do-
91. Shri P.K. Ravindran -do-
92. Smt. T.C. Chandrika -do-
93. Shri P.P. Chandrasekharan Nair -do-
94. Miss Leela. C.A -do-
95. Shri A. Dickson Jebaraj -do-
96. Shri N. Ravindranathan Nair SGO

SUPPORTING STAFF

SS Gr. IV

1. Shri T.A. John Khalasi
2. Shri K.P. Joseph L.A.
3. Smt. N. Leela Daftry
4. Shri M.K. Peethambaran Fieldman
5. Shri M.L. Antony Library Attendant
6. Shri K.S. Vaidyalingam Fieldman
7. Shri A.P. Sebastian Peon

SS Gr. III

1. Shri T.A. Vijayan Peon
2. Shri E.F. Francis Watchman
3. Shri P.A. Vasudevan Lab. Attendant
4. Smt. R. Devalakshmi Messenger
5. Shri A. Gopinathan Messenger
6. Shri B. Zainudheen Messenger
7. Shri T. Sreedharan Messenger

SSGr.II

1. Shri K. Velayudhan Watchman
2. Shri N.T. Velappan Peon
3. Shri G. Mithralal Watchman
4. Smt. K.K. Kalliani Safaiwala
5. Shri G. Vijayan Watchman
6. Shri T. Vijayakumar Messenger
7. Shri C.O. Viswambharan Fieldman
8. Miss B. Savithri Messenger
9. Shri N.P. Mohanan Safaiwala
10. Shri V.C. Gopi Safaiwala
11. Shri P.K. Achuthan Watchman
12. Shri M.P. Mohandas Messenger
13. Shri T.M. Abdul Aziz Messenger
14. Shri K.T. Rajappan Watchman
15. Shri R. Ravindranathan Nair Messenger
16. Shri T.I. Soman Helper
17. Shri K.C. Rajappan Messenger
18. Shri V.T.Ravi Watchman
19. Miss A. Latha Safaiwala
20. Shri P.K. Chellappan Watchman
21. Smt. Pennamma Joseph Messenger
22. Shri K.G. Jayaprasad Gardner

SS Gr. I

1. Shri P.D. Karunakaran Watchman
2. Shri V.A. Kuttappan Messenger
3. Shri K. Sankaran Gardner
4. Shri E.J. James Watchman
5. Shri S. Mohanan Lift Operator
6. Shri T.K. Antony Lift Operator
7. Shri V. Krishnan Messenger
8. Shri V.H. Venu Binder
9. Shri N.V. Thambi L.A.
10. Smt. J. Sudhadevi Cane Weaver
11. Shri S. Narayanan Achari L.A.
12. Shri P.B. Jeevaraj Fieldman
13. Shri P.V. Joy Fieldman
14. Shri M.K. Anil Kumar Fieldman
15. Shri P. Satheesh Kumar Messenger
16. Shri M. Radhakrishnan Messenger
17. Shri T.P. Aboobacker Messenger
18. Smt. S. Seethalakshmi -do-
19. Smt. V.S. Savithri -do-
20. Shri Sunil.P.V. Fieldman
21. Shri Sathyan. M.N. Fieldman
22. Shri Shaji.A.K. Fieldman
23. Smt. Prakashini. K.T. Messenger
24. Miss Sheela. P.P. Messenger
25. Smt. Usha. S. Messenger
26. Shri Prasad. S.P. Messenger
27. Smt. Usha. P.K. Safaiwala

28. Miss Sujatha. K.K. Safaiwala
29. Smt. Shyamala. M.P. Safaiwala
30. Shri Sreekumar. K.M. Safaiwala
31. Shri Vijayan. M.T. Safaiwala
32. Miss Sujatha. P.K. Messenger
33. Shri Ajith. K.S. Fieldman
34. Shri Gireesh. P.M. Fieldman
35. Shri Jestin Joy. K.M. Watchman
36. Shri M.J. Joseph L.A.

MANDAPAM CAMP

Ministerial Staff

1. Shri R. Kuppuswamy Asstt. Adm. Officer
2. Shri P. Ganesan Superintendent
3. Shri A. Kajendran Assistant
4. Shri S. Nagarajan -do-
5. Shri K. Maragathavadivelu -do-
6. Shri S. Jeyachandran -do-
7. Shri V. Chandran -do-
8. Shri P. Selvaraj -do-
9. Shri S. Abdulla -do-
10. Shri A. Yagappan Senior Clerk
11. Shri N. Natarajan -do-
12. Smt. S. Parisa Junior Clerk
13. Smt. M. Rameshwari -do-
14. Shri N. Ilamparuthi -do-
15. Shri S. Muthumari -do-
16. Smt. N. Gomathi Stenographer

SUPPORTING STAFF

SSGr. IV

1. Shri A. Raman Fieldman
2. Shri A. Muniasamy L.A.
3. Shri M. Ibrahimsa L.A.
4. Shri S. Muthuramalingam L.A.
5. Shri S. Mani Fieldman
6. Shri A. Subramanian Fieldman
7. Shri A. Pitchai Daftry
8. Shri. K. Muthaiah Watchman
9. Shri K Kuruvan Safaiwala
10. Shri M.R. Bharathan Deckhand

SSGr.III

1. Shri V. Santhanam L.A.
2. Shri R. Sevugan Safaiwala
3. Shri M. Muthu Safaiwala
4. Shri R. Sonai Watchman
5. Shri M. Ramu Fieldman
6. Shri P. Karuppaiah Watchman
7. Shri K. Muniasamy Watchman
8. Shri G. Saivadurai Watchman
9. Shri M. Govindaraj Watchman
10. Shri K. Vellayan Watchman
11. Shri A. Mari Safaiwala
12. Shri R. Alagan Fieldman
13. Shri K. Gurusamy Safaiwala
14. Shri L. Sathan Safaiwala
15. Shri M. Thangavelu Watchman
16. Smt. S. Nagammal Safaiwala
17 Shri G. Ankaiah Safaiwala
18. Smt. J. Kondammal Safaiwala
19. Shri R. Sonaimuthu Safaiwala
20. Shri M. Athimoolam Cook

SSGr.II

1. Shri S. Arulsamy Messenger
2. Shri S. Arumugham Safaiwala
3. Shri P. Ramu Watchman
4. Shri N. Rajavelu Watchman
5. Shri S. Murugan Safaiwala
6. Shri J. Hameed Sultan Pump Driver
7. Shri M. Kuberaganesan Fieldman
8. Shri K. Thangavel Fieldman
9. Shri Y. Balu Oilman
10. Shri G.K. Rajan Pump Driver
11. Shri V. Alagan Fieldman
12. Shri V. Narasimha Bharathy Daftry
13. Shri U. Rajendran L.A.
14. Shri M. Shahul Hameed Messenger

SSGr.I

1. Shri N. Ramakrishnan L.A.
2. Shri S. Murugaboopathy L.A.
3. Shri C. Ramadoss L.A.
4. Shri E. Natarajan L.A.
5. Shri M. Shahul Hameed Messenger
6. Shri S.M. Sikkender Patcha Fieldman
7. Shri T. Thananjayan Oilman
8. Shri I. Syed Sadiq L.A.
9. Shri M. Shanmugavelu Messenger
10. Shri V. Muniasamy L.A.
11. Shri M. Seeni L.A.
12. Shri K. Shanmuganathan L.A.
13. Shri N. Nagamuthu Safaiwala

14.	Shri K. Govindan	Khansama
15.	Shri Y. Arul Pragasam	Binder
16.	Smt. Subbulakshmi	Safaiwala
17.	Shri M. Saravana Kumar	Safaiwala
18.	Shri K. Anandan	Safaiwala
19.	Shri K. Ganesan	Safaiwala
20.	Shri K. Chandran	Safaiwala
21.	Shri N. Ramamoorthi	Lascar
22.	Shri B. Kathiresan	Khalasi
23.	Shri M. Thayalan	L.A.
24.	Shri M. Saravanan	L.A.
25.	Shri K. Muniasamy	Helper
26.	Shri K. Senthil Kumar	Helper

TUTICORIN

Ministerial Staff

1.	Shri D. Gnanajebamani	Superintendent
2.	Shri B. Bavanandam	Assistant
3.	Smt. S. Leelavathi	Stenographer
4.	Smt. T. Mahalakshmi	Junior Clerk
5.	Miss S. Sarada	-do-
6.	Smt. C. Rajeswari	-do-
7.	Shri M. Samuthiram	-do-
8.	Shri Jayakanthan. C.	-do-
9.	Smt. C. Pushparani	-do-

Supporting Staff

SSGr.III

1.	Shri D. Motcham	Daftry
2.	Shri A. Francis	Watchman

SSGr.II

1.	Shri P. Muthumalai	Watchman
2.	Shri K. Thankaraj	Fieldman
3.	Shri V. Samayamuthu	Watchman
4.	Shri R. Uchimahali	Fieldman
5.	Shri W. Sathyavan Neelraj	Fieldman
6.	Shri P. Kandan	Fieldman
7.	Shri S. Balakrishnan	Watchman
8.	Shri John James	Gardner
9.	Shri M. Sankaran	Fieldman
10.	Shri K. Velayudham	Watchman

SSGr.I

1.	Shri G.S. Rayappan	Fieldman
2.	Shri I. Ravindran	Fieldman
3.	Shri S. Alagesan	Fieldman
4.	Shri M. Mariappan	Safaiwala
5.	Shri M. Soundrapandian	Safaiwala
6.	Shri M. Kalimuthu	Watchman
7.	Shri K. Murugan	Watchman
8.	Shri G. Kosalram	Watchman
9.	Shri K. Subramanian	Safaiwala
10.	Smt. B. Koncies Mary	Messenger
11.	Shri S. Mariappan	Watchman
12.	Shri K. Jeevanathan	L.A.
13.	Shri S. Willington	Khalasi
14.	Shri K. Jerald Raja	Khalasi

MADRAS

Ministerial Staff

1.	Shri K.M. Karuppaiah	Superintendent
2.	Shri S. Mangalam	Assistant
3.	Shri S.K. Murali	-do-
4.	Shri S.Balasubramanian	Senior Clerk
5.	Smt. G. Abitha	-do-
6.	Smt. M. Parvathy	-do-
7.	Smt. A.B. Lalitha	Junior Clerk
8.	Smt. Rosy Joachim	Senior Stenographer
9.	Smt. P. Thankaleela	Junior Clerk

Supporting Staff

SSGr.IV

1.	Shri V. Joseph Xavier	Deckhand
2.	Shri S. Selvanidhi	Deckhand

SSGr.III

1.	Shri R. Ananda Jyothi	Watchman
2.	Shri G. Vijayarengan	Safaiwala

SSGr.II

1.	Shri D. Pakkiri	Watchman
2.	Shri A. Janakiraman	Watchman
3.	Shri G. Chakrapani	Watchman
4.	Shri T. Nagalingam	Watchman
5.	Shri M. Ravindran	Messenger
6.	Shri S. Imbamani	Watchman
7.	Shri M.P. Chandrasekhar	Watchman
8.	Shri M. Anbu	Messenger
9.	Shri R. Sunder	Fieldman
10.	Shri R. Vasu	Fieldman
11.	Shri P.Selvaraj	Safaiwala

SSGr. I

1. Smt. Anjalidevi. S. Peon
2. Shri S. Yuvarajan L.A.
3. Shri V. Seetharamacharyalu Helper
4. Shri Bareen Mohammed L.A.

BOMBAY

MINISTERIAL STAFF

1. Shri P.V. Shanbhag Senior Clerk
2. Shri M.R. Wadadekar -do-
3. Shri Rama D. Medar Junior Stenographer
4. Smt. Ashlesha Ashok Sawant Junior Clerk
5. Shri Vinoth P. Bhagayatkar -do-

Supporting Staff

SSGr.II

1. Shri K.G. Tawade Watchman
2. Shri S.M. Tandel Watchman

SSGr.I

1. Shri K.K. Baikar Fieldman
2. Shri M.P. Jadhav Watchman
3. Shri D.D. Jangam Watchman
4. Smt. Urmila V. Balmiki Safaiwala
5. Shri Rajani Sekharan Tambe Messenger
6. Sh. Bhangare Sunil Ramachandra Fieldman

MANGLORE

MINISTERIAL STAFF

1. Shri Balakrishna Naik Assistant
2. Shri K.M. Abdulla Senior Clerk
3. Smt. Martha R. Mascarenhas -do-
4. Shri K. Rama Naik -do-

Supporting Staff

SSGr.III

1. Shri Vasudev G. Kubal Lascar (CIFT, Goa absorption)
2. Shri Mohan S. Puthran Oilman
3. Shri U.B. Sadasiva Messenger

SSGr.II

1. Shri C.B. Shirodkar Watchman (CIFT, Goa absorption)
2. Shri D. Gangadhara Gowda Watchman
3. Shri Ramanna Sapaliga Watchman
4. Shri A. Kesava Watchman
5. Shri L.K. Suvarna L.A.

SSGr.I

1. Smt. V. Padmavathi Safaiwala
2. Smt. Savithri Fieldman
3. Shri S. Mahalinga Naik Messenger

VISAKHAPATNAM

MINISTERIAL STAFF

1. Shri R. Appa Rao Assistant
2. Miss V. Gauri Senior Clerk
3. Shri K. Santhi Prasad -do-
4. Miss B. Madhavi Latha Junior Clerk

SUPPORTING STAFF

SSGr.IV

1. Shri R. Balakrishnan Deckhand

SSGr.III

1. Shri R. Kanaka Raju Watchman
2. Shri V. Demudu Watchman

SSGr.II

1. Shri P. Krishna Rao Messenger
2. Shri R.V.S.Subramanyan Messenger
4. Shri L. Appa Rao Messenger
5. Shri R. Dalayya Safaiwala
6. Shri P. Prasantha Kumar Das Messenger

SSGr.I

1. Shri D. Jaganna Safaiwala
2. Shri P. Nagaraju Watchman

VIZHINJAM

Ministerial Staff

1. Shri M. Regunathan Assistant
2. Shri S. Radhakrishnan Nair Junior Clerk
3. Shri Vinoth Prabhu J. Vaz -do-
4. Mrs. K. Latha -do-

SUPPORTING STAFF

SSGr.IV

1. Shri J. Ansalam L.A.
2. Shri V. Sasidharan Pillai L.A.
3. Shri Kunju Kunju L.A.
4. Shri M.T. Mani Cook (Boat)

SSGr.III

1. Shri K. Chandran Safaiwala
2. Shri V. Viswanathan Watchman

SSGr.II

1. Shri R. Madhusudanan Nair Fieldman
2. Shri V. Kochunarayanan Nair Watchman
3. Shri S. Antony Messenger
4. Shri B. Prabhakaran Messenger
5. Shri B.K. Velukkutty Messenger
6. Shri B. Babu Safaiwala

SSGr.I

1. Shri A. Yesudhas L.A.

CALICUT

Ministerial Staff

1. Smt. C. Kamalakshi Assistant
2. Smt. P. Subhadra Senior Clerk
3. Shri R. Sreenivasan Junior Clerk
4. Smt. K.P. Shylaja -do-
5. Shri M. Balaraman -do-

Supporting Staff

SSGr.IV

1. Shri K. Janardhanan Fieldman
2. Shri M. Ramadasan L.A.

SSGr.III

1. Shri K.E. Joseph Victor Watchman

SSGr.II

1. Shri A. Sivadasan Messenger
2. Shri K. Chekutty Watchman
3. Shri P. Dassan Fieldman
4. Shri Haridassan Thannimukkoth Fieldman
5. Shri M.K. Chandran Safaiwala
6. Shri T.P. Renil Kumar Fieldman

SSGr.I

1. Shri Palaniappan Safaiwala
2. Shri K.T. Mohanan Messenger
3. Shri Thirumangalath Koman L.A.
4. Miss P. Renuka L.A.
5. Shri V. Rajendran Messenger

KARWAR

MINISTERIAL STAFF

1. Shri G. K. Kudalkar Assistant
2. Shri Gangadhar B. Naik Senior Clerk
3. Shri Yellappa H. Gamanagatti -do-
4. Smt. Jayashree Junior Clerk

SUPPORTING STAFF

SSGr. IV

1. Shri G.M. Korar Fieldman

SSGr.III

1. Shri D.D. Naik L.A.
2. Shri R.D. Pednekar Peon
3. Shri Menino Souza Lascar
4. Shri P.S. Morajkar Watchman

SSGr.II

1. Shri M.R. Kotharkar Watchman
2. Shri M.B. Kotharkar Watchman
3. Shri Subhash K. Naik Watchman
4. Shri Gopi X. Chodendar Lascar
5. Shri V.P. Halarnakar Net maker
6. Smt. Somi M. Harijan Safaiwala
7. Shri Somayya S. Gonda Watchman

SSGr.I

1. Shri Rajendra D. Hulswar Watchman
2. Miss Pramila Harish Borkar Messenger
3. Shri Harish Chandra Naik Watchman
4. Shri Ramakant Shankar Harikantra Oilman
5. Shri Suresh Rumo Majalikar Fieldman

VERAVAL

Ministerial Staff

1. Shri J.N. Jambudiya Senior Clerk
2. Shri Vanvi Mansukhlal Madhavji Jr. Clerk

SUPPORTING STAFF

SSGr.II

1. Shri H.M. Bhint Messenger
2. Shri Asim Abubin Mehsan Watchman
3. Shri L.M. Waghale Watchman

SSGr.I

1. Shri Haridas Khimdas Makwana Fieldman
2. Shri Makwana Somapitha Watchman
3. Shri Prabhakar Sankar Salvi Messenger

KAKINADA

Ministerial Staff

1. Shri S. Suryanarayana Murty Senior Clerk
2. Shri S. Appa Rao -do-

Supporting Staff

SSGr. IV

1. Shri K. Narasimha Murty L.A.

SSGr.II

1. Shri S. Tatabhai Messenger

SSGr.I

1. Shri G. Sainyadhipathi` Watchman
2. Shri D. Bhaskara Rao Safaiwala
3. Shri C.H. Moshe Watchman

MINICOY

MINISTERIAL STAFF

1. Smt. M. Safiabi Junior Clerk

SUPPORTING STAFF

SSGr.IV

1. Shri P.I. Koya L.A.
2. Shri C.M. Rajappan L.A.

SSGr.III

1. Shri O. Ismail Watchman
2. Shri N. Pookoya Watchman

SSGr.II

1. Shri Suresh Babu. P.K. Watchman

SSGr.I

1. Shri Mohammed Khaleel Fieldman

KRISHI VIGYAN KENDRA, NARAKKAL

MINISTERIAL

1. Shri B. Vijaya Kumar Superintendent
2. Shri N.K. Mohanan Junior Clerk
3. Shri C.D. Manoharan Junior Stenographer

Supporting Staff

SSGr.IV

1. Shri N.K. Asokan Fieldman
2. Shri K.P. John Fieldman

SSGr.III

1. Shri K. Ganesan Fieldman

SSGr.II

1. Smt. Chinnamma Anjalo Safaiwala

SSGr.I

2. Shri P.V. Gopalan Messenger

TRAINERS' TRAINING CENTRE, COCHIN

MINISTERIAL STAFF

1. Smt. D. Geetha Superintendent
2. Smt. P.K. Anitha Junior Stenographer
3. Smt. Ponnamma Radhakrishnan Senior Clerk

SUPPORTING STAFF

SSGr.II

1. Shri K.G. Bhaskaran Nair Messenger