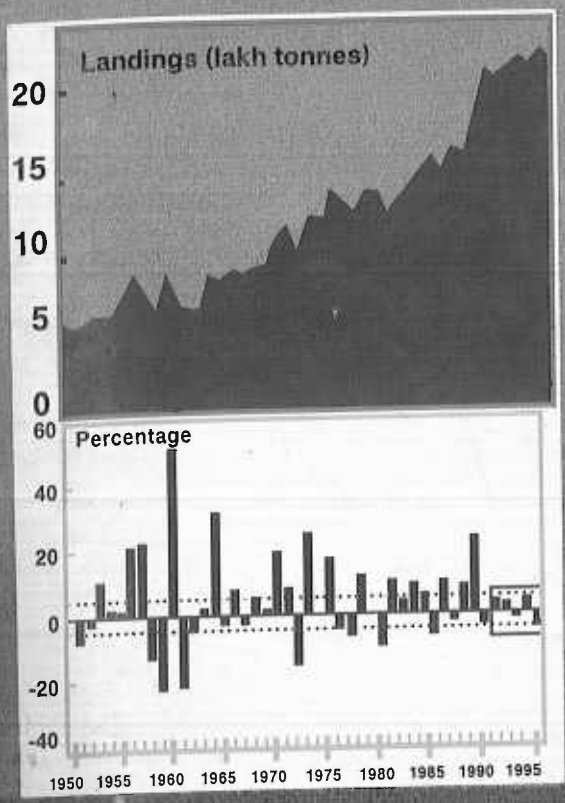
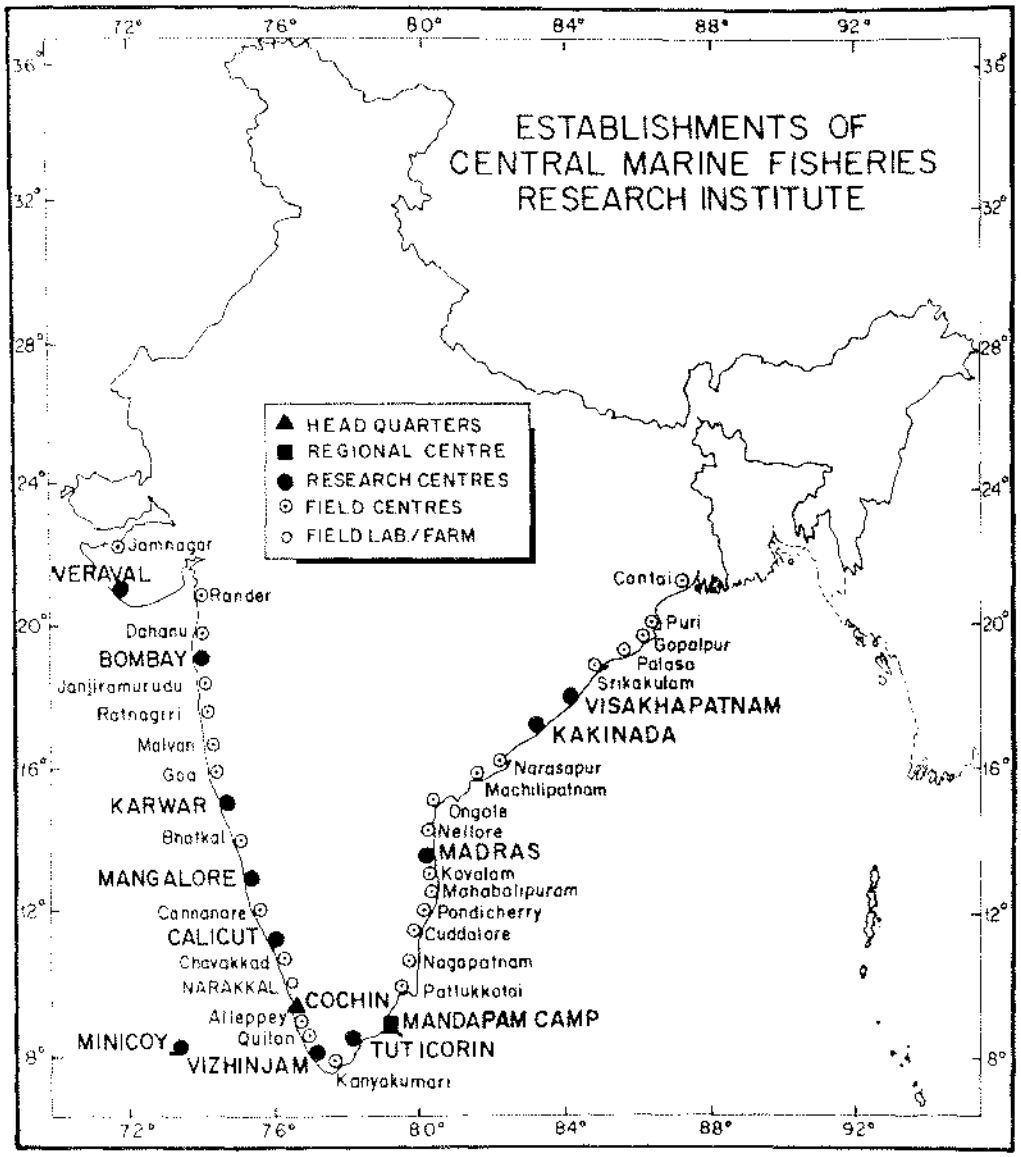
ANNUAL REPORT 1995 - '96



CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
Indian Council of Agricultural Research
Ernakulam, Kochi - 682 014



CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

Dr. Salim Ali Road, Post Box No. 1603
Tatapuram P.O., Ernakulam, Cochin - 682 014

Telephone	:	394867	394357	393192	394794
		394312	394061	390191	394268
		394795	394750	394296	
After office hours	:	391407			

Telegram	:	CADALMIN, Ernakulam
Telex	:	885-6435 MFRI IN
Fax	:	0091-0484-394909
E- Mail	:	MDC- CMFRI @ x 400.NICGW.NIC.IN

Director's Office

ANNUAL REPORT
1995-1996

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

Indian Council of Agricultural Research

SALIM ALI ROAD, POST BOX No. 1603, TATAPURAM P.O.
ERNAKULAM, KOCHI - 682 014, INDIA

Published by

Dr. M. Devaraj
Director
Central Marine Fisheries Research Institute
Cochin - 682 014

Compiled and edited by

Dr. V. Sriramachandra Murty, Senior Scientist
Dr. N.G.K. Pillai, Senior Scientist

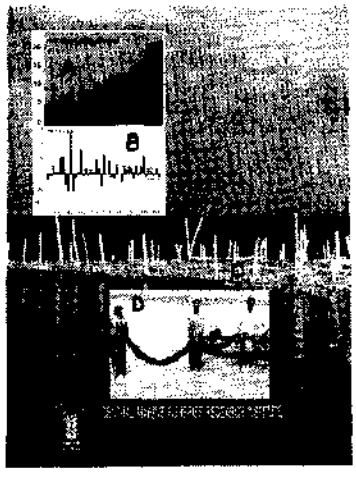
Hindi translation by

Mrs. E.K. Uma

Secretarial assistance by
Mrs. N.R. Latha Devi

CONTENTS

Front Cover



A. **Marine Fish production in India during 1950 - '95**

B. **Growth (%) of marine fish production during 1950-'95**

C. **CMFRI Farm for demonstration of edible oyster culture at Dalavapuram**

D. **Farmers with harvested mussels from long line farm at Andhakaranazhi**

Back Cover

Some publications of CMFRI during 1995-96

INTRODUCTION

We have great pleasure in presenting the Annual Report of the CMFRI for the year 1995-96. This year saw greater thrust on the development of infrastructure for mariculture and extension. Hatchery facilities have been developed at Calicut, Fisheries Harbour Laboratory at Cochin, Vizhinjam and Mandapam Camp besides the expansion of the Field Mariculture Laboratory at KVK, Narakkal (Cochin), Tuticorin and Visakhapatnam. The Field Mariculture Laboratory of the Madras Research Centre at Kovalam is being renovated to restart the seafarming programmes. Action has been initiated to develop seafarming and coastal mariculture facilities at all the Research Centres of the Institute located in different hydroclimatic zones along the maritime states of the country. The Institute conducted Fish Farmers and Fishermen Meet not only at the Headquarters, Cochin but also at most of the Research Centres regularly every month, to address their problems in seafarming, coastal aquaculture and capture fisheries. A large number of farmers, entrepreneurs and industrialists got benefited from these monthly Meets. Action has been initiated to acquire suitable sites for the construction of laboratory buildings and hatchery-cum-growout complexes for mariculture. The government of Kerala allotted 1.7 acres of land close to the Vizhinjam Bay to construct laboratory buildings and seafarming facilities for the Vizhinjam Research Centre. A proposal was submitted to the government of Andhra Pradesh for the allotment of 6.5 acres of land on long lease or outright transfer for the construction of similar facilities and also residential quarters at Kakinada. The government of Karnataka agreed in principle to allot land at Karwar and Mangalore for the construction of laboratory buildings and mariculture facilities. Similarly action has been initiated to obtain land for laboratory-cum-office building at Bombay from CIDCO or CIFE. Several proposals were submitted to various funding agencies in the frontier areas of marine fisheries and mariculture. A total of 54 Research Projects are being successfully implemented in addition to 12 externally funded projects.

The laboratory building of the Visakhapatnam Research Centre constructed jointly with the CIFT was inaugurated by the Hon'ble Minister of Agriculture, Dr. Balram Jakhar on the 17th September, 1995.

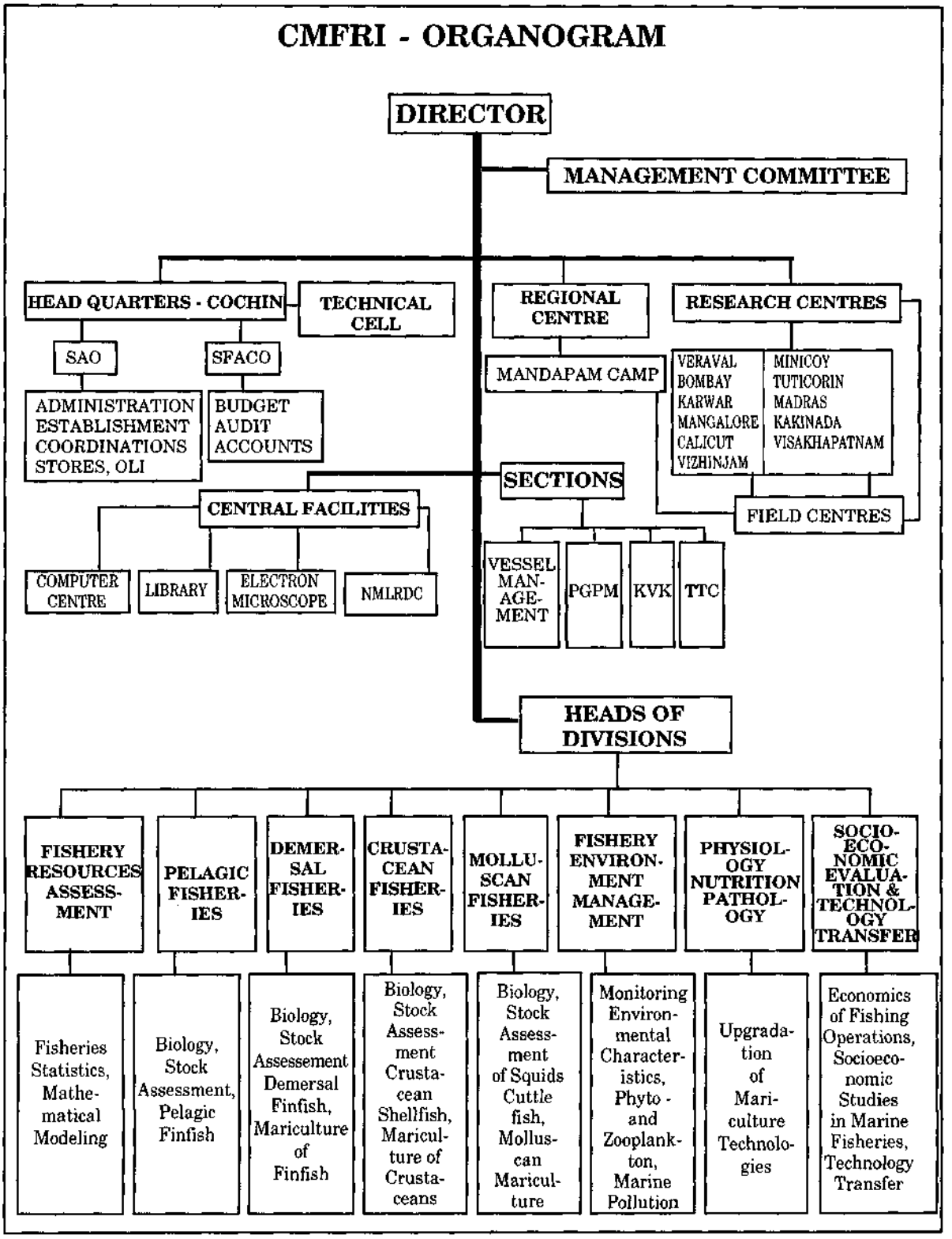
The total allocated budget of Rs. 935 lakhs was fully utilised during the year. The ICAR increased the allocation under T.A. by Rs. 6.4 lakhs which, though not fully adequate, facilitated the implementation of the Institute's field-oriented programmes more effectively.

We are thankful to the Director General, ICAR and the Deputy Director General (Fisheries), ICAR for extending their wholehearted support in implementing the various programmes of the Institute. I compliment my colleagues for continuing their efforts in the cause of marine fisheries and mariculture research and development in our country.

Cochin
August 1996

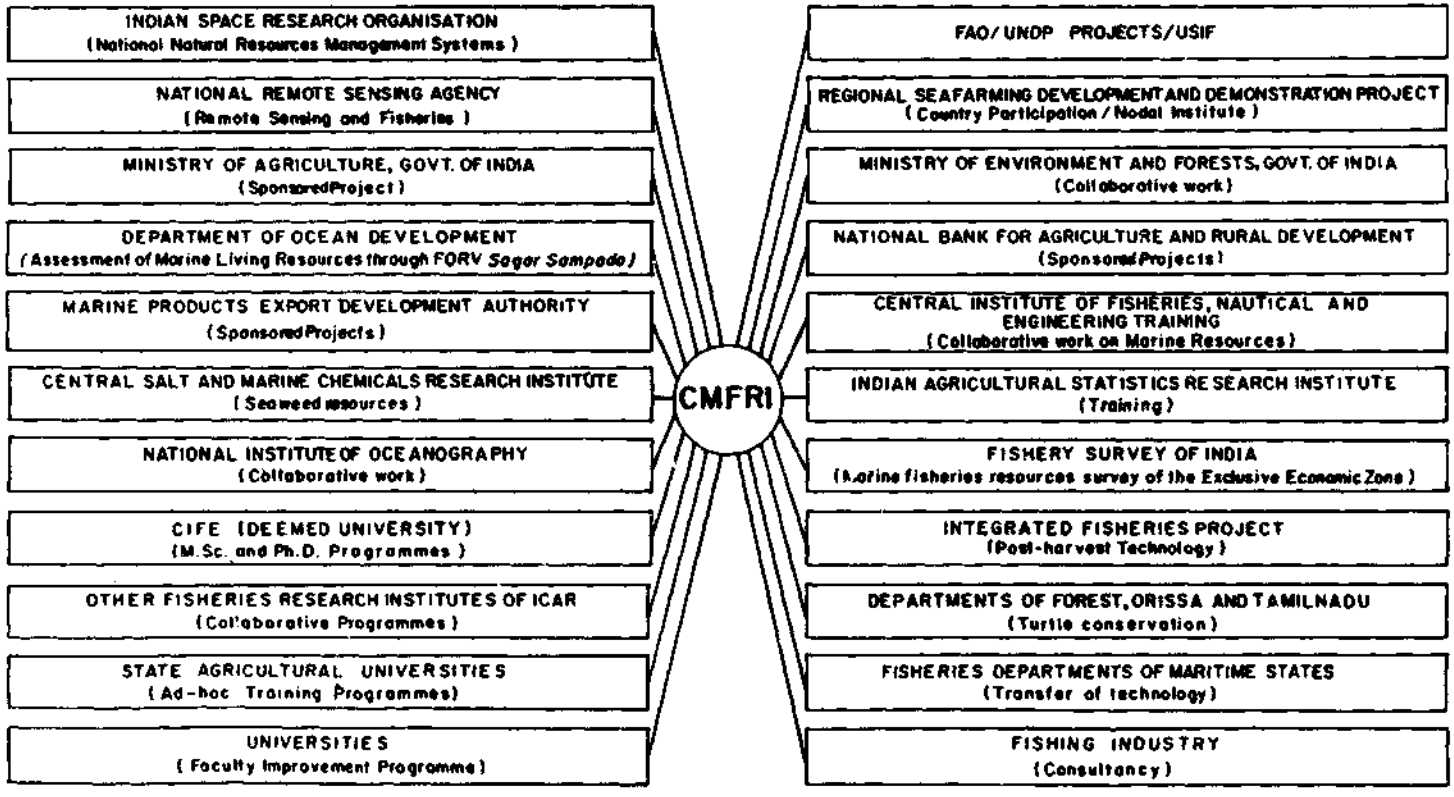
M. DEVARAJ
Director

CMFRI - ORGANOGRAM



CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN
(ICAR)

LINKAGES WITH OTHER ORGANISATIONS



THE CMFRI

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

The CMFRI has the mandate to:

1. Conduct researches on the exploited marine fishery resources aiming at stock assessment, management and conservation,

2. assess the under- and unexploited marine fisheries resources of the EEZ,

3. understand the influence of variations in the environment on the availability and abundance of fish stocks,

4. study the coastal ecology as related to artisanal fishing, endangered ecosystems and pollution,

5. develop suitable technologies for seafarming of finfish, shellfish and other cultivable marine organisms,

6. study the techno-economics of fishing and sea-farming operations and related social aspects,

7. conduct postgraduate teaching programmes in mariculture leading to M.F.Sc. and Ph.D. degrees,

8. transfer the viable technologies developed; to take up extension education and specialised training programmes and to undertake consultancy services.

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 to integrate the fluctuations of marine fish production with 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 socioeconomic 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 along

the country's coast. The entire activity is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory and field facilities including 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(+1), 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 1995-96

(Rs. in lakhs)

Budget Heads	Non Plan		Plan	
	Budget Estimates	Expenditure	Budget Estimates	Expenditure
Establishment Charges	623.00	622.99	1.70	1.70
O.T.A.	1.20	1.20	-	-
T.A.	11.80	11.80	10.00	10.00
Works	14.00	13.99	46.61	46.61
Other charges	30.00	30.00	191.20	191.20
Other Items	-	-	5.49	5.49
Total	680.00	679.98	255.00	255.00

the country's coast. The entire activity is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory and field facilities including 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(+1), 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 1995-96

(Rs. in lakhs)

Budget Heads	Non Plan		Plan	
	Budget Estimates	Expenditure	Budget Estimates	Expenditure
Establishment Charges	623.00	622.99	1.70	1.70
O.T.A.	1.20	1.20	-	-
T.A.	11.80	11.80	10.00	10.00
Works	14.00	13.99	46.61	46.61
Other charges	30.00	30.00	191.20	191.20
Other Items	-	-	5.49	5.49
Total	680.00	679.98	255.00	255.00

CMFRI COMMITTEES

I. MANAGEMENT COMMITTEE

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

2. ADG (Marine Fisheries) — Member
   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. M. Peer Mohamed — -do-
   Principal Scientist
   CMFRI, Cochin-14

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

7. Dr. K.A. Narasimham — -do-
   Principal Scientist
   CMFRI, Cochin-14

8. Dr. C. Suseelan — -do-
   Sr. Scientist
   CMFRI, Cochin-14

9. Shri R. Marichamy — -do-
   Principal Scientist
   Tuticorin Research Centre
   of CMFRI
   Tuticorin

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. Shri P. Bapaiah, — Member
    Sr. Adm. Officer — Secretary
    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 Director (Retd) CMFRI, Cochin-14	-do-
6.	Dr. M. Devaraj Director CMFRI, Cochin	-do-
7.	Asst. Director General (M.Fy.) ICAR, New Delhi	-do-
8.	Shri Choudhary G.S. Dhara Singh House No. VIII/2079 Palace Road, Cochin-2	-do-
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.	Dr. M. Devaraj 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. C.S.G. Pillai Principal Scientist CMFRI, Cochin-14	Member Secretary

IV. RESEARCH CO-ORDINATION AND MANAGEMENT UNIT

1.	Dr. C.S. Gopinadha Pillai Principal Scientist CMFRI, Cochin-14	Chairman
2.	Dr. V. Sriramachandra Murty Sr. Scientist CMFRI, Cochin-14	Member
3.	Dr. N.G.K. Pillai Sr. Scientist CMFRI, Cochin-14	Member

V. JOINT COUNCIL

Office side

1.	Dr. M. Devaraj, Director	Chairman
2.	Shri P. Bapaiah Sr. Adm. Officer	Member

3. Shri M.P. Chandrasekharan -do-
Sr. Finance & Accounts Officer

4. Shri P.R. Leopold -do
Tech. Officer (T-8)

5. Shri P.A. Naik Member
Asst. Adm. Officer Secretary

Staff side

1. Dr. R. Thangavelu Member
Sr. Technical Assistant (T-4)

2. Shri D. Sundararajan -do-
Technical Assistant (T-II-3)

3. Shri M.P. Sivadasan -do-
Technical Assistant (T-I-3)

4. Shri S. Hajanajeemudeen -do-
Sr. Technical Assistant

5. Shri S. Abdulla -do-
Assistant

6. Shri K.J. Mathew -do-
Jr. Clerk

7. Shri K. Sadanandan -do-
Sr. Clerk

8. Smt. E. Sasikala -do-
Hindi Translator

9. Shri M. Krishnan -do-
Binder

10. Shri A.P. Sebastian -do-
SS Gr. III

11. Shri B. Zainuddin -do-
SS Gr. II

12. Shri N.T. Velappan -do-
SS Gr. II

VI GRIEVANCE COMMITTEE

1. Dr. M. Devaraj Chairman
Director

2. Dr. M. Peer Mohamed, Member
Principal Scientist

3. Shri P. Bapaiah -do-
Sr. Adm. Officer

4. Shri M.P. Chandrasekharan -do-
Sr. Finance & Accounts Officer

5. Dr. A. Regunathan, -do-
Sr. Scientist

6. Dr. K. Muniyandi -do-
Sr. Technical Assistant

7. Shri Haji K.M. Abdulla -do-
Sr. Clerk

8. Shri U. Rajendran -do-
SS Gr. I

9. Shri P.A. Naik Member
Asst. Adm. Officer Secretary

DIVISIONS AND THEIR HEADS

1.	Fishery Resources Assessment Division	-	Shri K. Balan Scientist SG
2.	Pelagic Fisheries Division	-	Dr. P.P. Pillai Principal Scientist
3.	Demersal Fisheries Division	-	Dr. P. Bensam Principal Scientist
4.	Crustacean Fisheries Division	-	Dr. N.N. Pillai Senior Scientist
5.	Molluscan Fisheries Division	-	Dr. K.A. Narasimham Principal Scientist
6.	Fishery Environment Management Division	-	Dr. C.S.G. Pillai Principal Scientist
7.	Physiology, Nutrition and Pathology Division	-	Dr. M. Peer Mohamed Principal Scientist
8.	Socio-Economic Evaluation & Technology Transfer Division	-	Dr. R. Sathiadhas Senior Scientist

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
Veraval Research Centre of CMFRI Bhidiya Plot, Near B.M.G. Fisheries Veraval-362 267, Gujarat Phone : 20065	-	Dr. K.K. Joshi Scientist
Bombay Research Centre of CMFRI 148, Army & Navy Building, 2nd Floor, M.G. Road, Bombay-400 001, Maharashtra Phone : 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

DIVISIONS AND THEIR HEADS

1.	Fishery Resources Assessment Division	-	Shri K. Balan Scientist SG
2.	Pelagic Fisheries Division	-	Dr. P.P. Pillai Principal Scientist
3.	Demersal Fisheries Division	-	Dr. P. Bensam Principal Scientist
4.	Crustacean Fisheries Division	-	Dr. N.N. Pillai Senior Scientist
5.	Molluscan Fisheries Division	-	Dr. K.A. Narasimham Principal Scientist
6.	Fishery Environment Management Division	-	Dr. C.S.G. Pillai Principal Scientist
7.	Physiology, Nutrition and Pathology Division	-	Dr. M. Peer Mohamed Principal Scientist
8.	Socio-Economic Evaluation & Technology Transfer Division	-	Dr. R. Sathiadhas Senior Scientist

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
Veraval Research Centre of CMFRI Bhidiya Plot, Near B.M.G. Fisheries Veraval-362 267, Gujarat Phone : 20065	-	Dr. K.K. Joshi Scientist
Bombay Research Centre of CMFRI 148, Army & Navy Building, 2nd Floor, M.G. Road, Bombay-400 001, Maharashtra Phone : 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 : 24152	-	Dr. C. Muthiah Senior Scientist
Calicut Research Centre of CMFRI West Hill P.O., Calicut-673 005, Kerala Phone : 50377	-	Dr. P.S. Kuriakose Principal Scientist
Vizhinjam Research Centre of CMFRI Vizhinjam P.O. Trivandrum-695 521, Kerala Phone : 480224	-	Dr. P.A. Thomas Senior Scientist
Tuticorin Research Centre of CMFRI 90, North Beach Road Tuticorin-628 001, Tamil Nadu Phone : 20274	-	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
Kakinada Research Centre of CMFRI Door No. 8-14-18/2, Red Cross Street, Gandhi Nagar, Kakinada-533 004, Andhra Pradesh Phone : 76231	-	Shri G. Subbaraju Principal Scientist
Visakhapatnam Research Centre of CMFRI Andhra University P.O. Visakhapatnam-530 003, Andhra Pradesh Phone : 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)
Krishi Vigyan Kendra of CMFRI Prawn Culture Farm Narakkal-682 505, Ernakulam Dist., Kerala Phone : 492482, 492450	-	Dr. D. Noble Sr. Scientist
Field Lab of CMFRI Cochin Fisheries Harbour Thoppumpady, Cochin-682 005, Kerala Phone : 230892	-	Mrs. Grace Mathew Scientist (SG)

FIELD CENTRES

Alleppey Field Centre of CMFRI
Geetha Building, Kalarcode
Alleppey-688 003, Kerala

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

Chavakkad Field Centre of CMFRI
Chavakkad P.O. 680 506
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

Jamnagar Field Centre of CMFRI
Milan Chambers,
Khoodiyar Colony
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
Building, 27, Kidwai Road

Kanyakumari Field Centre of CMFRI,
Kanyakumari-629 702
Tamil Nadu
Chavakkad P.O. 680 506

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, Dawoolwada,
Pawar Chal
Malwan-416 606,
Maharashtra

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

Narasapur Field Centre of CMFRI
Door No. 222-5-5/1
Vanisadan
Bromly Compound
Narasapur-534 275
West Godavari District
Andhra Pradesh

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
K.T. Road (Near Ravi Electricals)
Palasa, Srikakulam Ddistrict
Andhra Pradesh

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

Pondicherry Field Centre of CMFRI
C/o Deputy Director of Fisheries
190-Chinnasubrayalu 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,
Devchand Nivas
Lower Lane,
Ratnagiri-415 612
Maharashtra

Srikakulam Field Centre of CMFRI
Door No. 8-15-68,
Ring Road
Near Head Post Office
Srikakulam-532 002

STAFF DEPUTED ABROAD

1. Dr. G. Maheswarudu, Scientist, to USA for long term Overseas Associateship under DBT for the period from 26-1-'95 to 25-1-'96.

2. Mrs. Dr. Mary K. Manisseri, Scientist (SG) to Australia for training in Shrimp Pathology at University of Queensland, Brisbane from 25-1-95 to 2-8-95.

3. Dr. A.P. Lipton, Sr. Scientist to USA to attend Overseas training under DBT for the period from 14-8-'95 to 16-11-'95.

4. Dr. C.S. Gopinadha Pillai, Principal Scientist to Mombasa, Kenya for the participation in Indian Ocean Conservation Workshop from 27-11-'95 to 1-12-'95.

5. Dr. D.B. James, Senior Scientist served as FAO consultant on seacucumber culture at Laama Atol in Maldivies from 12 - 22 December 1995

EDUCATION PROGRAMME

Under the postgraduate programme in Mariculture, a total of about 2200 man-hours was devoted by the scientists of the Institute in teaching the M.Sc./M.F.Sc. students and Ph.D. scholars. Of this, about 1600 man-hours were devoted for M.Sc./M.F.Sc. and 600 man-hours for the Ph.D. course.

Under the Masters programme, the second and third semesters of the 13th batch comprising of 9 students were completed and the students were admitted to the final semester for dissertation work in the subjects of their specialisation. The 14th batch comprising of 10 students completed the Deficiency course and the first semester of the Regular course. One B.F.Sc. candidate selected during 1995 was admitted to the regular course of 14th batch. Four students were admitted to the M.F.Sc. programme in September 1995 (15th batch) and their first semester of the Deficiency course was completed during the period under report.

Under Ph.D. programme, 5 candidates of the earlier batch belonging to the Cochin University regulation were awarded Doctoral degrees for their theses. Another 6 candidates completed their research work and submitted Ph.D. theses to Cochin University. Four Senior Research Fellows working under Cochin University registration have progressed well in their work. The four Ph.D. students (12th Ph.D.batch) who joined last year under the Deemed University regulation have completed their course work and started their research work. The 13th Ph.D. batch comprising of 5 students was admitted and the course work is being completed.

SUMMER INSTITUTE/SEMINAR/TRAINING

Summer Institute on Recent Advances in Marine Fish Stock Assessment - Methods and Models

The Summer Institute sponsored by the ICAR, New Delhi was held from 12 June to 1 July 1995 with Shri M. Srinath, Senior Scientist as its Director and over 10 experts of the Institute as the faculty. Twenty three participants representing the teaching staff, scientists and administrators belonging to the State Agricultural Universities of Kerala, Karnataka, Andhra Pradesh and Orissa; Department of Fisheries, Kerala; Cochin University of Science and Technology, I.A.S.R.I., New Delhi; C.I.F.E., Bombay; F.S.I., Bombay and C.M.F.R.I. attended the Summer Institute. The course consisted of theory in methods and models of fish Population Dynamics and practical training on the use of the standard software package for data analysis. Emphasis was given to the length based methods for estimation of the vital statistics of the stock. Various aspects of fishery management priniciples including economics were also dealt with.

Seminar on Recent Advances in Industrial Fisheries Research and Development

A seminar, sponsored by the University Grants Commission on Industrial Fisheries Research and Development was organised by the Institute during 22-24, January,1996.

The seminar was held under 4 technical sessions. 10 papers were presented by subject matter experts of Central Marine Fisheries Research Institute, Cental Institute of Fisheries Technology and Fisheries College of Kerala Agricultural University on marine capture fisheries, mariculture, Inland fisheries, harvest and post-harvest technologies and fisheries economics. Twenty two participants including Prinicipals, Heads of Departments, Professors, Course Co-ordinators drawn from 14 Colleges and two Universities from 10 States participated in the Seminar.

Training Programme for College Teachers of Vocational courses in Industrial Fish and Fisheries sponsored by the University Grants Commission

A training for college teachers of vocational course in the discipline 'Industrial Fish and Fisheries' sponsored by UGC was conducted at Headquarters from 2nd to 31st May 1995. Teachers of seven colleges representing 5 states participated in the training course. The participants were given training in the taxonomy, distribution and Biology of finfish and shellfish resources.

Training Programme on Fish and Shellfish disease investigations

A Training programme on "Fish and Shellfish disease investigations" was conducted at the Regional Centre at Mandapam Camp from June 26 to July 10, 1995.

KRISHI VIGYAN KENDRA

TRAINING

The following training programmes were conducted:

Sl. No.	Discipline Course	Duration (days)	No. of courses conducted	No. of persons trained		
				Male	Female	Total
1.	**FISHERIES**					
	a) Prawn farming	15	3	15	67	82
	b) Prawn farming	5	10	9	232	241
	c) Crab farming	5	1	20	-	20
	d) Prawn feed preparation	5	1	-	13	13
2.	**ANIMAL SCIENCE**					
	a) Poultry farming	2	2	-	32	32
	b) Livestock production	2	1	-	17	17
	c) Livestock production and Management	5	1	5	13	18
3.	**AGRICULTURE/ HORTICULTURE**					
	a) Vegetable cultivation	2	1	-	25	25
	b) Vegetable cultivation and Management	3	3	-	47	47
	c) Kitchen garden	3	1	-	28	28
	d) Coconut cultivation and Management	3	4	3	87	90
	e) Mushroom cultivation	3	4	7	40	47
4.	**HOME SCIENCE**					
	a) Fruit preservation	3	2	2	47	49
	b) Food and Nutrition	2	1	-	28	28
	TOTAL		35	61	676	737

EXTENSION

The KVK staff participated in the World Health day celebrations jointly organised by Field Publicity Department and 'Tapovanam', a non governmental Social Science Organisation, Puthuvype on 4-4-95.

A meeting of rural women was arranged at Vypeen Block Development Office, Kuzhupilly for the transfer of technology of prawn feed preparation among a group of 11 women.

Participated in the Ernakulam district Matsyamela 1995 organised by the Department of Fisheries, Govt. of Kerala at Maliyankara on 10-6-1995. A lecture on prawn farming was delivered by the staff of the Kendra during the mela.

Special lectures on prawn farming were delivered by the staff of KVK in the orientation courses for Rural youth under the special employment scheme of the state government. The programmes were arranged from 26th to 29th June 1995 at Kandakadavu, Edavanakkad, Kadamakudy, Narakkal, Pallipuram, Mulavukad, Elamkunnapuzha, Nayarambalam, Kumbalanghi and Vyttila by the respective Krishi Bhavans. Apart from rural youths, the local panchayat presidents, Agricultural Officers, Veterinary Officers and Bank officials participated.

KVK, Narakkal was associated in conducting the Farmers day on 18-8-1995 with Krishi Bhavans of Kuzhuppilly, Edavanakkad and Mulavukad. Lectures on prawn farming and coconut cultivation were delivered at those places for the benefit of farmers.

Based on a bench mark survey, 100 families were selected in Narakkal village for lab to land programme. The farm plan and input requirements were identified and 100 families selected for implementation of the programme. Based on another bench mark survey, 44 families of SC/ST people were selected. The farm plan and input requirement were also finalised.

A science camp for the plus 2 students of the govt. vocational higher secondary school, Narakkal was arranged on 23- 1-1996. 25 students and 2 staff members attended the camp. Lectures and practical classes on prawn farming were given. Films on "Aquaculture", "Induced breeding and Aquaculture" were shown.

A Parliamentary study group on Agriculture under the Chairmanship of Shri Nitish Kumar, MP with six other MPs visited KVK, Narakkal on 20-7-1995 to review the activities of the Kendra. The activities and achievements of the Kendra were explained to the Committee.

TRAINERS' TRAINING CENTRE

During the year under report, the Trainers' Training Centre of the Institute conducted 9 training progorammes and one Workshop dealing with mariculture and post harvest technologies developed by the Institute. 121 participants representing the State Fisheries Departments, NGO's and industry were benefitted from these programmes.

Financial sanction of Rs. 35 lakhs was obtained from the ICAR to construct its own training facility at HQs Campus. The construction work entrusted with the State Nirmithi Kendra has already been initiated by them.

TRAINING PROGRAMMES HELD IN 1995-96

Sl. No.	Topic of Training	No. of courses	Dates & Duration	No. of participants	Locality where training held
1.	Seaweed Culture &Utilisation	1	1-10 May 95 (10 days)	10	CMFRI, Mandapam Camp
2.	Pearl Culture	1	22-27 May 95 (5 days)	4	CMFRI, Calicut
		1	4-30 Sept.95 (27 days)	6	CMFRI, Tuticorin
		1	23 Dec. 95 16 Feb. 96 (Entrepreneurship Development Course) (54 days)	14	CMFRI, Tuticorin
3.	Fish & Shellfish disease investigations	1	26 June 95 10 July 95 (15 days)	14	CMFRI, Mandapam Camp
4.	Hatchery production of Marine Prawn Seeds	1	21 Aug. 95 4 Sept. 95 (15 days)	11	CMFRI, Mandapam Camp
5.	Marine Prawn farming for Financing Agencies	1	1-3 Nov. 95 (3 days)	12	CMFRI, Cochin
6.	Marine Prawn farming	1	2-11 Jan. 96 (10 days)	19	CMFRI, Cochin
7.	Artificial Reefs and Seafarming Technologies	1	16-22 Jan.96 (6 days)	20	CMFRI, Cochin
8.	Post-harvest Technology in Fisheries	1	16-25 Jan. 96 (10 days)	11	CIFT, Cochin
	TOTAL	10		121	

LIBRARY AND DOCUMENTATION SECTION

During the year under report, 169 new books and 1732 issues of journals were added to the library at the Headquarters. Essential books and periodicals were also acquired for the libraries at the Regional Centre and Research Centres. Inter library collaboration and Interlibrary 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 CMFRI Bulletins, Special publications and Indian Journal of Fisheries was also made during the period.

The following publications were issued:

1. CMFRI Special Publication Nos. 61-64
2. CMFRI Bulletin No. 48
3. Marine Fisheries Information Service Nos. 136-139
4. CMFRI Newsletter Nos. 65-67
5. CMFRI Annual Report 1994-95
6. CMFRI Research Highlights 1994-95
7. Brochure on CMFRI (English & Hindi)
8. Marine Biodiversity Conservation and Management (Book)
9. Contribution of CMFRI to R&D in Marine Fisheries of Andhra Pradesh
10. Mussel Culture Leaflet (Hindi)

VESSEL MANAGEMENT CELL

Cadalmin-I at Cochin had been decommissioned and disposed off in December 1995. R.V. Skipjack continues to be in laid up condition. A high level meeting was convened by ICAR at New Delhi with an intention to settle the dispute between ICAR and GRSE. An expert committee has been constituted by the Council to inspect and report about the present condition of the vessel. The first meeting of the committee was held on 10-5-'96. Cadalmin-IX is operating making average 20 days cruises per month. Other vessels in operational condition are Cadalmin-III at Madras, Cadalmin-IV at Tuticorin and VI at Vizhinjam.

A wooden boat (25´) has been constructed and commissioned as 'Karimeen' for undertaking trips to Narakkal.

Vessel Management Cell has been coordinating in organising cruises of FORV *Sagar Sampada* pertaining to the Institute. Shri P.R. Leopold, Skipper participated in the Krill resources assessment cruise of FORV *Sagar Sampada* at Antarctica during December 95 - March 96. The cruise planning and programme of FORV *Sagar Sampada* pertaining to CMFRI during 1996-97 had been prepared and submitted to the DOD.

An electrical fish feed drier was designed, developed and fabricated by VMC and handed over to SEETTD. VMC procured materials such as drums, ropes, concrete blocks and graphanel anchors and fabricated 20 x 20 m long line system for mussel culture programme at Andhakaranazhi, Mandapam Camp and Vizhinjam. The services of Cadalmin-IX and its crew were utilised for launching the long line system and to monitoring regularly and harvesting of the mussel. VMC also fabricated artificial reef modules and despatched to Vizhinjam Research Centre. A 10 x 10´pen system was fabricated and errected at Narakkal Field Centre by VMC staff. The vessel crew including officers were engaged in organising and maintaining the infrastructure facilities for the sea farming activities at Narakkal and Fishing Harbour Laboratory.

CONSULTANCIES

The consultancy on the 30 million shrimp hatchery in Andhra Pradesh taken up during 1994-95 was completed during the current year.

At Cochin, a consultancy programme of monitoring the impact of dredging for maintenance in the Cochin Port area was taken up during 1994-95 was continued during the year under report.

THE OFFICIAL LANGUAGE IMPLEMENTATION PROGRAMME

During the year under report a total of 230 letters were received in Hindi and all these were replied in Hindi. 1210 documents coming under Section 3(3) of the Official Language Act were issued in bilingual form.

Regular meetings of the Official Language Implementation Committees at Headquarters and Research Centres were conducted and progress made in Hindi Implementation activities was discussed.

Two meetings of the Cochin Town Official Language Implementation Committee were attended by Shri P. Bapaiah, Sr. Administrative Officer and Dr. M. Peer Mohammed, Principal Scientist.

Hindi fortnight was celebrated at Headquarters and Research Centres from 14-9-95 to 28-9-95. The Institute has actively participated in the Joint Hindi Week organised under Cochin Town Official Language Implementation Committee and got prizes in light music and poetry recitation.

During the year, 2 staff passed Hindi typewriting and one passed Hindi Pragya course. Two staff have completed Hindi Praveen and Hindi typewriting. One is undergoing Hindi Prabodh training.

In the National Scientific Seminar in Hindi on "Marine Living Resources" organised at NIO, Goa, Dr. V.V. Singh, Scientist (Sr. Scale) and Shri M. Feroz Khan, Scientist (Sr.Scale) participated and presented paper in Hindi. In the 2 day National Seminar in Hindi on "Fisheries Technology" at CIFT, Cochin, Dr. Naresh Kumar Verma, Scientist and Shri T.S. Velayudhan, Senior Scientist participated and presented papers in Hindi.

One post of Hindi Translator was filled up at Mandapam Regional Centre. Recruitment action was taken for filling up of two posts of Hindi typist.

Since more than 80% of staff have acquired working knowledge in Hindi, CMFRI Headquarters was notified in the Official Gazette under Rule 10(4) of Official Language Act.

Some of the publications of the Institute were released in Hindi/English.

The Institute won the second prize for excellent Hindi Implementation activities for the year 1994-95 among the Autonomous Bodies situated in the South west region from the Department of Official Language, Ministry of Home Affairs.

The CMFRI also received a rolling trophy for the best Hindi implementation for the year 1995-96 among the autonomous organisations under Cochin TOLIC.

PROGRESS IN RESEARCH

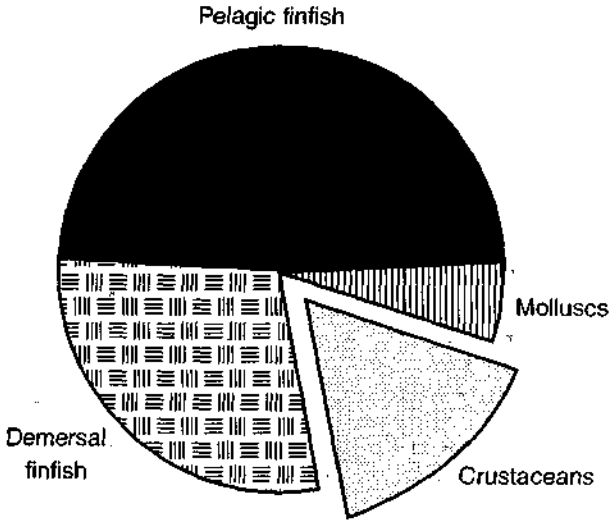
I. Fishery Resources Assessment Division

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 1995

The marine fish landing in India during 1995 was provisionally estimated at 2.26 million tonnes as against 2.36 million tonnes of 1994. The production showed a decrease of 92,000 t (3.9%) compared to that of 1994.



Composition of marine fish landings in India in 1995

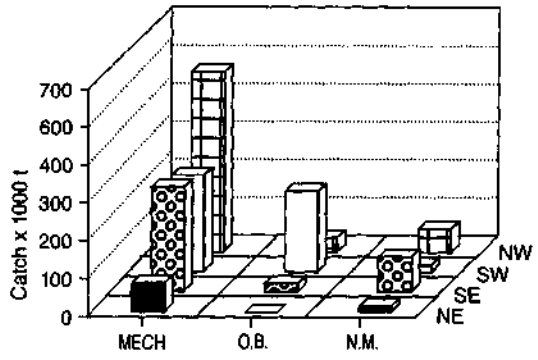
Table -1 Regionwise marine fish production (in tonnes) in India during 1995

Region	Estimated landings	% to the All India Total
1. Northeast (West Bengal & Orissa)	1,16,269	5.13
2. Southeast (Andhra Pradesh, Tamil Nadu & Pondicherry)	5,83,953	25.76
3. Southwest (Kerala, Karnataka & Goa)	7,11,908	31.40
4. Northwest (Maharashtra & Gujarat)	8,21,194*	36.22
5. Lakshadweep & Andamans	33,804*	1.49

*Provisional

The contribution of pelagic groups was 48.5% and demersal groups 51.5%. The mechanized (including motorised) units contributed 87.3% of the total landing and the traditional units 12.7%.

Among the major groups, reduced landings were observed in penaeid prawns (38,000t), mackerel (29,000t), ribbon-



Landings by mechanised (Mech), motorised (OB) and non mechanised (NM) units along the coasts of different regions in 1995.

fishes (39,000 t), croakers (28,000 t) and Bombay duck (17,000 t).

However fishery of carangids increased by 58,000 t and lesser sardines by 41,000 t.

Northeast region

The share of northeast region to the total production in 1995 was 5.13%; there was an increase of 7,000 t over 1994.

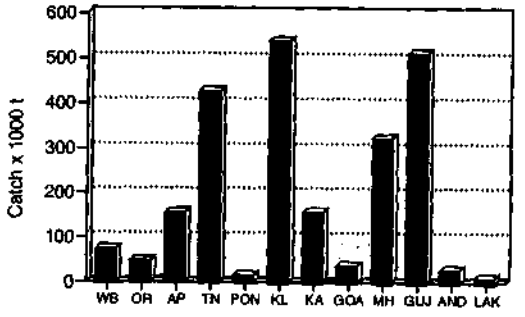
Bombay-duck landing was estimated at 12,000 t which is 5,000 t more than that in 1994. Penaeid prawns, non-penaeid prawns and cephalopods also registered increased landings in the region. The estimates of penaeid prawns, non-penaeid prawns and cephalopods were 8,700 t, 4,000 t and 300 t with increase of 5,000 t, 2,000 t and 100 t respectively. However, the important fishery of the region, Hilsa shad, registered a decline of 6,000 t with an estimate of 18,000t in 1995. The estimate of croakers was 16,000 t with a decline of 2,500t and that of pomfret 8,000 t with a reduction of 1,000 t in 1995.

Southeast region

The estimated landings in southeast region in 1995 was more or less the same as in 1994.

Among the major groups, lesser sardines, perches, mackerel, croakers, pomfrets and crabs recorded increased catches. However, oil sardine, silver bellies, penaeid prawns, non-penaeid prawn and cephalopod landings registered decline.

The landing of lesser sardine was 37,000 t with an increase of 14,000 t. Perch landing was 45,000 t with an increase of 6,000 t in 1995. An increase of 6,000 t was observed in mackerel landings with an estimate of 41,000 t. Pomfret fishery registered an increase of 5,000 t with an estimate of 11,000 t. Crab landing was 15,000 t and an increase of 1,300 t was noticed. However, the estimated landings of oil sardine, silverbellies, penaeid prawns, non-penaeid prawns and cephalopods were 37,000 t, 54,000 t, 42,000 t, 2,000 t and 16,000 t with a decrease of 6,000 t, 5,000 t, 4,000 t, 2,600 t and 1,200 t respectively.



Marine fish landings along the coasts of different States of India in 1995

Southwest region

Southwest region contributed to 31.4% of the total landings. A decline of 67,000 t, compared to 1994 occurred during 1995. Reduced landings were noticed in the case of mackerel by 42,000 t, penaeid prawns 3,000 t, stomatopods 35,000 t, ribbonfishes 18,000 t, perches 14,000 t and croakers 7,000 t. The landing of mackerel in 1995, was 1,05,000 t, penaeid prawns 53,000 t, stomatopods 34,000 t, ribbonfishes 8,000 t, perches 59,000 t and croakers 15,000 t. The estimate of tunnies was 13,000 t and a reduction of 4,000 t was noticed.

Oil sardine landing was 18,000 t in 1995 which showed an increase of 15,000 t. The landings of lesser sardine was 55,000t and an increase of 32,000 t noticed. The landings of carangids also showed an improvement of 54,000 t during the year. In 1995 the estimate of carangids was 128,000 t. The estimate of cephalopods was 53,000 t and an increase of 5,000 t noticed.

Northwest region

Northwest region also contributed for the decline in production during 1995. An estimated 8,21,000 t was landed showing a decline of 36,000 t over 1994.

Major groups that contributed for the decline are Bombay-duck, croakers, ribbonfishes, penaeid prawns, lesser sardines and cephalopods. However, slight increase in the landings of elasmobranchs, seerfishes, pomfrets and non-penaeid prawns was recorded.

Bombay-duck landing was 78,000 t in 1995 which registered a decline of 24,000 t. The estimated landing of croakers was 1,11,000 t and ribbonfishes 50,000 t which showed decline of 21,000 t and 22,000 t respectively. Penaeid prawn catch was 82,000 t with a reduction of 9,000 t over 1994. Lesser sardine landing was 6,000 t with a reduction of 5,000 t. Cephalopod landing was 47,000 t in 1995 with a decline of 1,500 t.

Elasmobranch production was 34,000 t with an increase of 8,000 t in 1995. Seerfish and pomfret landings were 23,000 t and 19,000 t with increase of 7,000 t and 4,000 t respectively. The estimate of tunnies was 12,000 t and an increase of 4,000 t was observed. A slight increase of 1,400 t was noticed in the landings of non-penaeid prawns with an estimate of 68,000 t.

Table 2: Estimated landings (in tonnes) of pelagic fishes in India during 1994 and 1995.

Name of fish	1994	1995
CLUPEOIDS		
Wolf herring	16738	13912
Oil sardine	46814	56633
Other sardines	87148	127905
Hilsa shad	25826	19518
Other shads	23333	13448
Coilia	32327	34201
Setipinna	1546	1771
Stolephorus	60298	69496
Thrissina	8	0
Thryssa	37365	36839
Other clupeoids	53870	46142
BOMBAY-DUCK	109307	92687
HALF BEAKS & FULL BEAKS	2718	5747
FLYING FISHES	219	4090
RIBBON FISHES	112787	73743
CARANGIDS		
Horse Mackerel	24698	21021
Scads	49559	103063
Leather-jackets	5105	5930
Other carangids	59822	66818

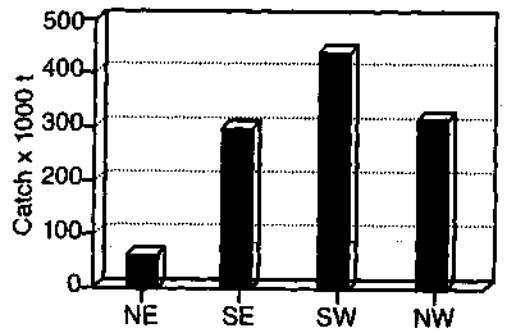
MACKERELS		
Indian mackerel	205844	176802
Other mackerels	22	28
SEER FISHES		
S. commersoni	24624	28587
S. guttatus	16355	17174
S. lineolatus	46	87
Acanthocybium spp.	0	5
TUNNIES		
E.affinis	15705	18781
Auxis spp.	12463	5917
K. pelamis	1086	968
T. tonggol	4953	7036
Other tunnies	3162	5087
BILL FISHES	1722	1388
BARRACUDAS	10400	14679
MULLETS	9976	6498
UNICORN COD	430	139
MISCELLANEOUS	45803	42440
TOTAL	**1102079**	**1118580**

Table:3 Estimated landings (in tonnes) of demersal finfish and shellfish in India during 1994 and 1995.

Name of fish	1994	1995
ELASMOBRANCHS		
Sharks	37830	45929
Skates	2079	2327
Rays	18188	20987
Eels	5994	6119
CATFISHES	45452	38108
LIZARD FISHES	32003	33820
PERCHES		
Rock cods	9449	12457
Snappers	3450	3655
Pig-face breams	9705	10149
Threadfin breams	80936	69549
Other perches	41489	42340
GOATFISHES	12223	9601
THREADFINS	8268	10489
CROAKERS	195233	166917
SILVERBELLIES	69915	64752
BIG-JAWED JUMPER	5820	7152
POMFRETS		
Black pomfret	13796	19976
Silver pomfret	23413	24077
Chinese pomfret	1132	540
FLAT FISHES		
Halibut	2708	3000
Flounders	322	244
Soles	41168	34937
CRUSTACEANS		
Penaeid prawns	224904	186623
Non-penaeid prawns	73500	73999
Lobsters	2692	1946
Crabs	29679	30744
Stomatopods	98052	66330
MOLLUSCS		
Cephalopods	114214	116841
MISCELLANEOUS	53832	44940
TOTAL	**1257446**	**1148548**

Contribution of Pelagic Fishes

Oil sardine: The landing of oil sardine was all time low during 1994 and slight improvement was noticed during 1995. The estimate was 57,000 t which registered an increase of 10,000 t. Oil sardine



Landings of Pelagic fish in different Regions along the Indian coast in 1995

landings accounted for 2.5% of the total production and 5.2% of pelagic groups. The improvement in the fishery was noticed along southwest, particularly from Kerala coast.

Mackerel: The mackerel accounted for 7.8% of the total landings and 16.3% of pelagic fish catch. The estimate was 177,000 t during 1995 which registered a decline of about 29,000 t which is mainly due to reduction in landing along southwest coast.

Whitebait: White bait landing during 1995 was 69,000t which showed an increase of 9,000 t; the production accounted for 3.06% of total landings. Whitebait production was to the tune of 6.39% of the pelagic groups. The southwest region contributed to the major share of whitebait.

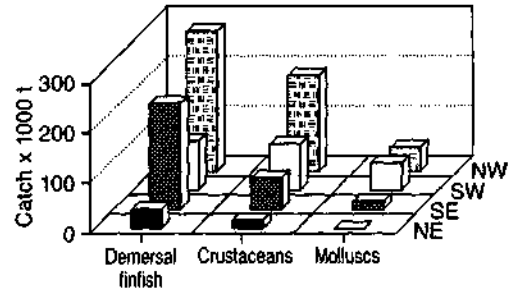
Bombay-duck: An estimated 93,000 t of Bombay-duck was landed accounting for 4.09% of the total landings and 8.55% of pelagic fish catch. A reduction of 17,000 t was noticed in the landings which is due to the declined landing along north east coast.

Ribbonfish: Ribbonfish landings accounted for 3.26% of the total catch. The estimate was 74,000 t in 1995, which accounted for 6.82% of the pelagic fish catch. A decrease of 39,000 t was observed in this fishery.

Tunnies: The tunnies production accounted for 1.67% of total marine fish landings. During 1995, the production was 38,000 t which is 3.49% of the total pelagic fish catch.

Contribution Of Demersal Fishes

Elasmobranchs: The elasmobranch catch of 69,000t accounted for 3.05% of the total



Landings of Demersal finfish and shell fish along the coasts of different regions in 1995

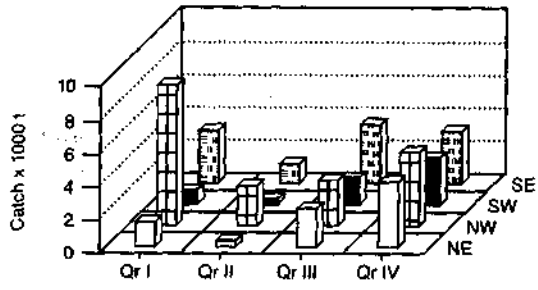
production and 6.02 of pelagic groups. The catch showed an increasing of 11,000t.

Catfishes: The estimate of catfishes was 38,000 t during 1995. A reduction of 7,000 t was noticed in 1995, compared to that of 1994. The production accounted for 1.68% of the total marine fish landings. The percentage contribution to the pelagic groups was hardly 3.3%.

Perches: The perch landings were estimated at 138,000 t which accounted for 6.09% of the total demersal fish catch and the contribution of perches to the total was 12.02%. A reduction of 7,000 t was noticed in 1995.

Croakers: The croaker landings were estimated as 167,000 t. A reduction of 28,000 t was noticed in the production of croakers in 1995 compared to 1994.

Silverbellies: A substantial reduction of 39,000 t was noticed during 1995 in the landings of silverbellies; the estimate was 74,000 t only. The silverbellies production accounted for 3.28% of the total landings and 6.41% of demersal groups.



Estimated quarterly landings of pomfrets along the coasts of different regions in 1995

Pomfrets: The estimate of pomfret landing of 45,000 t showed an increase of 6,000 t was recorded in 1995, compared to 1994. The production accounted for 1.97% of the total landings and 3.16% of the demersal groups.

Contribution of Shellfishes

Penaeid prawns: An estimated 187,000 t recorded in 1995 showed a substantial reduction of about 38,000 t. This fishery contributed 8.23% of total production and 16.24% of the demersal groups including crustaceans.

Non Penaeid Prawns: The non-penaeid prawn contribution was 74,000 t during 1995 and works out 3.26 % of the total marine fish landings. The estimate was of the order of 1994. The production accounted for 6.43 % of the demersal groups.

Cephalopods : The production of cephalopods accounted for 5.15 % of the total landings and 10.17 % of the demersal groups. The estimate was 1,17,000 t during 1995 which showed an increase of 3,000 t compared to 1994.

Landings by Mechanized and Non-mechanized Units

Mechanized, including motorized, units contributed to 87.3% of the total marine fish landings of the country during 1995. There was a slight upward trend of nearly 1% in the mechanized catch, compared to 1994. In the mechanized sector two different categories exist viz., Category I - boats/craft with mechanical power for propulsion and fishing; Category II - boats/craft with mechanical power for propulsion only. Category III consists of artisanal units. Category I units contributed 12,47,000 t (55.8%) to the total catch whereas category II accounted for nearly 7,03,000 t (31.5%). The production by units under Category I declined by about

Table 4: Percentage contribution of different categories of units to the total production of each region during 1994 and 1995.

	1994 Category			1995 Category		
Region	I	II	III	I	II	III
Northeast	25.7	58.6	15.7	34.1	51.1	14.8
Southeast	53.2	15.8	31.0	54.1	20.7	25.3
Southwest	65.8	30.7	3.5	52.3	44.2	3.5
Northwest	64.3	25.2	10.5	63.3	25.3	11.4

1,30,000 t in 1994. However, there was improvement in the contribution of units under category II -nearly 72,000 t.

In the Northeast region, maximum catches were landed from category II units. However, there was increase in the production of the units under category I. In the Southeast region there was a shift from category III units to category II units, persumably motorized units, contributing an additional 5% of production.

Southwest region showed a clear downward trend in the production under category I units. There was no change in the production under traditional sector in the southwest region.

Table 5: Percentage contribution of landings of different regions to the total of category of units.

Region	1994 Category			1995 Category		
	I	II	III	I	II	III
Northeast	2.0	10.5	5.4	3.2	8.5	6.1
Southeast	22.0	15.0	57.1	25.3	17.2	52.2
Southwest	36.6	39.2	8.8	29.8	44.7	8.8
Northwest	39.4	35.3	28.7	41.7	29.6	32.9

Northwest region contributed maximum (41.7%) production under category I units in 1995. A similar trend was noticed in 1994. But maximum contribution under category II units was made in the southwest region (44.7%). With regard to the contribution of category III units, southeast region produced maximum (52.2%).

Table 6: Effort (1000 units operation), Catch (tonnes) and CPUE (kg) of each category of units along different regions in 1994 and 1995

		1994			1995		
		Effort	Catch	CPUE	Effort	Catch	CPUE
Northeast	I	92	28025	306	94	39693	421
	II	342	63978	187	326	59397	182
	III	319	17097	54	291	17179	59
Southeast	I	718	308034	429	675	315667	468
	II	1292	91576	71	1842	120646	65
	III	4300	179417	42	3832	147640	39
Southwest	I	1035	513041	495	791	372171	471
	II	1300	239055	184	1499	314886	210
	III	1007	27398	27	1089	24851	22
Northwest	I	414	518268	1252	517	519551	1005
	II	959	236309	246	879	208360	237
	III	302	90348	299	406	93283	230

Table 5 also indicates that the production of category I units, except in southwest region, had increased. In the southwest region, an increase in the production by category II units was noticed.

Regionwise and categorywise effort, catch with CPUE are presented in Table 6. Effort in this context is the estimated number of unit operations.

In the northeast region, effort did not vary much, but catch and CPUE increased under category I. The other two categories in the region showed a trend similar to 1994.

In the southeast region also, the CPUE increased under category I units. In category II types of units, both effort and catch increased thereby CPUE was almost same as that of 1994. Southeast region contributed less in the traditional sector; both effort and catch declined.

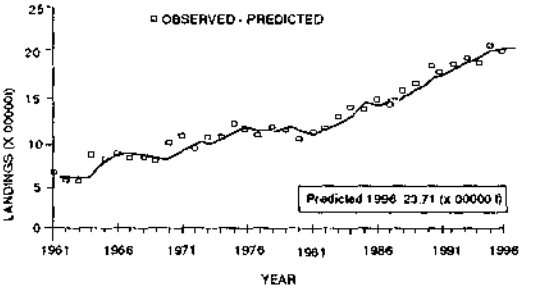
Southwest region depicted a different picture, both effort and catch reduced under category I reducing CPUE from 495 kg of 1994 to 471 kg of 1995. Though effort under category II increased by about 2,00,000 unit operations, CPUE increased from 184 kg to 210 kg in 1995. Variations in category III were not much as that of 1994.

In the northwest region, effort considerably increased under category I, but the catch stabilized with a lesser CPUE of 1,005 kg. Units under category II did not register much variation in the CPUE in this region. Catch more or less remained the same in the traditional sector .

Stock Assessment Techniques in Marine Fish And Shell Fish Resources And Management (FSS/FRA/1.3)

M.Srinath and T.V.Sathianandan

Forecasting of total marine fish landings, and those of some important groups was attempted using the Box-Jenkins ARIMA models. The landing data of 1961-95 formed the basis for the time series analysis. Making use of the autocorrelation and partial autocorrelation function in conjunction with with the AIC and SBC, the process models were identified after the diagnostic checking with the auto correlation of the residuals, appropriate models were formulated.



TOTAL LANDINGS - ALL INDIA
ARIMA (0,1,1)

EVALUTION OF CHANGES IN THE PATTERN OF CATCH AND COMPOSITION OF MARINE FISHERY RESOURCES IN INDIA (FSS/FRA/1.19)

K.S.Scariah,K.Balan, M.Srinath, T.V.Sathianandan and K.Vijayalekshmi

Data from Andhra Pradesh, Maharashtra, Gujarat, and Karnataka pertaining to the period 1960 - 1995 were analysed.

ANDHRA PRADESH

Data on estimated landings of 41 important marine fish species groups during 1960 to 1994 were anlaysed. To see the change in the landings by different gears, species wise estimates of landings by different gears during 1985-94 were also studied.

The estimated landings and percentage contribution of mechanised, non-mechanised and outboard sectors were studied. Charts were also prepared depicting the trends in production and further analysis is in progress.

MAHARASHTRA

The Bombay-duck which was the major component of marine fish landings in the state was showing signs of depletion. During the period, the maximum recorded landing was about 82,000 t in 1981 which gradually declined to about 15,000 t in 1993.

There was increase in the landings of perches from 1987 onwards. In the case of croakers there was not much variation in the landings during the last ten years. Ribbonfish landings showed increase in 1991 and 1992. Another traditionally important variety which suffered a set back was the pomfrets. The landings of pomfrets which were at about 23,000 t in 1983 declined to about 6,000 t in 1994. The landings of mackerel, showed wide fluctuations touching an all time high of about 29,000 t in 1993.

GUJARAT

The information on specieswise/ groupwise landings for three and a half decades from 1960 revealed that elasmobranchs, catfishes, wolf herring, hilsa shad, other shads, anchovies, threadfin, croakers, ribbonfishes, pomfrets, seer fishes, tunnies, penaeid prawn, non-penaeid prawn, crabs, other crustaceans and cephalopods were the major components of the landings. The tabulation and analysis of the gearwise data on marine fish landings for the past one decade was also attempted. The major gears considered for this analysis are trawl net, gill net/drift net, *dol* net and other mechanised gears.

KARNATAKA

During the period under report,some more tables required for drafting the report have been finalised. The contribution of important demersal groups of fishes in the marine fish landings of Karnataka during 1960-1994 was studied.

There was reduction in the landings of cat fishes from 1989 onwards. The maximum landing of 10,253 tonnes was no-

ticed during 1982 with a minimum of 49 t in 1993. Purse-seiner the major contributor for the landings of cat fishes in this state,followed by trawlers.

The contribution of perches showed increasing trend from 1985. A maximum of 10,165 t was landed during 1994. Trawl was the main gear for this group of fishes.

MANAGEMENT INFORMATION SYSTEM IN MARINE FISHERIES (FSS/FRA/ST-1)

T.V.Sathianadan, K.N.Kurup,K.Balan.K.S.Scariah and K.Vijayalekshmi

Besides developing software for creating data bases on marine fishery resources, indepth analysis was attempted to study the inter-relationship of different species as reflected in the commercial landings.

Computerized documentation of the data on resource characteristics of various species collected by Research Centres of the Institute was partly accomplished. This process is continuing.

Information on landings and effort was provided to various endusers such as Central and State Government Departments, MPEDA, CIFNET, NIO, Fisheries Colleges etc.

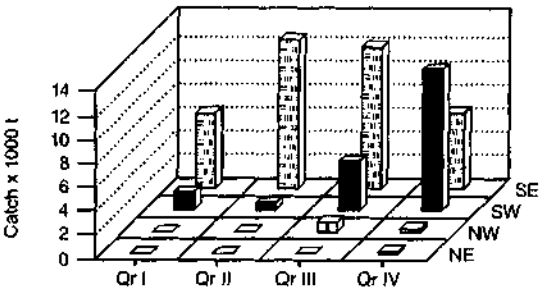
Documentation of survey results as and when data are processed also is being continued on a routine basis.

II. Pelagic Fisheries Division

Fishery And Resource Charactristics of Sardines *(Sardinella spp)* (PF/RE/1.1)

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

Investigations were carried out at Karwar, Mangalore, Calicut and Cochin along the west coast and Tuticorin, Mandapam, Madras and Visakhapatnam along the east coast. Sardines were exploited by purse seine, ring seine, trawl net, gill net and other artisanal gears at different centres. During 1995-96, the total landings of sardines in the four centres along the west coast were 6,312 t against 2,662 t in the previous year; however the landings along the east coast centres declined to 4,198 t in 1995-96 from 7,208 t in the previous year.

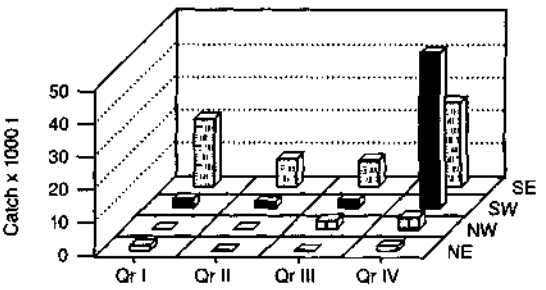


Regionwise Quarterly Landings of Oil Sardine in 1995

The oil sardine catch which was declining in the past two years along the west coast, sahowed increase in 1995-96. An estimated 1,488 t were landed at four observation centres against the 1,101 t in the previous year. Purse seine and ring seine contributed the bulk of the sardine catch along the west coast accounting for 51.8% and 7.4% respectively, followed by trawl and indigenous gears; along the east coast, gill net and trawl net were the principal gears.

Along the west coast excepting Karwar, *Sardinella gibbosa* was most dominant (62.4%) followed by *S.longiceps* (23.6%), *S. fimbriata* (9.8%) and *S.albella* (4.2%). Along the east coast, *S.gibbosa* was dominant at Tuticorin (56.6%) and Madras (54.8%), *S.albella* (63.4%) at Mandapam and *S.fimbriata* (51%) at Visakhapatnam.

In *S. longiceps* the length range in the catch was 80-220mm with fishes of 120-220mm length range being domi-



Regionwise Quarterly Landings of Lesser Sardines in 1995

nant. In *S.gibbosa* the size range was 45-175mm with size groups of 65- 165mm dominating the catches. *S.albella* occurred in the fishery in the size range 85-175mm with 125-145mm size groups dominating the fishery. The size range of *S.fimbriata* was 120-175mm with 140-150mm groups being most dominant.

In oil sardine at Mangalore, young fishes were abundant during December and January and gravid specimens during September. Females dominated both in the adults and pre-adults of the species as well as adults of lesser sardines. In *S.gibbosa* at Cochin females were dominant in the catch and the fishery was constituted mainly by maturing fish. Fishes in spent recovered stage formed about 22% and those in developing condition 34% of the total oil sardine catch at Cochin. At Tuticorin *S.gibbosa* in resting stage was observed in all the months. Young ones of *S.albella* were observed at Mandapam during July-August. Recruitment of oil sardine was reported at Mangalore during December and January and at Kochi during September- November.

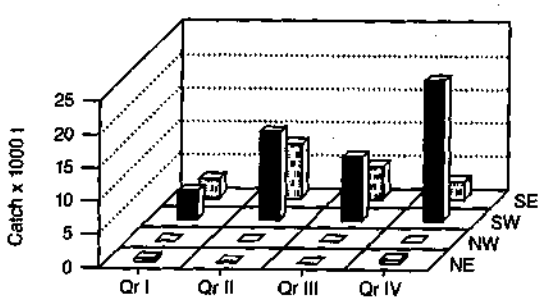
Fishery And Resource Characteristics of Anchovies (PF/RE/1.2)

R. Thiagarajan, Zafar Khan, Prathibha Rohit

Investigations on anchovy resource were carried out at Bombay, Mangalore, Cochin, Vizhinjam and Madras. The gears employed were purse seine, ring seine and trawl net except at Vizhinjam where the traditional gears such as *'Netholi vala'*, boat seine and shore seine were operated.

At Mangalore the estimated catch of 7,056 t recorded 84% increase over 3,828 t of previous year. Purse seine was the major gear (74%), followed by trawl (25%) and ring seine (1%). *Stolephorus* devisi and *S. bataviensis* constituted the fishery. *S. devisi* was the only species in purse seine catch; it formed upto 81% in trawl catch.

At Cochin an estimated 1,300 tonnes of anchovies were landed in 1995-96 with the trawl net accounting for to 314 tonnes and the ring seine for 986 tonnes. This gave an elevenfold increase over 117 tonnes landed in the previous year.Anchovies



Regionwise Quarterly Landings of whitebait in 1995

formed 1.7% and 31% of the total catch of trawl and ring seine respectively. In trawl net *Stolephorus bataviensis* (=*S. waitei*) and in ring seine *S.devisi* were the dominant species constituting 54% and 65% respectively. *S. macrops* (an upwelling related species) was first exploited by trawl net

from the offshore areas during early periods of upwelling (April) and was later caught in ring seine from inshore areas. As upwelling set in, *S. buccaneri* started concentrating in the inshore belt. However, their presence in the areas beyond the inshore region could not be ascertained due to the trawl ban during the peak monsoon months (June-July). The occurrence of *S. buccaneeri* at Cochin is only due to a northward movement of the shoals inhabiting in the inshore belt around Ambalapuzha, south of Cochin, where they are caught in large quantities from the *chakara* grounds during the monsoon period. From Cochin upto Nattika in the north the monsoon fishery was dominated by *S. macrops*. Interestingly the fishery of these two upwelling related species is limited to the south of Mangalore. Probably the clustering of oxygen depleted isopycnals close to south of Mangalore prevent their northward movement. Even among these two species, the northward movement of S. *buccaneeri* is still limited, extending only upto Cochin.

At Vizhinjam the total anchovy catch of 157 tonnes was 77.6% less compared to the previous year. The bulk (63%) of the catch was from boat seine. *S. devisi* and *S. bataviensis* together formed 98% of the catch. Among the upwelling related species *S. buccaneeri* formed only a minor fishery (1.6%) while *S. macrops* was totally absent. This supports the view that *S. macrops* and *S. buccaneeri* enter the inshore belt off Kollam during monsoon from the offshore areas and move northward, the former reaching upto south of Mangalore while the latter only upto Cochin. The greater abundance of *S. buccaneeri* at Centres south of Cochin is probably due to the availability of food items, particularly the bivalve larvae around this area, as evidenced from the occurrence of 25-30 bivalve larvae in the stomachs of individual fish.

At Bombay *Coilia dussumieri* constituted the fishery and the catch trend remained more or less the same as in the previous year.

The C/E of 403 kg noticed in ring seine at Cochin was the highest followed by 379 kg at Mangalore in the purse seine. *S. bataviensis* had a size range of 40-95mm in the catch, with smaller and larger sizes occurring at Vizhinjam. *S. devisi* had a size range of 45-95 mm. At Cochin the size of *S. macrops* was 55-75 mm.

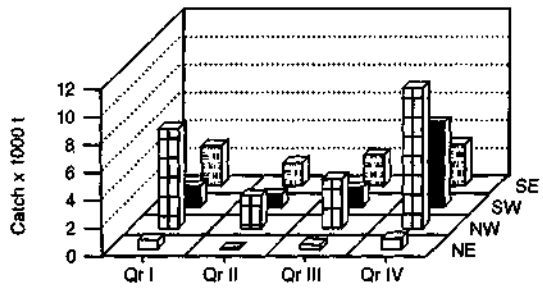
Though most of the species of anchovies are continuous spawners the peak spawning in *S. devisi* appeared to take place during April - August and December-January on the east coast; June, July and September at Vizhinjam; April-May at Mangalore; and April-June and October-December at Cochin.

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

C. Muthiah, B. Manojkumar, Alexander Kurian, K.P.Said Koya, N.G.K. Pillai, H.M. Kasim

Investigations on seerfishes were carried out at Veraval, Bombay, Mangalore, Calicut, Cochin, Tuticorin, Madras and Visakhapatnam. The fishery showed appreciable improvement at all the centres except at Mangalore and Calicut whereas compared to the previous year, the catch declined by 14% and 37% respectively. Seerfishes were exploited by gill net and trawl net; besides they were caught in hook & line also along the east coast centres . Along the west coast the landing was highest at Veraval (1,379 t) and lowest at Calicut (83 t). Along the east coast, the highest catch was at Madras (820 t) and lowest at Visakhapatnam (118 t). Gillnet continued to be the principal gear accounting for 57.3% of seerfish catch with the C/E ranging from 1 kg at Visakhapatnam to 136 kg at Madras, followed by trawl net accounting for 31.2% with C/E varying from 1.3 kg at Cochin to 15 kg at Mangalore-Malpe and hook & line accounting for 11% with a C/E of 5.4 kg at Visakhapatnam, 6.7 kg at Tuticorin and 92 kg at Madras.

The peak period of production was April at Madras; August at Tuticorin; September at Visakhapatnam, Cochin and Calicut; October at Mangalore and Bombay; and September & December at Veraval.



Regionwise Quarterly Landings of Seerfish in 1995

Four species namely, the *Scomberomorus commerson* (king seer), *S. guttatus* (spotted seer), *S. lineolatus* (streeked seer) and *Acanthocybium solandri* (Wahoo) occurred in the fishery, of which the former two were the economically important forming 66.3% and 32.9% respectively. The species distribution was such that the king seer was more common at the southern centres while the spotted seer in the northern centres.

The king seer was caught by all the four gears. The fishery was supported by large fishes (58-114 cm) in hook & line, medium size fishes (48-96 cm) in large mesh gill net and smaller fishes (14-66 cm) in trawl net and small mesh gillnet *'podi valai'* (Tuticorin). The spotted seer was exploited mostly by gillnet and trawl net and the fishery was sustained by 20-48 cm size fishes in both the gears.

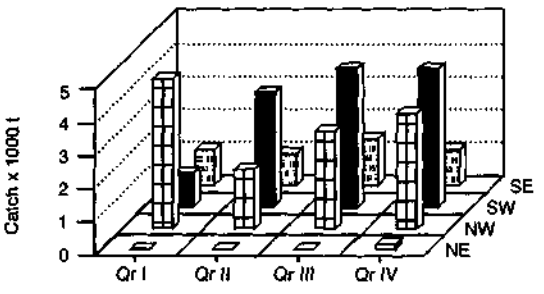
In the case of king seer, the young fish component (18-35 cm) was relatively high in the *podivalai* at Tuticorin (58%) and trawl net at Mangalore (64%) and Tuticorin (49%). The lengths of almost all fishes caught in these two gears at both the centres were less than the size at first maturity (67 cm FL).

The exploitation ratios (F/Z) at Tuticorin (0.55) by hook & line and Mangalore(0.49) by gillnet suggest that the king seer is being exploited at near optimum level, however, the same by trawl at Mangalore-Malpe (0.80) and, by trawl (0.80), *podivalai* (0.83) and *paruvalai* (0.87) at Tuticorin suggest heavy fishing pressure on the stock.

Fishery and Resource Characteristics of Tunas, Tuna Livebaits and Billfishes (PF/RE/2.2)

P.P. Pillai, K.P. Said Koya, M. Zafar Khan, C. Muthiah, N.G.K. Pillai, G. Gopakumar, H. Mohammad Kasim, M. Sivadas and A.K.V. Nasser

Gill net was the sole gear at Veraval, Bombay, Calicut and Madras. At other centres, in addition to gillnet, purse seine (Mangalore and Cochin) and hooks and lines (Vizhinjam and Tuticorin) also exploited this resource. At Minicoy the pole and line was the major gear, followed by troll lines.



Regionwise Quarterly Landings of Tunas in 1995

A decline in the catch was noticed at most of the west coast centres. The centre-wise catch and the trend compared to the previous year were: Veraval 882 t (-119 t),Bombay 173 t (-17.8 t; 9.3%), Mangalore 652 t (-691 t; 51.6%), Calicut 103 t (-303 t; 74.6%), Cochin 548 t (-295 t; 35%). Vizhinjam 3660 t (+1870 t; 104%), Tuticorin 503 t (+158 t; 45.7%), Madras 211.6 t, Minicoy 1562 t (+471 t; 43%) and at Agatti, Bangaram and Perumal par islands 1377 t.

The highest C/E of 484 kg was in the pole and line at Minicoy followed by 94 kg in the purse seine at Cochin. In the gillnet, the C/E ranged from 21 kg at Vizhinjam to 116 kg at Bombay. The hooks and line realised a high C/E of 24.5 kg at Vizhinjam but a low value (2 kg) at Tuticorin.

At Veraval and Malpe *T. tonggol* (62.5% & 56%), at Vizhinjam *A. rochei* (66.3%), and at other centres *E. affinis* (49.4% at Tuticorin to 95.6% at Madras) contributed to the fishery. Skipjack (84.3%) and yellowfin (15.3%) constituted the pole and line fishery. The bullet tuna (*A. rochei*), was concentrated in the off shore waters were exploited almost throughout the year by the mechanised hooks and line at Vizhinjam with peak catch in the pre and post monsoon periods.

The size range of *E. affinis* was 28-72 cm with younger fishes (of 12 cm) noticed in June at Madras. The size range in respect of other species was: *A. thazard* 24-52 cm, *A. rochei* 16-30 cm, *S. orientalis* 16-60 cm, *T. tonggol* 30-96 cm and *T. albacares* 66-122 cm. *K. pelamis* in the pole and line had a size range of 24-72 cm.

The fishery of the important species at Mangalore namely *E. affinis*, A. thazard and *T. tonggol* was supported by 1-year old fish. The exploitation ratios (F/Z) of these species were estimated as 0.61, 0.54 and 0.60 respectively, which suggest that

the present level of exploitation of all the three species is above the optimum.

At Tuticorin,the exploitation rates were computed as 0.13 for males and 0.74 for females of *E. affinis* and 0.80 and 0.56 for the corresponding sexes of *A. thazard*. This indicates that, except for the males of *E. affinis*, all categories are exposed to higher fishing pressure by gill net *(Paruvalai)*. It is, therefore suggested that, in regard to *Paruvalai*, an increase in the mesh size or a decrease in the effort, is essential for a sustained yield along the Tuticorin coast.

The food of skipjack at Minicoy consisted of scads and flying fish. An interesting observation was the occurrence of *Thalassocaris* sp. during monsoon and *Leptochela* sp. in other months. Males dominated throughout the year and spawning appeared to take place during July - October.

Live bait fishery

At Minicoy, 12 t of live baits, which is 2 t less than the previous year, was exploited at a C/E of 3.8 kg. Clupeids (60%), apogonids (39.5%), and pomacentrids(0.5%) constituted the live bait catch. Caesionids were absent in the fishery. At Agatti 59 t of live baits, at a C/E of 15 kg, were exploited. Perumal par was the chief fishing area during April-May; from November onwards the concentration of live bait was at Bangaram. Total tuna catch was 1,378 tonnes at a catch per unit (1 kg) bait (CPUB) of 23 kg. *K. pelamis* dominated the catch forming 91%, and the length range was 24-68 cm (fork length).

Monsoon fishery at Minicoy

The monsoon fishing in the lagoon using trolling, hooks and line and gillnet yielded 15.9 tonnes of fish with a C/E of 14 kg. The hooks and line accounted for 60%. Elasmobranchs, carangids and seerfishes were the dominant groups caught in trolling; carangids (75%) in hooks and line; and perches and belonids mainly in the gillnet.

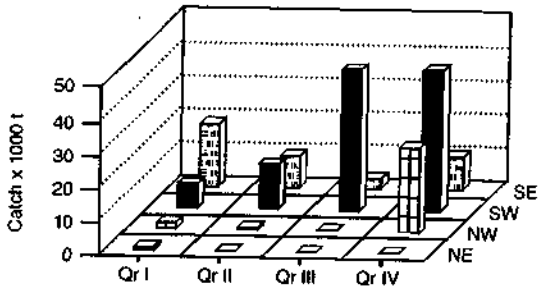
Live-bait culture

Nearly 50 specimens of *Archamia fucata* (Apogonidae), maintained in the aquarium, were fed mainly with clam meat daily. A growth rate of 5-10 mm per month was noticed. Eventhough the fishes were found to be very active, gonadal development was lacking in them even after the attainment of size at first maturity.

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

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

Investigations were carried out at Karwar, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Kakinada and Visakhapatnam. Along the west coast, purse seine was the major contributor at Karwar (100%), Mangalore (70.9%), and Cochin (67.1%), while it was ring seine at Calicut (91.3%) and gillnet at Vizhinjam (54.7%)



Regionwise Quarterly Landings of Mackerel in 1995

and Kakinada (100%), and silk net at Visakhapatnam (68.5%) followed by gillnet at Tuticorin (45.3%) and trawl net at Visakhapatnam (22.8%).

The total mackerel production was maximum at Mangalore (7,730 t) and minimum at Visakhapatnam (86.5 t). In other centres, the estimated production was 120 t at Karwar, 644 t at Calicut, 3194 t at Cochin, 628 t at Vizhinjam, 435 t at Tuticorin and 837 t at Kakinada. Compared to the previous year the catch decreased by 70 t at Karwar, 1,241 t at Mangalore, 1,297 t at Cochin, 409 t at Kakinada, and 142 t at Visakhapatnam; it increased by 278 t at Calicut and 173 t at Tuticorin. The catch at Mangalore and Cochin decreased mainly due to the reduction in the effort of purse seine by 28% and 48% respectively. At Cochin, though increase in the ring seine catch (515 t) took place, the same could not compensate the decline of 2,067 t by purse seine units.

The size ranges of mackerel in the major gears were 80-275 mm in purse seine, 70-279 mm in trawl, 70-254 mm in boat seine. The recruitment size varied from place to place and the minimum size recorded was 55 mm in purse seine at Karwar 80 mm in purse seine at Mangalore; 70 mm in trawl net at Calicut, ring seine at Cochin and boat seine at Visakhapatnam; 120 mm in trawl net at Tuticorin and 85 mm in trawl net at Kakinada. Among the pre-adults, males dominated in trawl at Mangalore and in purse seine at Cochin whereas the females in purse seine at Karwar; in trawl at Cochin and Kakinada and in ring seine at Cochin. Among the adults, the males generally dominated except in *Pattabale* at Mangalore, in purse seine at Cochin, in gill net at Vizhinjam, and in silk net and trawl bet at Visakhapatnam.

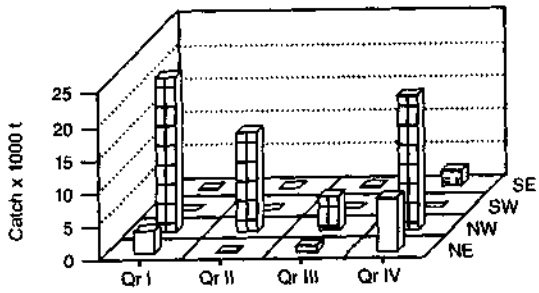
Among the adults, the percentages of gravid and spent fishes were very high in most of the centres, especially at Mangalore, Cochin, Vizhinjam, Kakinada and Viskhapatnam where they ranged from 19% in purse seine at Mangalore to 98% in silk net at Visakhapatnam.

The stock assessment studies were carried out at Tuticorin. The mortality parameters were estimated as Z=7.2 in *podivalai* and 6.62 in trawl net; F = 5.34 in *Podivalai* and 4.76 in trawl net and M=1.86 in both the gears. The exploitation rates estimated were 0.74 and 0.72 in the respective gears which indicated that this species was exposed to higher fishing pressure by both *Podivalai* and trawl net. It is, therefore suggested that a reduction in the effort input or an increase in the mesh sizes of these nets is necessary for a sustainable yield of mackerel at this centre.

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

Alexander Kurien and B. Manoj Kumar

In Maharashtra, the Bombay-duck catch was estimated at 3,287t with a C/E of 306.4kg. The fishery was supported by 30-315mm size groups. The catch has shown increase of 1,491t from that of 1994-95 with marginal increase in effort (9.%). This has been mainly attributed to the absence of pronounced winter, resulting in increase in temperature.



Regionwise Quarterly Landings of Bombay Duck in 1995

Observations on the feeding habits showed that cannibalism is prevalent; the juveniles of Bombay-duck constituted a high percentage of the diet followed by non-penaeid prawns.

Studies on maturation and spawning indicated that though bimodality was seen in the ova diameter distribution, the development of oocytes progressed in paired manner. A recruit spawner took 7.7 months to complete the first spawning cycle and 8.23 months for the second one.

In Gujarat the total catch was estimated at 6654t with CPUE of 40.6 kg/haul. There has been manginal decrease in effort but the catch declined by 13.5% from the previous year. The *dol* net constituted upto 73% at Rajpara and Jaffrabad and 50% at Nawabunder. In all the three centres, the Bombay-duck catch decrease when compared to the previous year. The rate of decrease was 40.6% at Nawabunder, 6.5% at Rajpara and 28.2% at Jaffarabad.

The size distribution of Bombay-duck was 30-314mm at Nawabunder and Rajpara with peaks at 60-74, 150-154, 180-194mm at Nawabunder and 60-74, 105-190, 180-194mm at Rajpara. The sex ratio (M:F) was 54.1:45.9 at Nawabunder and 42:58 at Rajpara.

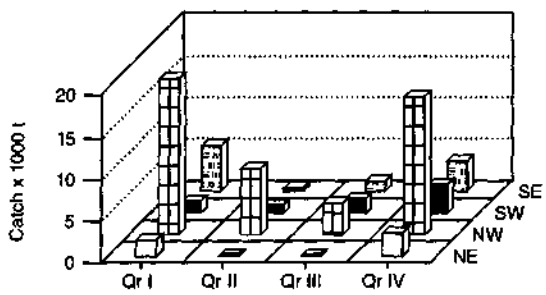
Fishes with empty stomachs dominated at Rajpara. Maturing females were dominant at all the centres.

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

P.N. Radhakrishnan Nair, K.K. Joshi, M. Zafar Khan, K. Preetha, C. Muthiah, R. Thiagarajan and E.M. Abdusaamad.

Trawl net was the principal gear exploitating the ribbonfish at the major centres in the country; 80-90% of the ribbonfish catch at these centres was landed by trawl. During 1995-96, ribbonfish constituted 0.3% (Cochin) to 12.2% (Veraval) of the total trawl catches at different centres. It is also caught in gill net, purse seine, boat seine and other indegenous gears in certain centres. At Vizhinjam, only traditional gears were in operation and ribbonfish was landed in drift gill net and boat seine.

During 1995-96, marginal (2%) to moderate (26.6%) increase over the previous year in the trawl effort took place at Veraval, Bombay, Karwar and Mangalore and a decrease (9% to 22%) at Cochin, Madras, Kakinada and Visakhapatnam. Gillnet effort also declined at Veraval (6.1%), Madhwad (0.8%) and Vizhinjam (20%). At Mangalore, while the purse seine units increased by 19.4%, the number of other gears decreased by more than 50%.



Regionwise Quarterly Landings of Ribbon Fish in 1995

A declining trend in the ribbonfish catch was noticed in the past two years at major centres such as Veraval, Bombay, Mangalore, Cochin, Madras and Kakinada. At Veraval and Bombay, the two major centres for the resource along the north west coast of India, declining trend in the landings was observed: form 12,400t in 1992-93 to 6,311t in 1995-96 at Veraval and from 6,500t to 1,652t in the respective years, with a slight upward trend in 1994-95 at Bombay. At Karwar, the annual catch was never more than 80t in these years and it declined from 78.9t in 1992-93 to 19.5t in 1994-95. At Mangalore, also a major centre along the southwest coast, the catch declined, but at Cochin, Madras and Visakhapatnam, the catch was fluctuating in the past four years. At Kakinada, though the annual catch fluctuated between 838 t and 3,683t during 1989-90 to 1995-96, the fishery generally showed a progressive nature. At Vizhinjam, a centre for traditional gears, the fishery was drastically falling down in the past three years.

During 1995-96 the ribbonfish catch declined in almost all the major centres to the tune of 17% at Kakinada to 81% at Cochin, except at Karwar and Visakhapatnam where the catch increased by 26.6% and 21.8% respectively. In gears other than trawl, increase in the catch was noticed in gill net at Veraval (12.5%) and Vizhinjam (29.4%), and in purse seine (19.4%) at Mangalore. The estimated catch of ribbonfish in trawl net at various centres ranged from 21.8t at Karwar to 6,311t at

Veraval along the west coast and 202.8t at Visakhapatnam to 3,054t at Kakinada along the east coast. In other gears, the estimated landings were 117t, 195.5t, and 14.2t in gill net at Veraval, Madhwad and Vizhinjam respectively; 7.8t in purse seine at Mangalore; 29.7t at Vizhinjam and 11.8t at Visakhapatnam in boat seine and 1.2t in indegenous gears at Mangalore.

The C/E in trawl net ranged from 1.2Kg at Karwar to 87.8 Kg at Veraval with 54.4Kg at Bombay, 16.4 Kg at Mangalore and 2.5Kg at Cochin along the west coast and 1.2 Kg at Visakhapatnam to 65.5 Kg at Kakinada, with 20.5Kg at Madras, along the east coast. In other gears the catch rates were 3.9Kg at Veraval, 8.6 Kg at Madhwad and 0.3 Kg at Vizhinjam in gill net; 0.5 Kg in purse seine at Mangalore; and 4.3Kg at Vizhinjam and 8.4Kg at Visakhapatnam in boat seine.

The fishery existed throughout the year at Veraval, Bombay, Mangalore, Madras, Kakinada and Visakhapatnam with periods of abundance during April-May and October-March. At Vizhinjam, it was a monsoon fishery while at Cochin a post-monsoon one. At major centres, 82 to 92% of the annual catch was landed in the post-monsoon period of October-March (82.6%) at Veraval; September-March (82%) at Bombay and Mangalore; and August-March at Kakinada (90.4%) and Visakhapatnam (91.7%).

Trichiurus lepturus constituted the bulk of the catch at all the centres. *T. ruselli, Lepturacanthus savala, L. gangeticus, Eupleurogrammus muticus* and *E. glossodon* together constituted 10% at Kakinada and 7% at Visakhapatnam. From all other centres *T. lepturus* alone was reported.

The size of *T. lepturus* ranged from 8 to 135cm in trawl; 36 to 116 cm in gill net and 19 to 60cm in boat saine. A multimodal length distribution with modes ranging from 24cm to 104cm in trawl; 38 to 108cm in gill net; and 28 to 43cm in boat seine was reported.

The recruitment size in trawl net was the smallest (8 cm) at Kakinada. It was 16,20,30,32 and 40cm at Visakhapatnam, Veraval, Mangalore, Cochin and Bombay respectively. The recruitment sizes were 36cm in gill net and 19cm in boat seine.

The sex-ratio (M:F) among the pre-adults reported from trawl catches at Mangalore, Cochin, Kakinada and Visakhapatnam was 46.4:53.6, 63.6:36.4, 52.9:47.1 and 47:53 respectively. Among the adults, females dominated at Veraval (55%), Bombay (56.5%), Mangalore (58.7%) and Kakinada (52.8%) while males at Cochin (55.6%) and Visakhapatanm (59%). In gill net and boat seine also the females dominated. Spawning season was generally from November to May or June. The percentge of gravid and spent individuals was more at Mangalore, Cochin, Kakinada and Visakhapatnam.

Using trawl data of Mangalore and the values of $L\infty$ and K of 123cm and 0.35/year respectively, the mortality rates in *T. lepturus* were estimated as Z = 1.41, M=0.73 and F = 0.68. The exploitation ratio was estimated as 0.48 which indicated that *T. lepturus* was exploited at optimum level during 1995-96; during 1994-95 however, the exploitation ratio was estimated as 0.61.

Fishery Forecasting In The Malabar Upwelling Zone (CMFRI/IDP/FF/1)

P.P Pillai, M. Devaraj, P.N.R. Nair, V.N. Pillai, K.G. Girijavallabhan, K. Balan, M. Sreenath, P. Bensam, N.G. Meneon, S. Sivakami, N.N. Pillai, K.N. Rajan, K.A. Narasimham, P. Laxmi Latha.

The data on estimatd monthly landings of oil sardine and mackerel during 1989-1994 and on quarterly landings of mackerel during 1971-1978 from Kerala and Karnataka coasts were compiled.

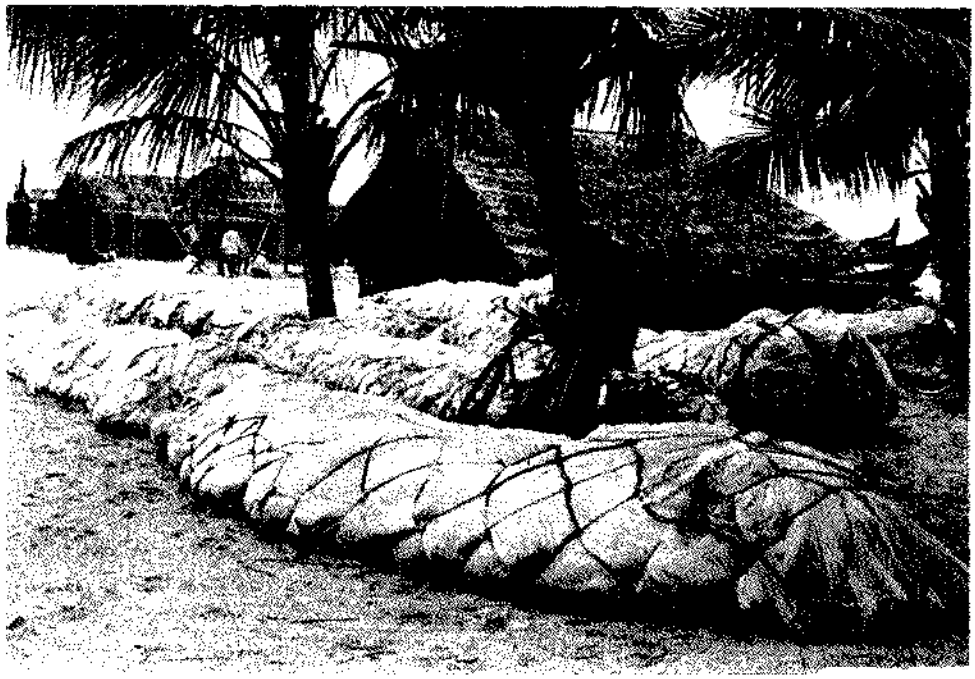
Based on the data of 1984-1990 a correlation between wind direction and pole and line fishery for skipjack tuna was established.

The monthly SST values off Cochin at 20m depth station for the period 1980 to 1993 were analysed to examine the effect of SST on the landings at Cochin Fisheries Harbour. The analyses revealed that the variations in the pelagic fish landings are affected by variations in SST and it is inferred that SST can be a predictor of their landings.

During the period, the relationship between the intensity of upwelling and the sea surface temperature and dissolved oxygen was studied. Though, in general upwelled waters showed low oxygen content and low SST, the relationship is much clear only in the case of SST. Thus, SST can be taken as proxy variable for evaluating the upwelling intensity.

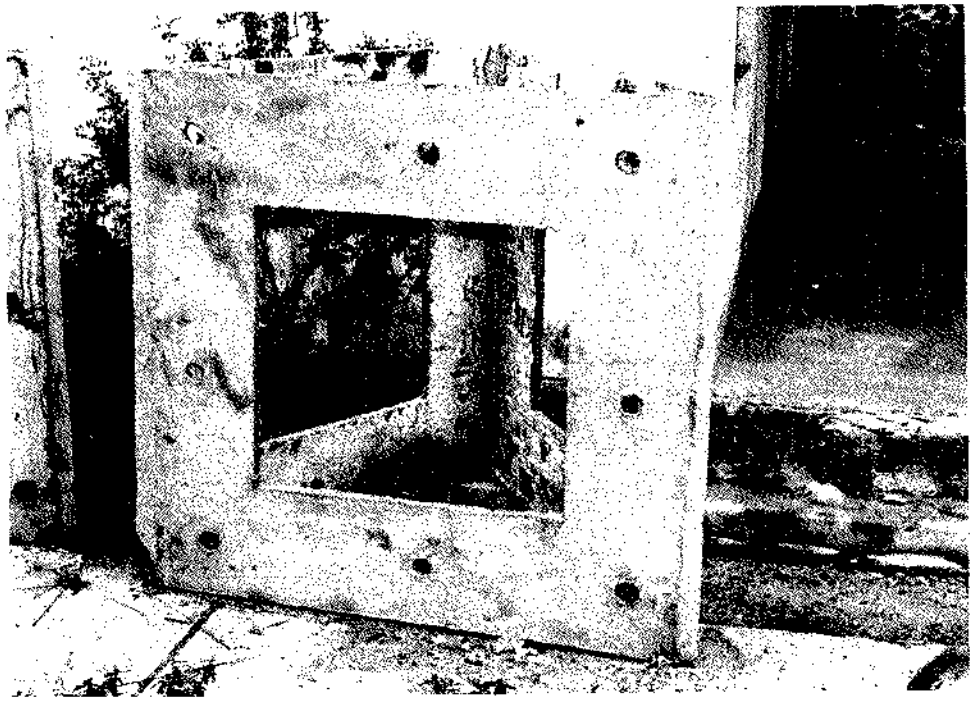
To understand the relationship between abundance of oil sardine and SST and dissolved oxygen, quarter-wise catch and effort data for oil srdine for the period 1972-78 along with quarterly SST and dissolved oxygen values off Cochin and Quilon during the period were considered. The average. SST and dissolved oxygen values at these two stations were taken as representative values for the Kerala coast and it was noticed that the abundance of oil sardine is clearly related to higher SST and higher dissolved oxygen.

With this background, suitable predictors of the success of the fishery seem to be intesity of upwelling, which in turn can be assesed through the SST. It is proposed to consider some more environmental parameters such as wind velocity, atmospheric temperature and rainfall for developing robust forecasting models.

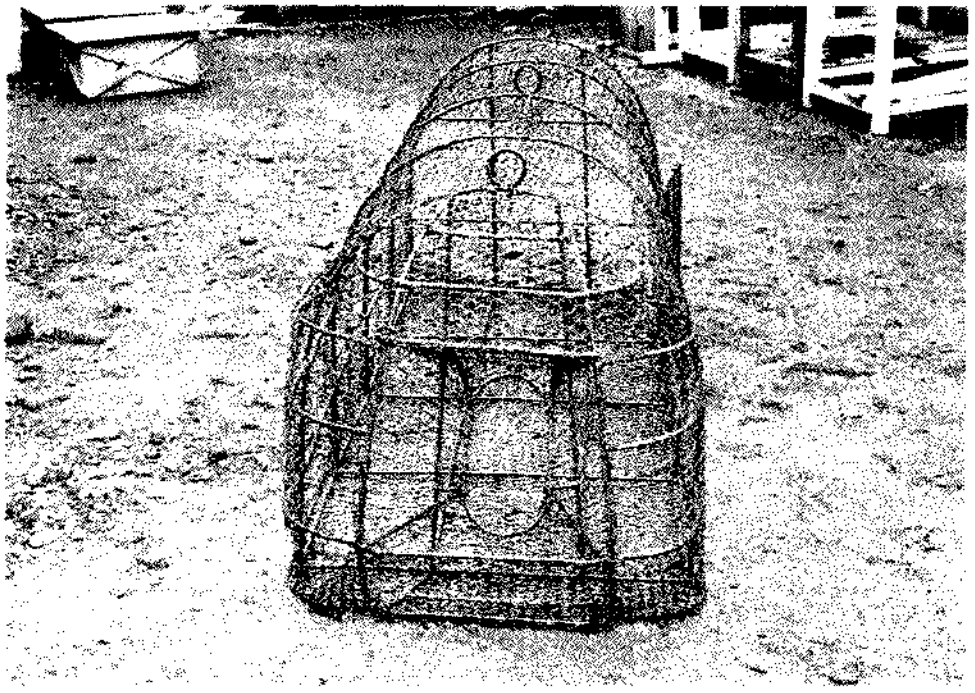


Three units of `ring seine' the simulative type of purse seine, at Purakkad landing centre near Alleppey

Heavy landings of whitebait by ring seines at Purakkad



Concrete module of the artificial reef set by CMFRI along Vizhinjam coast



Cage developed by CMFRI for collecting marine ornamental fishes

III. Demersal Fisheries Division

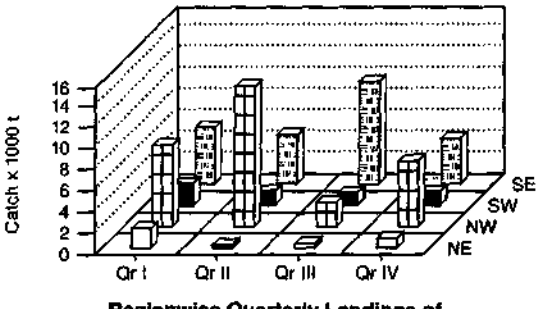
The division undertook ten research projects during the year, of which seven were on resources characteristics and stock assessment, one on evaluation of the non-edible biota and juveniles affected by bottom trawling, one on broodstock development for induced breeding of seabass and groupers and one on ornamental fish resources of Lakshadweep. The resources covered are: elasmobranchs, large perches, catfishes, threadfin breams, silverbellies, croakers, flatfishes, flatheads, goatfishes, threadfins, lizard fishes and whitefish.

The depth of operation of bottom trawls ranged between 10 and 100 m at Veraval, 10 and 70 m at Madras, 20 and 60 m at Visakhapatnam, 40 and 95 m at Puthiappa, 50 and 180 m at Beypore and 8 and 160 m at Cochin. The depth of operation of gillnets at Dhamlej (Veraval) ranged between 5 and 40 m.

Monitoring the Resource Characteristics of Elasmobranchs (DF/RE/1)

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

Work on the project was continued at Bombay, Cochin, Tuticorin, Mandapam and Madras. Maximum catch was brought by trawlers. Long lines at Cochin and bottom set nets at Tuticorin also landed elasmobranchs. At Madras the catch by trawlers was 863 t and by drift gill nets 69 t, dominated by rays. The size range was 20-169 cm in the case of *Rhinoptera javanica* and 20-140 cm in *Dasyatis jenkinsii*. At Mandapam, an estimated 631 t was caught by trawlers at a CPUE of 7.8 kg. *Dasyatis uarnak* was the major species, in the size range of 84-122 cm. At Tuticorin, the total catch was 1,330 t of which trawlers contributed 83% and the rest by bottom set nets and drift gill nets. The bottom set nets appear to be more effective (catch rate of 75 kg per unit), than the others and the catch has improved over that of last year.



Regionwise Quarterly Landings of Elasmobranchs in 1995

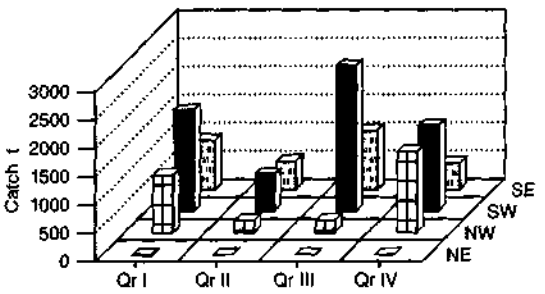
At Cochin, the total catch was 122 t of which 78 t was by trawlers in contrast to 126 t of the previous year. Only 71 units of long lines were operated and they were more effective with a catch rate of 213 kg per unit. Size frequency data in respect of *R. acutus* and *C. melanopterus* were collected. At Bombay, bottom trawlers landed an estimated 2,656 t of sharks, rays and guitar fishes. There was a 19% decrease in the landings when compared to that of last year. Sharks formed 73%. *S. laticaudus*, *D. zugei* and *R. djeddensis* were the dominant species in their respective groups.

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

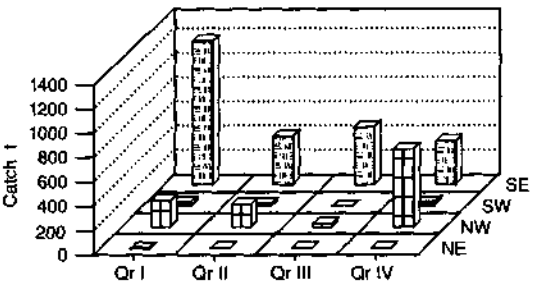
Grace Mathew, S.K. Chakraborty, K.K. Philipose, R. Marichamy and P. Nammalwar

At Bombay, the landing during April-December was 170 t. The catch showed a decline of 270 t over that of the same period of previous year. Trawlers alone landed this resource. October- December was the period of abundance. *Priacanthus hamrur* in the length range of 8-33 cm with the mean at 20.7 cm and *Epinephelus diacanthus* in the length range of 12-44 cm with the mean at 20.5 cm were the dominant species.

At Vizhinjam, the total catch was 394 t by hooks and lines (94%) and 27 t by mechanised drift nets (6%). *L. lentjan, Lutjanus* sp and *Epinephelus undulosus* were the important perches. The length range of *Lethrinus nebulosus* was 16-42 cm, with modes at 34 cm and 38 cm. *L. lentjan* ranged in length from 22 to 64 cm with modes at 42 and 51 cm. E. undulosus ranged from 32 to 74 cm.



Regionwise Quarterly Landings of Groupers in 1995



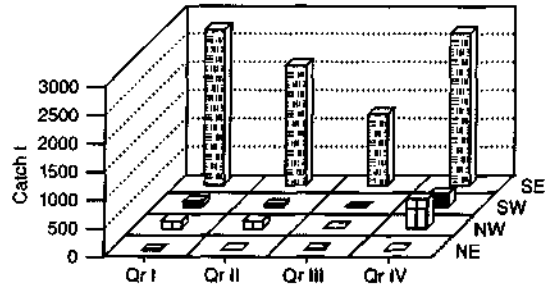
Regionwise Quarterly Landings of Snappers in 1995

At Cochin also bottom trawlers alone landed the perches. There was improvement in the catch when compared to the same period of previous year. *Epinephelus diacanthus* (83%), *Pristipomoides typus* (16%) and *Lutjanus sp.* (1%) contributed to the fishery. August and September were the months of higher landings. The length range of *E. diacanthus* was 20-45 cm with the mode at 44 cm. *P. typus* ranged from 30 to 62 cm in length with the mode at 25 cm.

The estimated total catch at Tuticorin was 3,116 t which was 14% of the total fish production there. Bottom trawls accounted for 88%, hooks and lines for 9% and drift nets for 3%. *Lethrinus nebulosus, Lutjanus rivulatus, Epinephelus tauvina* and *E. undulosus* were the dominant species. *L. nebulosus* ranged in length from 10 to 70 cm, with modes at 19 and 38 cm in trawl nets and 19 cm in drift nets. *L. rivulatus* ranged from 44 to 71 cm with the

mode at 55 cm. July and September were the months of higher abundance.

At Madras, 81 t of perches were landed, mostly from hooks and lines. Groupers formed 86%, snappers 11% and pigface breams 3%. *Epinephenus tauvina* ranged in length from 25 to 110 cm with modes at 55 and 60 cm. Females predominated in maturing stages of I - IV. *Lutjanus johni* ranged from 25 to 70 cm with modes at 37 and 57 cm. Females were predominant. *Lethrinus nebulosus* was the dominant species among pigface breams in the length range of 19 -60 cm with the mode at 47 cm.

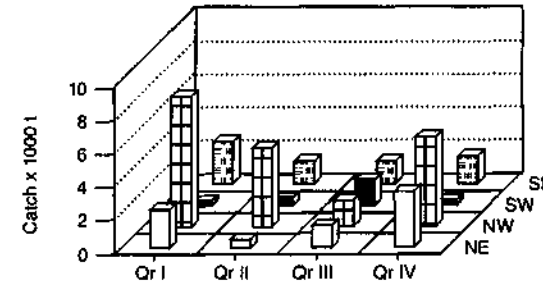


Regionwise Quarterly Landings of Pigface breams in 1995

MONITORING THE RESOURCE CHARACTERISTICS OF CATFISHES (DF/RE/3)

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

The marine catfish landing at Bombay, Cochin, Madras and Visakhapatnam were monitored for the fishery and biology of dominant species. The production showed an increase only along the Northwest coast. At Bombay the catfish landing registered a 15% increase and the catch rate fluctuated from 16.2 kg (June) to 94.7 kg (September). The dominant species were *T. dussumieri, O. militaris, T. caelatus* and *T. sona.* The size range of *O. militaris* was 13-46 cm, with male:female ratio of 1:1.36 and the species has fed on crustaceans. The length range of *T. caelatus* was 18-48 cm, the sex ratio was 1:4.8 and the diet composed chiefly of fishes. At Cochin, the drift gillnets landed 18t of catfishes at a catch rate of 3.3 kg. The production showed a continuously declining trend. *T. thalassinus* (14-54 cm) was the dominant species followed



Regionwise Quarterly Landings of Catfish in 1995

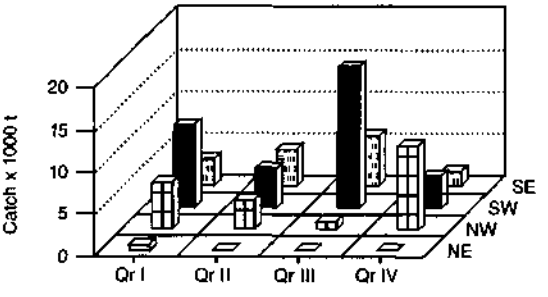
by *T. serratus* (85-100 cm). Mature and ripe females of *T. serratus* occurred in August and September. A total catch of 24 t of catfishes was landed at Madras by hooks and lines and gill nets at Madras. The catch rate ranged from 6.6 to 18 kg per unit. The maximum catch was recorded

in August. *T. dussumieri* was the dominant species and its size range varied from 15 to 95 cm. The dominant size classes were 70-74 cm in June (gill net) and 60-65 cm during August (hooks & lines). In Visakhapatnam, the catfish production by small mechanised trawlers was only 9 t as against 17 t during last year showing a decline of about 50%. *T. thalassinus* has accounted for 77% of the catfish catch followed by *T. tenuispinis* (22%). The size range of the former was 8-24 cm and the entire catch belonged to youngones under the size at first maturity.

Stock Assessment of Threadfin Breams and Silverbellies (DF/RE/4)

E. Vivekanandan, P.P. Manoj Kumar, S.K. Chakraborty, P.U. Zachariah, K.V.S. Nair, V.S. Rengaswamy, V. Gandhi, A. Raju and K.M.S.A. Hamsa

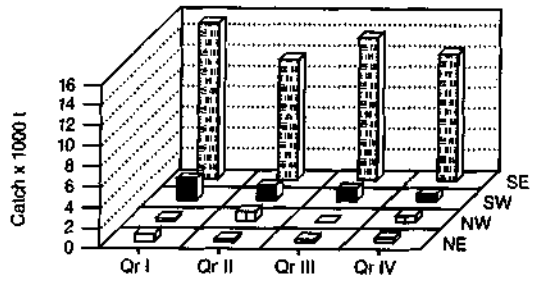
The project on threadfin breams and silverbellies is implemented at 10 Research Centres. Data on catch and effort and biological characters of the exploited population have been collected.



Regionwise Quarterly Landings of Threadfin Breams in 1995

At Veraval, the length-weight relationship, spawning period (October, November), length at first maturity (196 mm), sex ratio and fecundity (14,212 - 48,287 eggs) have been studied on *Nemipterus japonicus*. Length frequency data for estimation of various population parameters have been collected. At Bombay mortality, yield and stock parameters were estimated for *N. japonicus* and *N. mesoprion*. The fishing mortality was considerably higher than natural mortality (F = 2.39 and M = 1.55) for *N. japonicus* and there was a steep fall in the landing of threadfin breams compared to last year. In Karwar, threadfin breams and silverbellies do not form major fisheries. At Mangalore, the length-weight relationship, length at first maturity (145-165 mm), period of spawning (October-January), sex ratio, fecundity, growth (K = 1.2/year), mortality rates (Z = 7.155; M = 2.041), yield and biomass were estimated. The MSY of *N. japonicus* was estimated as 4,947 t for 1.04 times of the present effort. It is advised that the fishing effort is maintained at the present level in the inshore areas; but there is scope for extension of fishing to deeper waters upto 150 m. At Cochin, there was a steep fall in the landings (76%) and the CPUE (64%) of threadfin breams; so also at Tuticorin (22%) and Mandapam (21%) in the landings of Silverbellies.

At Madras, the estimates on stock parameters were made for *N. japonicus, N. mesoprion, Leiognathus bindus* and *Secutor insidiator*. The MSY of the threadfin breams is lower (by 10%) than the



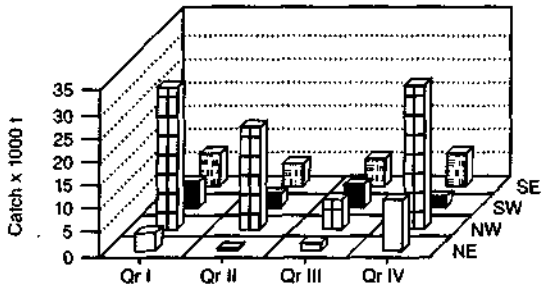
Quarterly Regionwise Landings of Silverbellies in 1995

present yield. It is advised that the fishing effort should not be increased in the present fishing grounds. However, trawling effort beyond 50 m depth could be increased. Presently, only 12% of the catch is from depths beyond 50 m. As more than 40% of the catch comprised of juveniles, increase in the cod end mesh size of the trawl nets from the present 10-15 mm to at least 20 mm is very much essential. In Kakinada, the threadfin bream landings decreased sharply by 48%; but the landings of silverbellies remained almost same. In Visakhapatnam, the decline was sharp in threadfin breams (39%) and silverbellies (29%); the CPUE also decreased by 38% and 28%, respectively.

STUDIES ON THE FISHERY AND BIOLOGY OF SCIAENIDS (DF/RE/5)

S.K. Chakraborty, P.P. Manoj Kumar, P. Livingston, M. Feroz Khan, S. Sivakami, V.S. Rengaswamy, A. Raju, P. Devadoss and K.M.S.A. Hamsa

The work was continued in Veraval, Bombay, Karwar, Calicut, Cochin, Tuticorin, Mandapam, Madras, Visakhapatnam and Kakinada Research Centres of CMFRI.



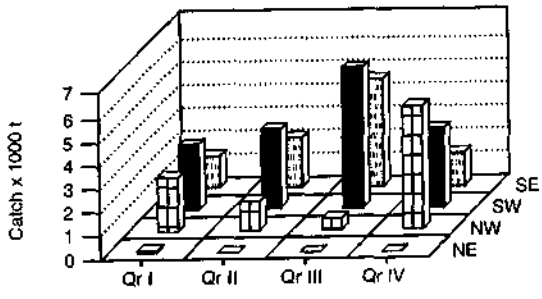
Regionwise Quarterly Landings of Croakers in 1995

Work on the biology was done on *O. cuvieri, J. glaucus* and *P. diacanthus at Veraval, O. cuvieri, J. vogleri, J. macrorhynus, J. sina, P. macrophthalmus, O. biauritus and J. dussumieri* at Bombay; *O. cuvieri at Karwar; J. sina* and *O. ruber* at Calicut and Cochin; *N. maculata, O. ruber* at Tuticorin; *N. maculata* at Mandapam; *K. axillaris* and *J. maculata* at Madras; *N. maculata* and *C. aureus at Kakinada;* and *N. maculata* and *J. macrorhynus* at Visakhapatnam.

Resource Characteristics and Biology of Lizard Fishes, Threadfins and Flat Heads (DF/RE/6)

S. Sivakami, M. Ferozkhan, E. Vivekanandan, P.P. Manoj Kumar and S.G. Raje

(A) Lizard fishes: The lizard fish landings by bottom trawls showed decline at Veraval (by 17%), Mangrol (30%), Bombay (40%), Madras (37%), Visakhapatnam (43%)



Regionwise Quarterly Landings of Lizard Fish in 1995

and Cochin (6%). While centres such as Veraval, Mangrol, Madras and Bombay indicated only marginal changes in effort, at Visakhapatnam, there was a decline of 37% and at Cochin 23%. At Madras, landings of juveniles of lizardfish (above 10 cm), is reported. In Calicut a sharp increase in lizard fish landings (Puthiappa 6.8 times; Beypore 7.78 times) was recorded. *Saurida tumbil* was dominant at Veraval, Mangrol, Bombay and Calicut (Puthiappa and Beypore), and *S. undosquamis* at Cochin and Madras; both these species were landed in almost same quantities at Visakhapatnam. Size range of *S. tumbil* was 15-46 cm (modes 22, 33, 35 cm) at Veraval, 21-38 cm (30, 34 cm) at Mangrol, 11-45 cm with many modes at Bombay and 15-38 cm (22 cm) at Beypore. *S. undosquamis* had a size range of 10-28 cm (19 cm mode) at Madras, 12-34 cm with many modes at Cochin and 16-28 cm (18 and 24 cm) at Visakhapatnam.

(B) Polynemids: Data were collected from trawl and gill net catches at Veraval, bottom trawls at Mangrol and gill nets at Dhamlej. In trawls the catch showed an increase by 16% at Veraval and 212% at Mangrol with a decrease in effort by 8% at Veraval and an increase by 6.5% at Mangrol. In gill net also polynemids showed a sharp increase by 314% in spite of a decrease in effort by 40%. At Dhamlej, the polynemid fishery in gill nets showed an increase by 265% with an increase in effort by 66%. *Polynemus indicus* followed by *Eleutheronema tetradactylum* and *P. sextarius* were the major species represented in the catches. *P. indicus* in gill nets had a size range of 22-99 cm (37, 43, 49 and 63 cm) while in trawls the size range was 30-70 cm (41, 57 cm).

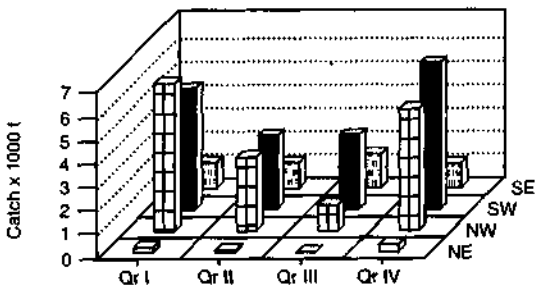
(C) Flatheads: Fishery of flatheads was studied at Veraval, Calicut and Cochin. The fishery showed an increasing trend at Veraval (52%) and Calicut (Puthiappa 59%, Beypore 72%) and a decreasing trend at Cochin (74%). *Platycephalus indicus, P. maculipinna* and *Rogadius asper* were the dominant species oberved at various centres.

Biology and Fishery of Flatfishes, Goat Fishes and Whitefish (DF/RE/7)

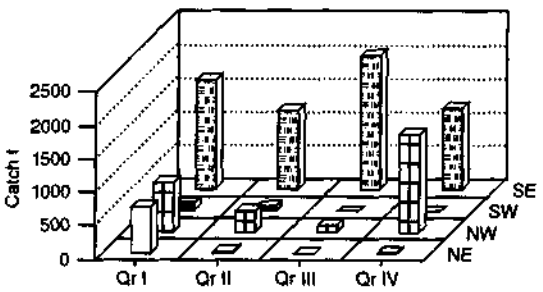
P. Bensam, P.U. Zachariah, M. Ferozkhan, Grace Mathew, S. Krishna Pillai, P. Devadoss and K.M.S.A. Hamsa

(A) Flat fishes: At Mangalore the landings were estimated at 1,726 t, as against 1995 t in the corresponding period of last year, showing a decrease of 13%. Almost the entire catch was obtained by trawlers at an average catch rate of 1.3 kg/hr which is 58% less than that of the previous year. *Cynoglossus macrostomus* was the dominant species which formed 98% of the flat fish catch, followed by *C. arel* and *C. bilineatus*. The length of *C. macrostomus* ranged from 6 to 17 cm with modes at 7 and 12 cm. Mature fishes constituted 52%). At Malpe the landings have decreased from 882 to 126 t, all by trawlers. The dominant species was *C. macrostomus* (99%) in the length range of 7-16 cm with modes at 10.5 and 13.5 cm of which about 62% were mature. At Calicut 1,382 t flatfishes were landed by trawlers at Puthiappa with a CPUE of 21 kg/U. The catch and catch rates have increase considerably compared to the corresponding period of previous year which were only 55 t and 22 kg/U respectively. Bulk of the landings was taken during April, May and June. *Cynoglossus macrostomus* dominated the landings (95%) followed by *Psettodes erumei* (3%) and *C. dubius* (3%). The size of *C. macrostomus* ranged from 7 to 15 cm with the dominant mode at 9 cm. The male:female ratio was 25:65. Maturity stages ranged from I to III with immature fishes dominating.At Beypore 626 t of flat fishes were landed by trawlers at a CPUE of 32 kg/U, showing a considerable increase over the corresponding period of previous year. *C. macrostomus* of 8 to 15 cm dominated the landings.

At Cochin an estimated total of 24 t were landed by trawlers during April-December at an average catch rate of 5 kg/U. There was a drastic decline in the catch when compared to the corresponding period of previous year, probably due to



Regionwise Quarterly Landings of Flatfish in 1995



Regionwise Quarterly Landings of Goatfish in 1995

concentration of trawling activities beyond 50 m and due to the trawl ban imposed by the State Government during June-July. *Cynoglossus macrostomus* formed the bulk (90%) of flat fish catch followed by *Pseudorhombus javanicus* and *Synaptura* sp. In *C. macrostomus* the size range was 7.5-15.5 cm with modes at 9 and 12.5 cm. Indeterminates and preadults constituted 44% and males outnumbered females. Most adults were in advanced maturity stages of IV-VI and VII. *P. javanicus* ranged from 19 to 22 cm. At Vizhinjam a total of 456 t of flat fishes was landed during April-September by disco nets during the monsoon months of May and August. The maximum catch and catch rates were recorded in July followed by June. The major species contributing to the fishery were *Cynoglossus bilineatus*, *C. puncticeps*, *Pseudorhombus triocellatus* and *Zebrias quagga*. In *C. bilineatus* the dominant modes were at 10, 21 and 26.5 cm during June and at 22.5 cm in July. The sizes ranged from 9.5 to 13.4 cm for *Pseudorhombus triocellatus* and from 15.5 to 17.0 cm for *Zebrias quagga*.

(B) White fish: At Mangalore the landing was estimated at 370 t as against 270 t in the corresponding period of the previous year, showing an increase of 37%. At Malpe the white fish landings increased marginally from 44 to 50 t. The length ranged from 10 to 23 cm, with the mode at 15 cm. Mature and gravid fishes constituted the dominant proportion of the catch. About 70 tonnes of whitefish were landed at Calicut (Puthiappa) by trawlers at a catch rate of 3 kg/U. The catch and catch rates during the same period in the last year were only 4 t and 0.34 kg respectively. At Beypore Fishing Harbour, 20 tonnes of whitefish were landed at a catch rate of 2 kg/U.

At Cochin, an estimated 8.4 t were landed by trawlers, as against 8.7 t during last year. The sizes ranged from 11.5 to 14.5 cm with the dominant mode at 12.5 mm. Immature specimens predominated in the fishery. At Vizhinjam, a total of 9.8 t of whitefish was landed during April-September by 'disco' nets with a catch rate of 0.57 kg/Unit. The maximum catch and catch rates were obtained during August and September.

(C) Goat fishes: At Mangalore and Malpe there were no landings of goat fishes as against 690 kg during last year. At Calicut a total of 15 t were landed with a CPUE of 0.6 kg, showing an upward trend compared to the corresponding period of previous year. *Upeneus vittatus* formed 57% and the rest by *U. sulphureus*. In Cochin, the estimated landings of about 7 t during April-September as against 46 t during last year showed a decline of 85%. The catch and catch rates were the highest during April; during October-December the catches were poor. The fishery was constituted mainly by *U. bensasi*. The sizes ranged from 11.5 to 16.5 cm with the dominant mode at 13.5 cm. Maturing (stages III-IV) and gravid (V-VI) specimens predominated in the catches.

At Madras, inspite of a marginal increase (3%) in effort, there was a steep decline in goat fish landings during April-September from 1,981 t to 263 t and from a catch rate of 68.3 kg to 8.8 kg/unit. The decline during October-December was 74% from that of last year. *Upeneus bensasi* was the dominant species (58%) followed by *U. sulphureus*; and *U. moluccensis* occurred only in negligible quantities. The length of *U. bensasi* ranged between 6.5 and 16.5 cm with the dominant modes at 8.5 and

13.5 cm. In *U. sulphureus* the range was between 8.5 and 16.5 cm with modes at 11.5 and 15.5 cm. In the latter species, maturing and spent resting fishes predominated in the fishery. The major food item of the species was found to be prawns. At Visakhapatnam a total of 92 t of goatfishes was landed at a catch rate of 0.7 kg/hr. They formed 3.6% of the total trawl catches and the production has decreased by 47% when compared to the previous year. *Upeneus vittatus* formed 64%, followed by *U.sulphureus* 31%. The size range of *U. vittatus* was between 9.5 and 18.2 cm with the mode at 13.5 cm. Females have constituted about 80% with stages I and I predominating in the fishery. The food was composed mainly of juvenile prawns *(Metapenaeus spp),* crabs *(Charybdis spp)* and *Squilla.*

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

N.G. Menon, P.U. Zachariah, P. Bensam, E. Vivekanandan and A. Raju

At Karwar the nonedible benthic organisms formed 18%, dominated by *Squilla.* Juveniles of flatheads, *Lactarius,* flatfishes, *E. diacanthus,* silverbellies, and *Saurida occurred* in good quantities. At Tadri, the nonedible biota formed 21%, chiefly by *Squilla,* juveniles of *E. diacanthus, Lactarius,* sciaenids and flatheads. At Mangalore the day trawlers landed 29% of benthic biota consisting of nonedible crabs, Squilla etc. Young fishes and juveniles of sciaenids, pomfrets, carangids, *Lactarius* and silverbellies formed 14% of finfish catch of the gear. In Malpe the juvenile fishes caught are those of flatfishes, pomfrets, *Epinephelus* and sciaenids. In Cochin, the discarded bycatch formed about 2% of the total trawl catch. Juveniles of sciaenids, flatfishes and Epinephelus were often recorded in the gear. *Squilla* was the dominant discarded catch. At Quilon the discarded catch mostly comprised of nonedible crabs, gastropods, hermit crabs, juveniles of *P. stylifera,* flatfishes, silverbellies, sciaenids and carangids.

At Mandapam, the nonedible biota formed about 31% (1,328 t), composed of groups like nonedible crabs, echinoderms, *Squilla* and gastropods. At Pamban 10% was by nonedible biota like crabs, gastropods, bivalves, *Squilla etc.* The trawlers at Rameswaram landed 15% of benthic biota. In Madras, the discarded benthic organisms and juveniles formed about 5% of the total trawl catch. Gastropods, crabs and *Squilla* were the dominant items. The discarded juvenile catch included silverbellies, threadfin breams and *Saurida.* At Kakinada, 2% was composed of nonedible organisms like crabs, *Squilla* etc. Juveniles of sciaenids, perches, flatfishes, goatfishes and catfishes also occurred.

Broodstock Development of Seabass and Selected Species of Perches (DF/CUL/3)

R. Marichamy, A. Raju, I. Jagadish and V.S. Rengaswamy

During the period under report, a seed collection Centre of the commercially important grouper, *Epinephelus sp.* was located. The young groupers stocked in concrete tanks and fed with trash fish have shown good growth and survival showing scope for fattening them in coastal ponds. Efforts were made to collect young sea bass from coastal waters with an aim to raise a brood stock. But specimens were not available. Also no healthy adult sea bass was obtained from the wild. However arrangements were made through 'Scanet Aqua Exports Ltd.' to buy the live adult groupers for induced breeding experiments. Intensive efforts were made to stock *E. tauvina* in two coastal ponds along with tilapia in the ratio of 1:8. The recent investigations revealed the scope for collection of mature specimens of groupers for brood stock maintenance and for spawning inducement.

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 in the lagoons at Amini, Agathi, Chetlat, Kalpeni, Kadamat and Kavaratti islands in the months of October, November and December 1995 and January and March 1996. A total of 3695 ornamental fish specimens of 115 species were collected by conducting fishing using gill nets, encircling nets and drag nets. This puts the total collection of ornamental fishes at about 12,000 specimens of 163 species belonging to 22 families. Of the fishes collected so far, the undermentioned species were found to be commonly available in the lagoons of different islands:

Surgeon fish : *Acanthurus triostegus, Ctenochaetus strigosus, A. lineatus, A. leucosternon*

Parrot fish : *Callyodon taeniurus, C. bataviensis, Cryptotomus spinidens, Callyodon ghobban, C. scaber*

Trigger fish : *Rhineacanthus aculeatus*

Puffer fish : *Canthigaster margaritatus*

Butterfly fish : *Chaetodon auriga, C. trifasciatus, C. xanthocephalus, C. falcula, C. meyeri, Heniochus acuminatus*

Squirrel fish : *Myripristis murdjan, Neoniphon sammara, M. adustus*

Wrasses : *Halichoeres centriquadrus, H. scapularis, Stethojulis axillaris, S. albovittata, H. marginatus, Thalassoma hardwickii*

Goat fish : *Mulloidichthys samoensis, Parupeneus macronemus, P. barberinus, M. auriflamma, P. bifasciatus*

Angel fish : *Centropyge multispinis*

Damsel fish : *Chromis caeruleus, Dascyllus aruanus, Abudefduf sexfasciatus, A. saxatilis*

Scorpian fish : *Pterois volitans*

Moorish idol : *Zanclus canescens*

Sandsmelt : *Parapercis hexophthalma*

Lizard fish : *Synodus variegatus*

Data on length and sex composition, maturity condition and food of 30 important species were collected. The growth parameters and mortality rates of Chromis *caeruleus, Dascyllus aruanus, Acanthurus triostegus and Callyodon taeniurus* were estimated . The analysis of the data collected so far on all the species is in progress.

IV. Crustacean Fisheries Division

With a total production of 3.6 lakh t in 1995, the crustaceans formed 15.86% of the country's annual marine landings. The landings in 1995 declined by 13.4% over the previous year. Penaeid prawns contributed to 51.89% of the crustaceans followed by nonpenaeids (20.58%), stomatopods (18.45%), crabs (8.54%) and lobsters (0.54%). When compared to the previous year, the penaeid prawn landings declined by 12.13%, lobsters by 29.13% and stomatopods by 32.35%. However, landings of crabs increased by 6.10% and of nonpenaeids by 0.68%. Trawlers accounted for 81% of the crustacean landings in the country.

Assessment of Fishery and Resource Characteristics of The Penaeid Shrimps of The West Coast of India (CF/RE/1.11)

C. Suseelan, A.P. Dinesh Babu, V.D. Deshmukh, V.S. Kakati, E.V. Radhakrishnan, K.N. Rajan, K.R. Manmadhan Nair, Mary K. Manisseri, P.E. Sampson Manickam, G. Nandakumar and K.K. Philipose

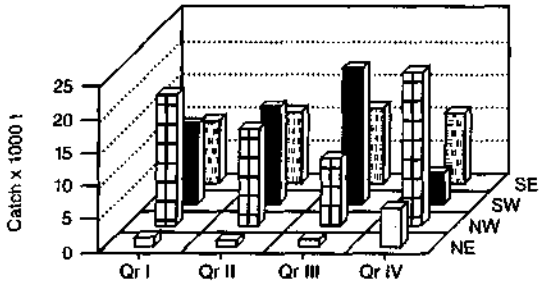
West coast of India contributed 1.4 lakh tonnes of penaeid prawns in 1995 accounting for 72.5% of Indian penaeid prawn landings and registering a decline of 16.5% over the previous year. Kerala contributed 43,224 t, Karnataka 7,783 t, Goa 1,853 t, Maharashtra 40,450 t and Gujarat 42,013 t. The landings declined by 39.86% in Kerala, 7.54% in Karnataka, 29.19% in Goa and 22.82% in Maharashtra over those of previous year. An increase of 56.94% in the landings was obtained in Gujarat. Along this coast 79% of the catch was taken by trawlers.

Investigations were carried out at Veraval, Mumbai, Karwar, Tadri, Malpe, Calicut, Kochi and Sakthikulangara (Neendakara) using trawl data and at Mangalore, Calicut, Kochi, Ambalapuzha and Vizhinjam using data collected from artisanal gears.

Trawl fishery: Trawlers accounted for 72% of the landings in Kerala, 88% in Karnataka, 85% in Goa, 91% in Maharashtra and 56% in Gujarat. Estimated penaeid prawn landings and catch/boat trips at major trawling centres during 1995-96 were 3,765 t (52 kg/unit) at Veraval, 11,641 t (383 kg/unit) at New Ferry Wharf (Mumbai), 435 t (30 kg/unit) at Tadri, 507 t (26 kg/unit) at Karwar, 2,185 t (48 kg/unit) at Mangalore, 956 t (38 kg/unit) at Malpe, 1,053 t (29 kg/unit) at Calicut, 5,101 t (83 kg/unit) at Kochi and 15,700 t (97 kg/unit) at Sakthikulangara (Neendakara). The landings declined by 33.5% at Mumbai, 5% at Malpe, 22% at Calicut and 55% at Kochi over those of previous year. Fishery improved by 4% at Veraval, 46% at Tadri, 21% at Karwar, 10% at Mangalore and 22% at Sakthikulangara (Neendakara). A ban on monsoon trawling in the territorial waters along the Kerala coast was in actual operation for 37 days.

Monsoon fishery for *Parapenaeopsis stylifera* was good at Sakthikulangara; with a total catch of 11,968 t in monsoon months. This species registered an increase of 92% over that of the previous year.

Species composition: *Parapenaeopsis stylifera* was the dominant species in the trawl fishery at New Ferry Wharf (45%), Karwar (75%), Tadri (69%), Malpe (43%), Calicut (54%), and Sakthikulangara (79%). *Solenocera crassicornis* dominated the fishery at Veraval (45%), *M. monoceros* at Mangalore (46%) and *M. dobsoni* at Kochi (56%). Other important constituents of the fishery were *P. stylifera* (39%) and *P. hardwickii* (4%) at Veraval, *Metapenaeus affinis* (16%), *M. monoceros* (9%) and *S. crassicornis* (9%) at New Ferry Wharf, *M. dobsoni* at Tadri (25%), Karwar (16%), *M. monoceros* (33%) and *M. dobsoni* (21%) at Malpe, *M. dobsoni* (17%) and *P. stylifera* (17%) at Mangalore, *M. dobsoni* (25%) and *Penaeus indicus* (9%) at Calicut; *P. stylifera* (33%) at Kochi and *Trachypenaeus* spp (10%) at Sakthikulangara (Neendakara). *Penaeus japonicus* at Mumbai, *Penaeus merguiensis* at Karwar and Tadri, *Penaeus semisulcatus* at Veraval, Kochi and Sakthikulangara and *P. indicus* at Mangalore, Calicut, Kochi and Sakthikulangara supported minor fisheries.



Regionwise Quarterly Landings of Penaeid Prawns in 1995

With the changes in the fishing practices, like multiday fishing operations, extension of trawling to relatively deeper grounds and introduction of night trawling, nonconventional species such as *Metapenaeopsis stridulans* at New Ferry Wharf. *Trachypenaeus* spp and *Solenocera* sp. at Mangalore and Sakthikulangara supported sizeable fisheries.

Dominant sizes supporting the *P. stylifera* fishery were 86-110 mm at Veraval, 71-95 mm at New Ferry Wharf, 76-85 mm at Karwar, 61-95 mm at Mangalore, 61-95 mm at Calicut and 71-95 mm at Kochi and Sakthikulangara.

In *S. crassicornis*, males of 63-73 mm length range and females of 68-108 mm length range dominated the fishery at New Ferry Wharf. In *M. monoceros* dominant size classes were 126-165 mm at Veraval, 108-168 mm at New Ferry Wharf, 98-133 mm at Mangalore and Malpe. *Trachypenaeus curvirostris* fishery at Sakthikulangara was largely supported by 56-80 mm sized prawns.

Artisanal fishery: Estimated total prawn catch in *'Chakara'* at Ambalapuzha (Kerala) amounted to 644 t (41 kg/unit), registering a decline of 12% over the previous year. *M. dobsoni* measuring 78-103 mm dominated the *Chakara* prawn fishery. This species cosntributed to 97% of the prawn landings. Spawners formed 39% of the catch.

At Mangalore, ring seines and hand trawls together landed 612 t of prawns in the monsoon months registering an increase of 199% over the previous year. *M. dobsoni* formed 97% of the fishery.

At Valanjavazhi in Alapuzha district of Kerala, Mini trawl operations in nearshore waters in pre- and postmonsoon months landed 1,095 t of prawns at a catch rate of 56 kg/unit. *Karikkadi* (96%) dominated the fishery. More than 50% of the *Karikkadi* landings are composed of undersized prawns. Wide spread operation of mini trawls in the nearshore waters of Kerala coast has caused considerable damage to the juvenile populations of *'Karikkadi'*. The annual catch of 6,407 t landed by this gear formed 15% of Kerala's prawn production in 1995. This gear registered an increase of 97% in landings over the previous year.

Bottom set gill nets locally known as *Konchu' vala* landed 116 t (3 kg/unit) of prawns at Vizhinjam and Manakudi along the south west coast. Maximum landings took place in the monsoon months. *Naran (P. indicus)* formed 70% of the landings. 156-170 mm sizes dominated the fishery.

Purse seine fishery: Purse seiners at Malpe and Mangalore landed 126 t (8 kg/unit) of prawns registering an increase of 158% over the previous year. The catch was solely supported by *M. dobsoni*.

Juvenile prawn fishery: stake nets at Korapuzha estuary landed 54 t (9 kg/unit) of juvenile prawns comprising of *M. dobsoni* (64%), *M. monoceros* (28%) and *P. indicus* (8%). Catch declined by 62% due to reduction in fishing units and early onset of southwest monsoon.

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

G. Sudhakara Rao, V. Thangaraj Subramanian, K.N. Saleela, M. Aravindakshan, Josileen Jose and M. Rajamani

With a total production of 51,041 t in 1995, the east coast of India contributed to 27.4% of the country's penaeid prawn catch. The fishery showed a marginal increase of 1.6% in the landings over the previous year. Statewise landings are 3,352 t (1.80%) in West Bengal, 5,350 t (2.8%) in Orissa, 13,863 t (7.43%) in Andhra Pradesh, 458 t (0.24%) in Pondicherry and 28,038 t (15.03%) in Tamil Nadu. The landings declined by 11.64% in Andhra, 7.09% in Tamil Nadu and 41.66% in Pondicherry. Remarkable increase of 168.81% in West Bengal and 112.30% in Orissa were recorded. Trawlers accounted for 91% of prawn landings along this coast.

Trawl fishery: Trawlers accounted for 49% of the penaeid catch in West Bengal, 99% in Orissa, 87% in Andhra, 97% in Tamil Nadu and 88% in Pondicherry. Estimated penaeid prawn catch and catch per boat trip during 95-96 at important trawling centres along the coast are: 164 t and 15 kg at Tuticorin, 306 t and 26 kg at Pamban, 997 t and 24 kg at Mandapam, 4,335 t and 88 kg at Madras, 6,975 t and 149 kg at Kakinada, 538 t and 57 kg at Visakhapatnam and 1,215 t and 39

kg at Paradeep. The catch declined by 79% at Tuticorin, 10% at Kakinada and 5% at Paradeep over that of previous year whereas, fishery improved by 35% at Mandapam, 2% at Madras, and 5% at Visakhapatnam.

Species composition: *Penaeus semisulcatus* (55%) dominated the fishery at Tuticorin, *Parapenaeopsis maxillipedo* (36%) at Pamban, *Metapenaeopsis stridulans* (56%) at Mandapam, *M. dodbsoni* (20%) at Madras, *M. monoceros* at Kakinada (28%) and Visakhapatnam (24%) and *Parapenaeopsis* spp. (35%) at Paradeep. Other important constituents of the fishery were *Parapenaeopsis* spp. (26%) and *M. dobsoni* (11%) at Tuticorin, *P. semisulcatus* at Pamban (31%) and Mandapam (32%), *P. indicus* (14%) and *P. maxillipedo* (12%) at Madras, M. dobsoni (26%) and *Solenocera crassicornis* (12%) at Kakinada, *M. dobsoni* (17%) at Visakhapatnam and *M. affinis* (16%), *M. dobsoni* (14%), *Metapenaeus lysianassa* (13%) and *Solenocera crassicornis* (13%) at Paradeep.

Analysis of data for the past few years revealed that 1) large-sized species of *Penaeus* and *Metapenaeus* declined in the fishery leading to the predominance of smaller species of *Metapenaeopsis, Parapenaeopsis* and *Solenocera* along the east coast. 2) *P. maxillipedo* at Pamban and *M. stridulans* at Mandapam have replaced *P. semisulcatus* as dominant constituents. 3) Along the north east coast *Parapenaeopsis* spp., *Solenocera sp.* and *Metapenaeus dobsoni* and *Metapenaeus lysianassa* are caught in abundance.

Juveniles of *P. semisulcatus* formed a significant component of the landings at Mandapam and Tuticorin. Data on length frequency distribution of this species in different years show that there was a gradual decline in the bigger size groups in the landings indicating overfishing of this resource.

Juveniles and subadults formed the mainstay of the fishery in *M. monoceros* at Kakinada. Over the years, there was a gradual decline in the bigger size groups in the fishery indicating that the stock is subjected to heavy fishing mortality. More than 75% of the *M. monoceros* caught by trawlers at Kakinada were juveniles.

Sona boat fishery: 'Sona' boats (43' in length) operating at Visakhapatnam landed 980 t (2.5 kg/hr) of prawns indicating a decline in landings to the tune of 16% over the previous year. *M. monoceros* (30%), *M. dobsoni* (20%) and *P. indicus* (14%) were the principal components of the fishery. Smaller sized *Metapenaeopsis* spp., *Trachypenaeus* spp, *P. longipes* and *Parapenaeopsis* spp. formed about 26% of the penaeid fishery. Prawn landings of 'Sona' boats for the past 4 years indicated a declining trend in the fishery.

Deep sea prawn fishery at Tuticorin: Trawlers operating at a depth of 200-300 meters landed 1,856 t (438 kg/unit) of prawns registering an increase of 455% in the fishery over the previous year. *Metapenaeopsis* spp and *Heterocarpus* spp dominated the fishery.

Artisanal fishery: *Thallumadi* operations at Tuticorin and *Thalluvalai* at Mandapam landed 23 t (2.8 kg/unit) and 6 t (1 kg/unit) of prawns respectively. The fishery was dominated by small sized P. semisulcatus of 80-135 mm length.

Gill nets at Puri landed 59 t (2.4 kg/unit) registering a decline of 60% in landings. *P. indicus* formed 90% of the catch.

Juvenile prawn fishery: Stake nets at B.V. Palem (Kakinada) landed 345 t at a catch rate of 21 kg/unit of which *M. monoceros* formed 70% and P. *indicus* 8%. Landings showed an increase of 86% over the previous year.

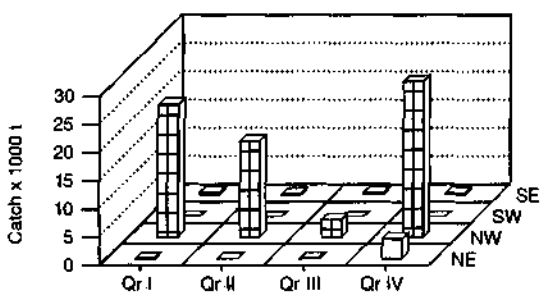
Investigation of the Nonpenaeid Shrimp Fishery of North West Coast of India(CF/RE/1.13)

V.D. Deshmukh and A.P. Dinesh Babu

The estimated nonpenaeid prawn catch in 1995 was 73,999 t, of which Gujarat contributed to 72% and Maharashtra 20%. While Maharashtra showed a decline of 9.6% in the catch, the landings improved by 6% in Gujarat. *dol* nets accounted for 77% of the landings in Maharashtra whereas trawlers for 83% in Gujarat.

Investigations on *dol* net fishery were carried out at Nawabandur and Rajpara at Veraval and New Ferry Wharf and Versova at Mumbai.

Trawl fishery: With a total catch of 14,437 t (201 kg/unit) during 1995-96 nonpenaeid fishery by trawlers declined by 30% at Veraval. Nonpenaeids formed 79% of the prawn fishery in trawlers. Almost the entire nonpenaeid catch (99.6%) was composed of *Acetes* spp.



Regionwise Quarterly Landings of Non-Penaeid Prawns in 1995

Trawl catch at New Ferry Wharf and Versova amounted to 1,981 t (65 kg/unit) and 367 t (25 kg/unit) respectively. Catch declined by 9% and 38% respectively at these centres. Almost the entire catch comprised of *Nematopalaemon tenuipes* of 24-75 mm length.

Dol net fishery: In the *dol* net operations at Nawabunder and Rajpara, the estimated catch was 2,583 t (94 kg/unit) and 2613 t (62 kg/unit) respectively. Fishery improved by 14% at Nawabunder and declined by 28% in Rajpara over the previous year. *N. tenuipes* dominated at Nawabandur (72%) and Rajpara (56%). *Acetes* spp formed 21% at Nawabandur and 36% at Rajpara. Rest of them comprised of *Exhippolysmata ensirostris*. In *dol* net catches 41-52 mm sized *N. tenuipes* dominated the catches. Maximum number of berried females were encountered in September and October.

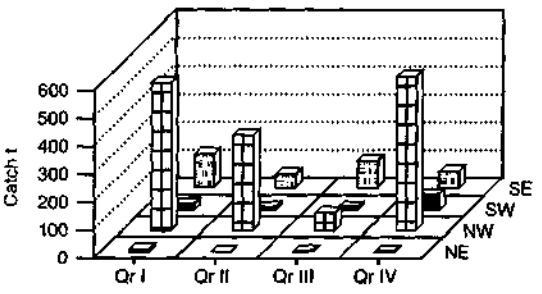
At Versova and New Ferry Wharf in Mumbai, *dol* nets landed 1,969 t (285 kg/unit) 1,981 t (65 kg/unit) of nonpenaeids. The catch registered a decline of 11% at the former and increase of 22% at the latter centre. *Acetes* spp. formed 68% and *N. tenuipes* 31% in *dol* net fishery. 24-66 mm sized *N. tenuipes* was represented in the fishery with maximum berried females in August and September months.

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

N. Neelakanta Pillai, A.P. Dinesh Babu, V.D. Deshmukh, V.S. Kakati, E.V. Radhakrishnan, C. Suseelan, Mary K. Manisseri, K.K. Philipose, M. Rajamani, D.B. James, Josileen Jose, V. Thangaraj Subramanian and K.N. Saleela

LOBSTER

The lobster landings were estimated as 19,946 t in 1995 which showed a decline of 29.13% over the previous year. Gujarat contributed to 64.18% of the lobster fishery followed by Tamil Nadu (15.11%), Maharashtra (14.80%) and Kerala (4.98%). Landings declined by 5.31% in Gujarat, 47.41% in Tamil Nadu, 28.89% in Maharashtra and 78.10% in Kerala. Trawlers accounted for 67% of the lobster landings in the country.



Regionwise Quarterly Landings of Lobsters in 1995

Investigations on lobster fishery were carried out at Veraval, Bombay, Calicut, Vizhinjam, Tuticorin and Madras. While trawl was the major gear operated for exploitation of this resource at Veraval, Bombay, Tuticorin and Madras, artisanal gears were in operation at Calicut, Vizhinjam and Tuticorin.

Trawl fishery: Trawler landing during 1995-96 were estimated at 134 t (1.9 kg/unit) at Veraval;. 74 t (2.5 kg/unit) at New Ferry Wharf, 21 t (0.6 kg/unit) at Tuticorin and 44 t (0.9 kg/unit) at Madras. Landings declined by 5% at Veraval, 16% at New Ferry Wharf, 14.5 % at Tuticorin and 65% at Tuticorin.

T. orientalis was the dominant constituent at Veraval (56%) and Madras (82%). The entire fishery at Bombay was supported by *Panulirus polyphagus*. At Tuticorin, 69% of the fishery was contributed by *Panulirus ornatus*. Other species represented in the trawler landing were *P. polyphagus* (44%) at Veraval, *P. homarus* at Tuticorin (29%) and Madras (18%). Sand lobster *Thenus orientalis* has totally disappeared from Bombay waters. Upto the middle of eighties this lobster formed nearly 45% of the fishery at Bombay.

16 to 200 mm sized lobsters dominated the fishery at Veraval. At Bombay 155 to 255 mm sized *P. polyphagus* formed the major component in the fishery. The present exploitation ratio in *P. polyphagus* at Bombay is higher than the optimum. Hence the exploitation of *P. polyphagus* should be controlled by reducing the present fishing effort by 38%. At Tuticorin, *P. ornatus* of the size 190-250 mm in total length was dominant in the fishery. Berried lobsters were encountered in good numbers in August, October and December.

Deep sea lobster fishery at Tuticorin: Fishing at a depth of about 300 m between December and February, trawlers landed 29 t (12 kg/unit) of deep sea lobster *Puerulus sewelli*. Catch was almost the same as that of the previous year.

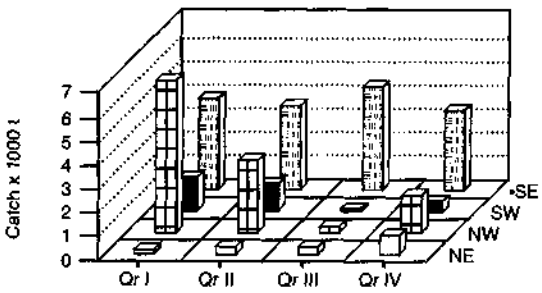
Artisanal fishery: Bottom set gill nets were employed for lobster fishing at Tikkoti (Calicut), Kayalpatnam and Tharuvaikulam (Tuticorin). Traps were operated for lobsters at Vizhinjam, Kolachel and Muttom centres along the south west coast. Bottom set gill nets landed 2.3 t (1.2 kg/unit) at Tikkoti and 38t (2 kg/unit) at Kayalpatanam and Tharuvaikulam. While *P. homarus* dominated the fishery at Tikkoti (76%) and Kayalpatnam (53%), *P. ornatus* (67%) was the dominant constituent at Tharuvaikulam. *Panulirus versicolor* was reported for the first time from Calicut coast. This lobster formed nearly 1% of the catch at Tikkoti.

Traps at Vizhinjam; Kolachel and Muttom together landed 7.6 t (0.6 kg/unit) of *P. homarus*. 61-80 mm sized lobsters in carapace length were dominant in the fishery. Berried females were abundant in March and September.

CRABS

With a total production of 30,702 t in 1995, crab fishery improved by 6.01% over the previous year. Tamil Nadu (37.68%), Gujarat (33.94%), Andhra Pradesh (9.71%) and Kerala (6.61%) were leading in crab fishery. Fishery registered an increase of 60% in Gujarat whereas it declined by 15% in Tamil Nadu, 9% in Andhra Pradesh and 58% in Kerala. Trawlers accounted for 75% of crab landings in 1995.

Trawl fishery: Estimated catch and catch per boat trip during 1995-96 at important trawling centres were 1,131 t and 16 kg at Veraval, 203 t and 7 kg at New Ferry Wharf, 336 t and 7 kg at Mangalore, 128 t and 5 kg at Malpe, 171 t and 5 kg at Calicut, 68 t and 1 kg at Kochi, 858 t and 18 kg at Madras and 202 t and 4 kg at Kakinada. When compared to the previous year, the fishery declined by 42% at Veraval, 54% at New Ferry Wharf, 16% at Malpe, 5% at Calicut, 32% at Kochi, 33% at Madras and 39% at Kakinada. Only at Mangalore, the fishery improved by 51%.



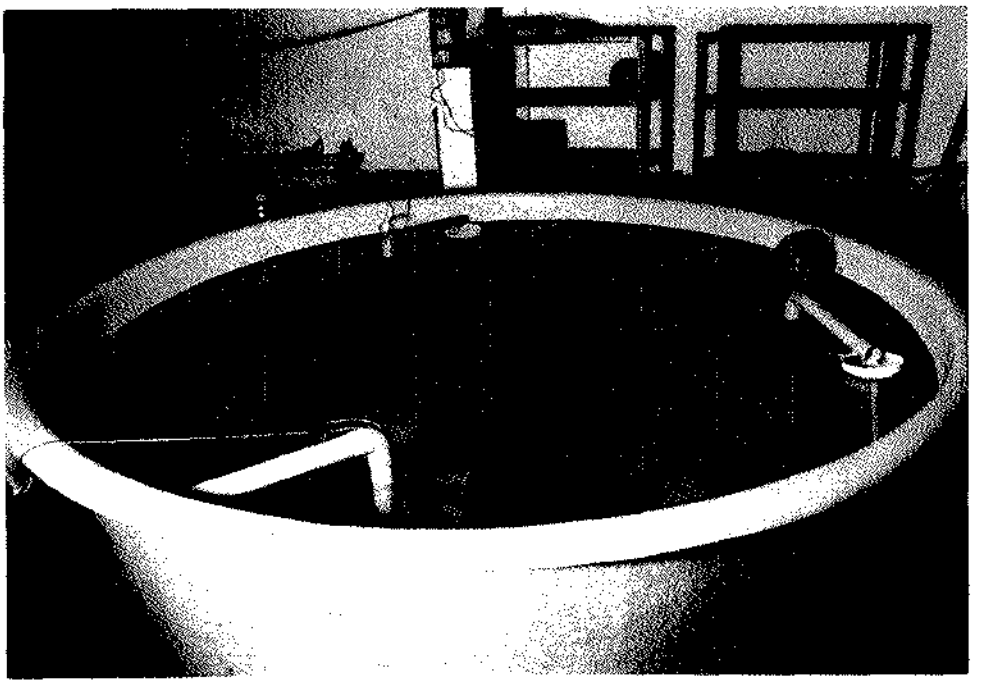
Regionwise Quarterly Landings of Crabs in 1995

In the trawl fishery, dominant constituents were *Charybdis lucifera* (98%) at Veraval, *Charybdis cruciata* at Bombay (69%), Malpe (44%) and Mangalore (67%), *Portunus pelagicus* (40%) at Calicut and *Portunus sanguinolentus* at Madras (39%) and Kakinada (67%). Other important constituents were *P. sanguinolentus* at Bombay (12%), Mangalore (23%), Malpe (32%), Calicut (38%), *P. pelagicus* at Malpe (23%) and Kakinada (15%) and *C. cruciata* at Malpe (28%), Calicut (22%) and Kakinada (18%). Nonconventional species such as *Charybdis smithii* (17%), *Podophthalmus vigil* (12%) and *Charybdis natator* (11%) supported minor fisheries at Madras. With the extension of trawling to deeper waters *C. cruciata* has emerged as the leading component of the trawl fishery at most of the centres.

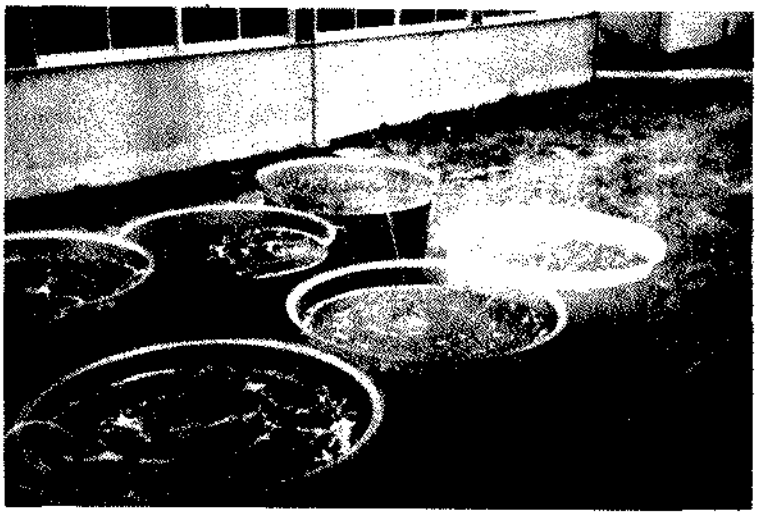
In *C. cruciata* 83-113 mm sized individuals dominated the trawl fishery at New Ferry Wharf. Berried females were abundant in August-October period.

Artisanal fishery: *'Konchu vala'* landed 71 t (3 kg/unit) at Vizhinjam and bottom set gill nets fished 128 t (12 kg/unit) at Tharuvaikulam. *P. pelagicus* dominated the fishery at Vizhinjam (53%) and Tuticorin (90%).

Onshore mariculture facilities developed at Fisheries Harbour Laboratory of CMFRI, Cochin



Indoor phytoplankton culture facility at the shellfish hatchery of Tuticorin Research Centre



Outdoor phytoplankton culture at the shell fish hatchery of TuticorinResearch Centre

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

N. Neelakanta Pillai, K.R. Manmadhan Nair, P.E. Sampson Manickam, V.S. Kakati, Josileen Jose and P.T. Sarada

At the mini shrimp hatchery at Mandapam Camp (one lakh seed per run) experiments on the seed production of *Penaeus semisulcatus* and *P. indicus* were carried out. Prawns for brood stock were collected from the trawl catches. 34 *P. semisulcatus* and 3 *P. indicus* spawned in controlled conditions releasing healthy nauplii. These nauplii were reared in one ton capacity FRP tanks until they metamorphosed into postlarvae. Post larvae were reared in concrete nursery tanks of 6-8 ton capacity. Upto mysis I, larvae were fed with mixed diatom culture. From Mysis II, the larvae were fed with egg, prawn, custard until they reached PL 20. 9,23,272 postlarvae produced in the hatchery were used for sea ranching experiments.

Rearing experiments were carried out on the portunid crab *P. pelagicus*. Berried specimens caught from the wild, were brought to the laboratory and maintained in controlled condition. The specimens spawned within 3-4 days releasing about 2 lakh zoeae. Experiments were carried out by stocking these zoeae in different concentrations (10 to 40 zoeae/ litre) in one ton FRP tanks. These larvae were provided with *Chlorella* and rotifer. Advanced zoeae were fed with prawn meat - egg custard. Within 20- 21 days, zoeae completed the larval stages and metamorphosed to first instar. Survival was 8-9%. Further experiments on its broodstock development and farming are being carried out. Initial experiments revealed that this species can be considered for sea farming.

At Minicoy, postlarvae and juveniles of *P. latisulcatus* and *P. canaliculatus* were collected from lagoons and rearing experiments carried out.

Prawn and Fish Seed Resources (CF/RE/2)

G. Subbaraju, G. Sudhakara Rao, A. Raju and K.N. Saleela

Studies carried out on the exploitation of prawn seed resources of Kakinada coast revealed that despite the availability of good quantities of prawn seed along this coast, due to the wide spread disease in the shrimp farms, the price of the seed per piece came down from 14 paise to 2 paise. Hence there was a drastic decline in the exploitation of wild seed

V. Molluscan Fisheries Division

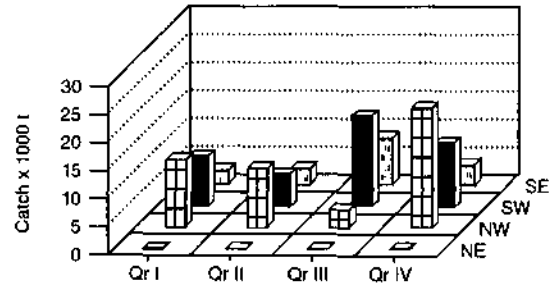
Investigations on the Resource Characteristics of Cepahalopods (MF/RE/1)

M.M. Meiyappan, K.K. Joshi, Kuber Vidyasagar, K. Sunilkumar, Mohamed, P. Laxmilatha, K.K. Appukuttan, K. Prabhakaran Nair, A.P. Lipton, E.M. Abdussamad, R. Sarvesan

The cephalopod production in the country in 1995 was estimated at 1,16,841 t registering an increase of 2,900 t over the previous year. Trawl contributed to the bulk of the cephalopod landings, except in Vizhinjam where indigenous gears were used.

The cephalopod production at various centres during 1995 is as follows:

When compared to the corresponding period of 94-95, the catch has increased by 12% at Bombay,54% at Veraval, 27% at Mangalore, 19% at Vizhinjam and 23% at Mandapam/Rameswaram. The catch



Regionwise Quarterly Landings of Cephalopods in 1995

Centre	Catch (t)	C/E (kg)	% in AF	Squids (t)	Cuttlefish (t)	Octopus (t)
Veraval	3599	50	7	2172	1427	0
Mangrol	1009	43	6	590	418	0
Bombay NFW	13438	442	22	7685	5710	44
Bombay SD	7055	435	22	4918	2135	2
Mangalore	4399	97	12	2649	1750	0
Malpe	2125	85	17	957	1168	0
Cochin	8183	111	20	1475	6210	498
Vizhinajm	569	BS9 HL6	6	360	209	0
Mandapam**	655	7	2			
Madras	1499	31	5	652	828	19
Kakinada	920	20	3	260	660	0
Visakhapatnam	150	6	5	42	108	0

** Only data of April - January for both Mandapam and Rameswaram
C/E : kg per trawler day; AF : All fish; BS : Boat Seine; HL : Hooks and lines

declined by 36% at Mangrol, 13.11% at Cochin, 56% at Madras, 11% at Kakinada and as much as 90% at Visakhapatnam. The fishing effort declined at Bombay by 8%, Mangrol 9%, Mangalore 22%, Mandapam 10%, Kakinada 9% and Visakhapatnam 29%. Increased (by 10%) effort was expended only at Madras.

Catch composition: The groupwise production trend showed the dominance of cuttle fishes in most centres excepting Bombay and Veraval. The catch composed mainly of *Sepia pharaonis* and *S. aculeata* at most centres. Beside these, *S. elliptica* contributed to the fishery at Veraval, Cochin and Kakinada.

The squid landing was dominated by *Loligo duvauceli* at all centres. *Doryteuthis* sp. was landed at Mangalore, Cochin, Vizhinjam, Madras and Kakinada in moderate quantities.

The octopus production was less compared to the other two groups and production came only from Bombay (46 t), Madras (19 t) and Cochin (498 t). At Cochin, *Octopus membranaceous* was the dominant species followed by *O. dolfusi* while at Madras the catch was composed of *O. dolfusi* and *Cistopus indicus*.

Biology: Biology of *L. duvauceli, S. pharaonis and S. aculeata* was studied at different centres. The fishery was supported mainly by immature/maturing squids and cuttlefishes although mature ones were observed throughout the year.

Loligo duvauceli: The size range of this squid was 30-310 mm, 20-280 mm, 30-310 mm, 60-160 mm, 80-220 mm, 50-160 mm, 20-150 mm and 40-190 mm respectively at Veraval, Bombay, Mangalore, Cochin, Vizhinjam, Madras, Kakinada and Visakhapatnam. Mature individuals were observed throughout the year in all centres. At Mangalore peak spawning activity was observed during September - November period and maximum recruitment during December-February period. Stock assessments made at Bombay and Mangalore gave MSY values of 12,277 t and 2,000 t respectively.

Sepia aculeata: The dorsal mantle length varied between 50 and 150 mm at Veraval, 20 and 200 mm at Bombay, 60 and 150 mm at Madras, 20 and 200 mm at Kakinada and 70 and 190 mm at Visakhapatnam. Mature individuals of both sexes were observed in all months. At Bombay the MSY of this species was estimated at 2,695 t.

Sepia pharaonis: The length range of this species was 85-310 mm at Veraval, 120-620 mm at Bombay, 40-230 mm at Cochin, 170-220 mm at Vizhinjam, 110-230 mm at Madras, 50-280 mm at Kakinada and 70-220 mm at Visakhapatnam.

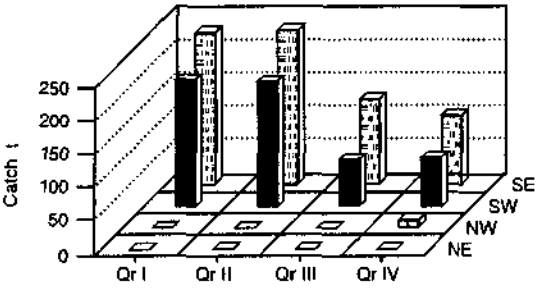
Incursion of squids and cuttlefishes into the nearshore waters was observed along the Tuticorin coast during July. The catch was dominated by *L. duvauceli* of which two dominant size groups at 160-250mm and 260-300mm. *S. pharaonis, Sepioteuthis lessonaina and S. inermis* were also landed. All species were in fully mature condition. This phenomenon which occurs during the monsoon along west coast has been observed for the first time along the Tuticorin coast.

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

P.S. Kuriakose, K.K. Joshi, M.E. Rajapandian, K. Sunilkumar Mohamed, P. Laxmilatha, K.K. Appukuttan, T.S. Velayudhan, N. Ramachandran, K. Ramadoss, A.P. Lipton, P.V. Sreenivasan, P. Natarajan, R. Sarvesan

Green mussel

The total production of green mussel (Per*na viridis*) between Challiyam and Koduvally along the Malabar coast was estimated at 2,472 t. This was 1,253 t less than the production (3,725 t) during the previous year. The total effort during the year was 52,683 man-days and the average catch rate was 46.92 kg per man-day. The size of mussels in the commercial catch ranged from 50-130 mm with modes at 50 mm, 85 mm and 110 mm. The price for 100 kg shell-on mussels at the landing centre varied from Rs.600-1000 and market price varied from Rs.650-1100. Spawning of green mussels started in August and spat settlement commenced in September. Good spat settlement was noticed at Elathur, Moodadi, Mahe and Koduvally during this year.



Regionwise Quarterly Landings of Bivalves and Gastropods in 1995

Brown mussel

The estimated annual landing of brown mussel(Perna indica) along the Vizhinjam-Mulloor, Pulinkudi, Kolachel and Enayam coast was estimated at 397.2 t. The total effort was 22,588 man-days and average catch rate was 17.58 kg per man day. The catch was maximum during October-December.

Clams

Details of clam production at various centres are given in the table below.

Based on the information furnished by Co-operative Societies, the production of black clam *Villorita cyprinoides* in the Vembanad lake was estimated at 56,400 t which is 1,102 t less when compared to the corresponding period of previous year (57,502 t). The average meat yield was 15% of the total weight. The price of black clam shell per tonne ranged from Rs.530 to 1316.

Mangalore: The estimated production of clams from the Mulki estuary was 239 tonnes which is 1.2 t less than that obtained during the previous year. The effort involved was considerably (62%) less mainly due to the absence of dense clam beds in the estuary. *Meretrix casta* was the only species in the fishery with length ranging from 19 to 31 mm. Modes were seen at 23 mm in April, 21, 23 and 27 mm in May.

Centre	Species		Estuary/area	Production t
Cochin	*Villorita cyprinoides*		Vembanad	56,400.00
Mangalore	*Meretrix casta*		Mulki	239.00
Kakinada	*Anadara granosa*	(707.64 t)	Kakinada Bay	889.50
	M. casta	(35 t)		
	M. meretrix	(73.12 t)		
	Paphia malabarica	(29.8 t)		
	Katelysia opima	(11.1 t)		
Karwar	*P. malabarica*	(4.64 t)		
	M. Meretrix	(3.34 t)		8.38

Kakinada: The total bivalve landing at Kakinada was estimated at 889.5 t. *Anadara granosa* contributed 707.6 t, followed by *M. meretrix* 73.2 t, *M. casta* 35.0 t, *Paphia malabarica* 29.8 t and *K. opima* 11.1 t. The length of *A. granosa* ranged from 16-75 mm; *M. meretrix* 36-87 mm and *P. malabarica* 52-87 mm.

Veraval: Detailed survey carried out at Veraval, Mangrol and Madhvad centres of the Saurashtra coast of Gujarat indicated that there is no commercial fishery of any of the bivalves and gastropods.

Gastropods

Tuticorin: During the period under report, 104 numbers of chanks were collected, tagged and released in the sea. The size of the chanks ranged from 80 to 133 mm and the weight ranged from 90 to 230 g. The tagged chanks were released in the open sea at Pulipoondu paar, north east of Tuticorin harbour in a depth of 8.5 - 9 fathoms.

Kakinada: The total gastropods landed at Kakinada Bay was 1,143t. *Cerethedium* sp. formed 34.7% of the total gastropod landing followed by *Telescopium* sp. 14.3%; *Umbonium* 6.9% and *Thias* 0.4%.

Madras: The total gastropods landed at Madras fishing harbour has been estimated as 14.9 tonnes. The species contributed to the fishery were *Bursa* sp; *Rapana bulbosa; Hemifusus pugilinus;Babylonia spirata; Ficus ficus; Turitella, Oliva* and Thias.

Mandapam Camp: The chank fishery was monitored at landing and collection centres. An estimated of 10,000 chanks were landed from Mandapam in trawlers. In Kannirajapuram area, chank diving was initiated in December, 1995 and 300 licences were issued by State Fisheries Department. The catch was 12 chanks/person/day. The size of chanks ranged from 90 to 170 mm.

In Rameswaram, directed exploitation of chanks was carried out by modified *Chanku madi*. An estimated 1.5 lakh chanks/month were caught by this method.

Seed Production of Molluscs and Ranching in The 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

Tuticorin : There were 19 spawnings in the edible oyster, *Crassostrea madrasensis* during the year. The oysters spawned for the major part of the year and, in 7 spawnings, the spat were successfully raised. A total of 1.49 lakhs cultchless spat and over 2 lakhs attached spat were produced. The number of attached spat per shell varied from 31 to 87.

There were 10 spawnings in the pearl oyster *Pinctada fucata* but there was no spat settlement due to poor water quality. The spat numbering 1.3 lakhs from spawning during the previous year were reared and transferred to the farm during April and May 1995. There was profuse spawing of *P. margaritifera* brought from the Andamans on 18-1-96, but there was no settlement. This species obviously prefers clear unpolluted oceanic waters. On 29-2-96 there was spawning of *P. sugillata* and spat settlement occurred in February. On 29-2-96, there was spawning in *P. fucata* resulting in 3.25 lakhs of spat of 1.3 mm average length. In a tank, without changing water for 41 days, 51,500 spat of *P. fucata* were produced.

There were two successful spawnings in the clam *Paphia malabarica* the spawning on 9-4-95 resulted in 4.11 lakh spat and the second spawning on 1-1-96 resulted in 3 lakh spat. For the first time this species was spawned in April which is outside the normal spawning period. For nursery rearing, stocking density of *P. malabarica* seed of 4.63 mm at the rate of 1000 per velon screen bag of 25x25 cm size is the optimum.

The stock culture of various microalgae was maintained. Mass production of both selected species and mixed cultures were carried out.

Vizhinjam : A 'two-in-one' cage was designed and experimented from a raft in the Vizhinjam bay. Spat settlement of the pearl oyster and also the occurrence of some economically important fishes and lobsters in the cages was reported.

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

K. Satyanarayana Rao, M.E. Rajapandian, K. Sunilkumar Mohamed, P.S. Kuriakose, T.S. Velayudhan, A.C.C. Victor, A. Chellam, S. Dharmaraj, K. Satyanarayana Rao, P.V. Sreenivasan, P. Natarajan, G. Syda Rao, E.M. Abdussamad

Visakhapatnam: Pearl oysters which were being held in cement tanks in SIRIS hatchery were shifted to Visakhapatnam fishing harbour. Nuclei were implanted in 82 pearl oysters in June 95, out of which 35 nuclei were rejected. Three good quality

pearls were produced. This is the first time that good quality pearls have been obtained from the N.E. coast of India.

One thousand pearl oysters of 30-40 mm size were transported from Tuticorin to Visakhapatnam in January 96. Enroute, profuse spawning of the pearl oysters at Madras Research Centre occurred resulting in viable larvae.

Madras: To study the feasibility of edible oyster culture at Chunnambaru near Pondicherry, oysterlings of 21 mm size were transplanted from Tuticorin to the Chunnambaru estuary. Spat attained a size of 55 mm in 5 months. No spatfall occurred at Chunnambaru although the edible oysters were matured.

Tuticorin: 500 pearl oysters and 30 mother oysters were transported from Tuticorin to Kakinada in June 95. High mortality occurred due to high atmospheric and water temperatures during transport.

In January 1995, nucleus implantation was done on 80 oysters transplanted earlier.

During October 1995 a total of 6,000 pearl oysters were transported from Tuticorin to Mandapam Regional Centre for carrying out onshore pearl culture. A second contingent of 10,000 oysters was also transported to Madras Research Centre.

Nucleus implantation was carried out in 460 pearl oysters during January 96.

Cochin: Pearl oyster seed of 16 mm size reared in cages on longline at Andakaranazhi near Cochin, recorded good growth. 33.3% pearl production was achieved.

There was good oyster spatfall of *Crassostrea madrasensis* on oyster shell strings in the Ashtamudi lake and marketable size was attained in 7-9 months. 2.4 t cultured oysters were harvested and 240 kg meat was obtained.

During November, 450 pearl oysters and 39 adult oysters were transported to Andakaranazhi from Tuticorin hatchery. They were reared in cages suspended from a longline. The spat recorded growth from 23.89 mm in length and 6.2 g total weight to 46.39 m in length and 10.76 g total weight in 91 days and reached the size for nucleus implantation.

An attempt has been made to rear the pearl oysters in a pond system. A total of 327 pearl oysters were transplanted to Munambam, to a pond in January. Of these 176 were implanted in February. The pearl oysters were stocked in 3 l capacity fruit baskets @ 20 nos and suspended from a rack in 1.5 m water depth. There is regular tidal flushing of water into the pond.

A longline mussel farm of 400 sq.m was established at Andakaranazhi, 50 km from Cochin, at 10 m depth in October. A total of 100 seeded ropes were suspended in the farm. The seeded length varied from 4.5 to 6 m. The size of brown mussel seed ranged from 20 to 40 mm and that of green mussel 15-25 mm. The average weight of the mussel seed was 2 g. In 4 months, the brown mussel recorded good growth of 66.03 mm and 17.6 g average total weight while green mussel attained 56.76 mm and 9.75 g average total weight. The meat percentage was 34.25 in the case of brown mussel and 31.5 in the case of green mussel.

Calicut: Pearl oysters transported from Tuticorin were cultured in cages in Puthiappa Bay. They attained implantation size of 45 mm in 4 months. Implanted oysters reared in Puthiappa Bay were harvested after six months. Pearl yield was 10% and of good quality.

Upgradation, Location Testing and Transfer of Technology of Pearl Culture (MF/CUL/10)

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

In the Tuticorin harbour four rafts were maintained. The farm at Valinokkam was closed in July 1995 due to sand drift. Nuclei of 3-5 mm were implanted in 5,940 pearl oysters, *Pinctada fucata*. A total of 534 pearls weighing 77.4875 g were sold for Rs 45,550.

An attempt was made to grow the pearl oyster spat in a private shrimp hatchery by adopting the onshore culture technique. In three months they have grown from 19.2 mm DVM to 28.6 mm against 32.7mm in the harbour farm. A total of 22,475 pearl oysters were supplied to Mandapam, Madras, Kakinada and Visakhapatnam research centres of C.M.F.R.I and also to Head quarters at Cochin. For onshore pearl culture at Mandapam, 460 oysters were operated and implanted with 3 mm nuclei. They are being reared both in the sea in cages suspended from a rack and also in the onshore tanks.

Three training programmes on pearl culture were conducted at Tuticorin.

A total of 200 black lip pearl oysters, *Pinctada margaritifera* were transported from the Andamans to Mandapam and Tuticorin . As there was mortality at Tuticorin they were shifted to Mandapam.

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

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

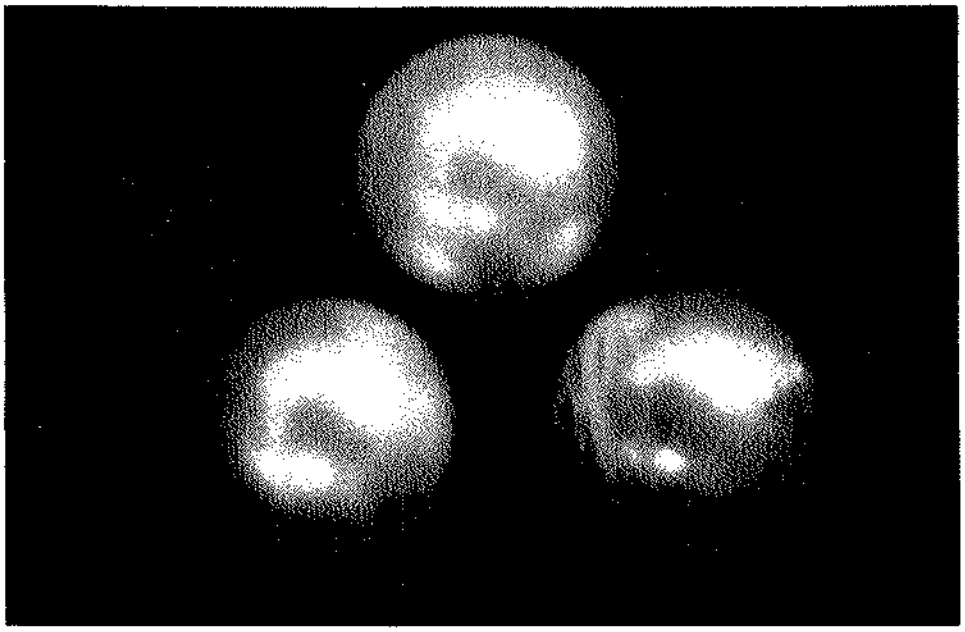
A demonstration farm was set up at Dalavapuram, Ashtamudi estuary, in an area of 0.22 ha adopting rack and ren method of edible oyster farming in November 1994. 800 strings (rens) were suspended in the farm for spat collection in November. Over 1 lakh spat settled by the end of December. The oysters reached harvest size by August, attaining 68.33 mm average length, 43.5 g average total weight and 5.6 average wet meat weight. An oyster harvest mela was organised by the Institute on 8.8.95, inviting all farmers in the area. 2.4 t of oysters was harvested in the presence of the District Collector, Quilon Shri L. Radhakrishnan.

In the light of the demonstration of technology of edible oyster farming, several farmers expressed interest to initiate edible oyster farming. Mr. Vincent Mukkadan was the first private farmer to do so and his farm was inaugurated by the District Collector, Quilon on 19.10.95.

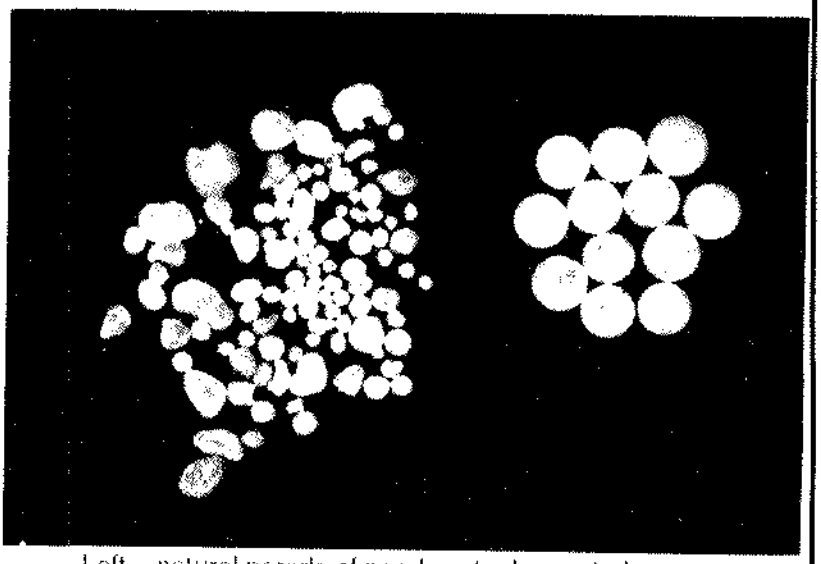
The CMFRI demonstration farm has been expanded to 0.4 ha area. Farmers who evinced interest in edible oyster farm-

Edible oyster seed collection device: close-set spat settlers in the CMFRI Demonstration Farm at Ashtamudi

Participants of workshop on Artificial reefs and Seafarming Sponsored by Ministry of Agriculture, New Delhi, examining the brown mussel rope and oyster spat settlers in the CMFRI Demonstration Farm at Ashtamudi



Orient pearls —harvested from the land—based culture system at Visakhapatnam



Left — natural pearls of pearl oyster harvested
Right—Good quality pearls cultured and harvested from CMFRI farms along southwest coast

ing were advised to release spat settlers in December 1995 profuse spat settlement commenced by middle of December. Six farmers at Dalavapuram (Ashtamudi), one at Munambam, and one at Padanna (Kasargode) have set up farms during the year, in addition to the one set up by CMFRI at Dharmadam (Cannanore). The farm size ranged from 200-400 sq.m.

Hatchery Production of the Seed of the Clam, *Paphia malabarica* and Ranching in Coastal Waters (CMFRI/Spo./2)

K.A. Narasimham, T.S. Velayudhan, D. Sivalingam

There were 2 successful spawnings in the clam *Paphia malabarica*. The spawning on 9.4.95 resulted in 4.11 lakhs spat of 1.84 mm average length and these were shifted to the Tuticorin bay. The spat numbering 67,144 and measuring 12.2 mm average length were ranched in a pen at Dalavapuram on 2.11.95. They attained the harvestable size of 32.1 mm (8.27 g) in 98 days. Strong currents at the ranching site dislodged the clams from the burrows and carried them away from the site. On 17.5.95 seed of *P. malabarica* numbering 21,526 (November '94 spawning) were ranched in the Chunnambaru estuary near Pondicherry. There was heavy mortality after 20 days and the entire stock perished by July '95. It may be due to the bar formation and closure of the mouth of the estuary which resulted in increased salinity and exposure.

P. malabarica spawned on 1.1.96 resulting in 3 lakhs of spat.

Some critical experiments were conducted to standardise the hatchery technology. *P. malabarica* was induced to spawn in April, which is outside the normal spawning period by inducing gonadal maturation in 25 days with high intensity feed and temperature control. For nursery rearing, stocking density of 1000 seed/velon screen bag of 25 x 25 cm size gave optimum growth. Stocked at 4.63 mm size, seed of *P. malabarica* reared in these bags and suspended from a rack erected in the Tuticorin bay have grown to 11.6 mm in one month with 71.8% survival.

Hatchery Produciton of Clam, *Meretrix* sp. Seed (CMFRI/Spo./3)

P.V. Sreenivasan, D. Sivalingam

Procurement action for major equipments and chemicals for the clam hatchery at Tuticorin was completed. Orders placed for diesel pump set, electric pump set FRP tanks and perspex tanks. The work on the breeding and seed production of the clams shall be initiated during the current year.

Hatchery Production of the Green Mussel (*Perna viridis*) Seed (CMFRI/Spo./4)

P.S. Kuriakose, P. Laxmilatha

The construction of the mussel hatchery at Calicut was completed and many of the equipments for the hatchery have been procured. Power connection is awaited. The mussel seed production work shall be initiated as soon as the power supply is obtained.

Studies on the Biology and Sea Ranching 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

Culture facilities for maintaining chanks were established at the Mandapam Regional Centre.

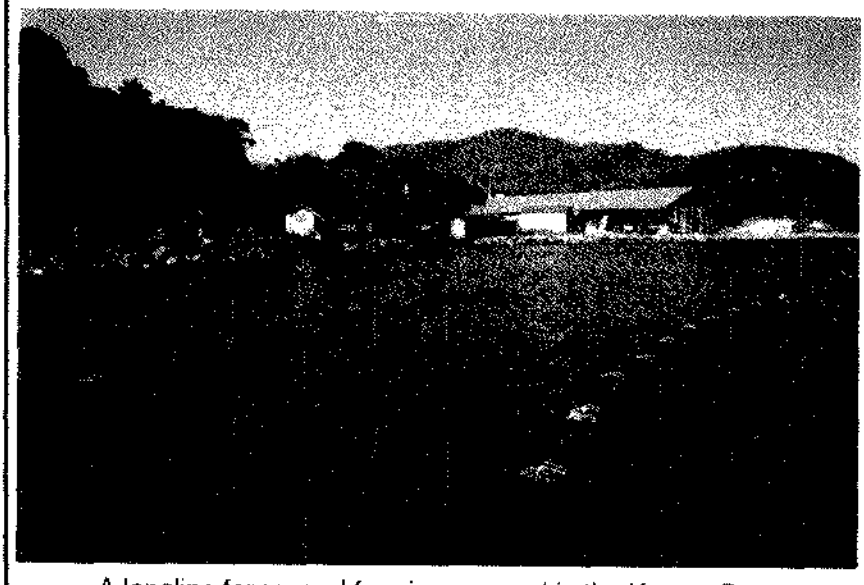
During the period under report, 13 egg capsules were collected from the Gulf of Mannar and on hatching 75 live baby chanks were obtained. The baby chanks were fed with oligochaete and polychaete worms. The laboratory-reared baby chanks attained MSD-wise growth of 22.2 mm (mean) from 4.07 mm (mean) during 120 days of study.

Tissue Culture in Pearl Oyster (CMFRI/Spo./6)

S. Dharmaraj, A.C.C. Victor

A tissue culture laboratory has been set up at Tuticorin. Procurement action for major equipments was completed. Other tissue culture materials are being procured. The work will be initiated after receiving a few essential equipments like Co_2 incubator and autoclave.

The Principal Investigator of the project underwent a refresher training in tissue culture at National Facility for Animal Tissue and Cell Culture, Pune, during 18-30 September, 1995.



A longline for mussel farming, moored in the Karwar Bay

A rope with fully-grown mussel in the longline, ready for harvest

Farmers preparing oyster spat strings and mussel ropes at Dharmadam estuary, Kerala

A green mussel rope ready for harvest in the CMFRI Demonstration Farm at Dharmadam, Cannannore, Kerala

PILOT PROJECT ON OYSTER CULTURE (CMFRI/Spo./7)

P. Muthiah, K. Ramadoss

Spat collection: Experiments on spat collection from the wild indicated that spat settlement on oyster shells (263 nos./m^2) was more compared to the settlement on netlon sheets (161/m^2 and automobile tyre pieces (77/m^2).

Supply of seed: Oyster seed was supplied as shown below, to two centres during August, 1995.

Growth of oysters: Oyster strings brought from Ashtamudi were reared at Tuticorin. Average growth increment of 4.7 mm per month was recorded. The condition factor ranged from 40 in March 95 to 135 in June '95.

Sale of oyster meat and shell: During the period under review, 579.5 kg of meat valued at Rs.17,385/- and 32 t of oyster shell valued at Rs.8774/- were sold.

	Nos.	Avg. size
1.Madras Research Centre	600	23.9 mm
2.Karwar Research Centre	3725	37.6 mm

3000 cultchless seed of average size 32 mm and 50 strings were reared for a period of 2 months at Minota Aquatech Prawn Culture pond at Pattinamaruthur. The oysters attained mean size of 51.8 mm with average growth of 10.4 mm/month. During the period, 606 strings with average 16-22 seed/string were transferred from nursery to farm area for further rearing.

VI. Fishery Environment And Management Division

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

C.P. Gopinathan, K.G. Girijavallabhan, V. Chandrika, S. Muthusamy, T.S. Naomi, Pon Siraimeetan, V.V. Singh, P.K. Krishnakumar, C.V. Mathew, P. Kaladharan, Rani Mary George, M. Rajagopalan, K. Vijayakumaran, and P.T. Sarada

Cochin: SST varied between 22.3°C in July and 30.67°C in April. Salinity ranged from 22.29 ppt in August to 35.12 ppt in April. The lowering of salinity was mainly due to the effect of rainfall and river run off. The dissolved oxygen showed a low value of 1.22 ml/l at 10 m depth during August. Phosphates and silicates showed comparatively high values during July and September: 6.03 to 8.9 mg at/l and 12.66 to 24.52 mg at/l respectively.

Chlorophyll *a* showed comparatively high values at surface level during April-June (4.27 to 8.2 mg/m^3) and September (6.4 to 10.15 mg/m^3). Highest zooplankton volume (121 ml/100 m^3) was observed during May at 20 m depth due to swarming of the Salpa *Thalia democratica*. Fish eggs and larvae were found to be abundant during monsoon compared to pre-monsoon.

Calicut: The SST ranged from 25.8°C in July to 30.8°C in April, salinity from 31.25 ppt in August to 36.16 ppt in December. Dissolved oxygen varied between 2.3 ml/l in September and 4.16 ml/l in April. Among nutrients, silicate showed large variations (6.64 mg at/l in April to 30 mg at/l in August).

Mangalore: The SST varied from 24.5°C in August to 30.7°C in April, salinity from 19.1 ppt in July to 35.5 ppt in April and dissolved oxygen varied from 0.41 ml/l during September to 4.63 ml/l in January 1996. Among nutrients, silicate at surface levels varied between 8.0 mg at/l in April to 86 mg at/l in September. Blooms of *Noctiluca* sp. were noticed in the inshore waters during July. Zooplankton volume was high during August and October (16 ml) at 10 m depth. Fish eggs and larvae were found in large numbers during April.

Karwar: The SST varied from 25°C in December to 31.5°C in April and salinity from 10 ppt in July to 31.72 ppt in November. Dissolved oxygen at 10m depth varied between 1.9 ml/l in August to 4.41 ml/l in October.

Bombay: The SST varied from 27.5°C in September to 32.0°C in May. Salinity varied from 16.53 ppt in November to 32.57 ppt in May. Dissolved oxygen varied between 1.63 ml/l in May and 4.25 ml/l in September. Among nutrients silicates at surface levels varied between 23.93 mg at/l in May to 94.95 mg at/l in November.

Minicoy: In the lagoon, SST ranged from 29.6°C in April to 26.9°C in July. Salinity was maximum (34.2 ppt) in April and minimum (25.25 ppt) in July. Dissolved oxygen values varied between 3 ml/l in July and 4.72 ml/l in September. The gross primary production ranged from

10.9 to 60 mgC/m^3/hr and net production from 1 to 50 mgC/m^3/hr.

Vizhinjam: The SST varied between 24.75°C in August to 29.9°C in April, salinity between 33.49 ppt in June and 35.04 ppt in April. Dissolved oxygen was low in September (3.34 ml/l). Primary production values ranged from 120 mgC/m^3/day to 520 mgC/m^3/day. The zooplankton volume varied between 1.2 ml and 7 ml.

Tuticorin: The SST varied from 26.6°C (December) to 29.3°C (October). Salinity varied between 33.32 ppt in November and 33.83 ppt in December. Dissolved oxygen was uniformly high between 4.02 and 4.11 ml/l. Primary production varied between 111 and 414 mgC/m^3/day. The volume of zooplankton varied between 2 and 5 ml in 10 minutes surface haul.

Mandapam: The SST varied from 28.0°C in August to 30.2°C in April. Salinity was maximum in August (35.6 ppt) and minimum in April (30.87 ppt). Primary production of surface waters ranged from 120 mgC/m^3/day in August to 530 mgC/m^3/day in September. Zooplankton volume ranged from 1.2 ml in August to 7 ml in July.

Madras: The SST varied between 28.0°C in September to 29.5°C in May and salinity from 27.9 ppt in October to 34.47 ppt in May. Dissolved oxygen varied from 3.7 ml/l in June to 5.8 ml/l in September.

Kakinada: The SST varied between 28.5°C (May) and 30.5°C (April) and salinity ranged from 5.4 ppt in May to 34.27 ppt in April.

Visakhapatnam: The SST varied from 25.8°C in December to 29.6°C in June. The surface salinity gradually decreased from April and reached a minimum of 20 ppt in October and rose to 25 ppt in November and 30 ppt in January-February. Dissolved oxygen at 10 m was comparatively low (3.9 ml/l) in May.

Based on upwelling indices (comparatively low temperature, low dissolved oxygen content and moderately high salinity) evidence of upwelling was found in the area between Cochin and Karwar in the inshore waters along the west coast during July and August. There were indications of mild upwelling along Visakhapatnam coast during second half of May.

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

V. Narayana Pillai, V.K. Pillai and K.G. Girijavallabhan

During the period under report, 2 cruises were undertaken on board FORV *Sagar Sampada* (Cruise 134 and 134-A), the former in July (between 7° and 11°N lat.) and the latter in August (10-14°N lat.), for collection of sea truth data.The surface waters upto a depth of 50m were characterised by comparatively low temperature (20.18°C to 24.65°C). The dissolved oxygen content at surface levels especially at depths between 20m and 50m was comparatively low (0.13 ml/l to 1.73

ml/l), between Kasargod (12°30'N lat.) and Mangalore (14°N lat.) indicating the presence of upwelled waters in this area.

Chlorophyll *a* at surface levels showed maximum values (2.4 mg/m^3) between lat. 11°N and 11°30'N (north of Calicut) when compared to 1.2 mg/m^3 of Mangalore (lat. 13°N) showing the occurrence of higher production values in areas south of the regions of upwelling, possibly indicating the effect of the southerly drift and the time lag between arrival of nutrient-rich waters at surface levels and the resultant photosynthetic activity. The zooplankton displacement volume showed the maximum of 660 ml at 8°20'N lat. and 74°58'E and minimum of 90 ml at 08°52'N and 71°55'E. Surface silicate varied between 1 and 18 mg at/l during July-August '95 in the south-eastern Arabian Sea. Variation of surface nitrite was between 2 and 28 µg at/l and for nitrate, the values ranged between 0.2 and 1.2 µg at/l. Phosphates ranged between 1 and 9 µg at/l with higher concentrations occurring towards the southern end of the sub continent.

Investigations On Zooplankton Components of The EEZ Of India (FORV/SS/3)

K.J. Mathew, K. Rengarajan, T.S. Naomi, Moly Varghese, R. Sarvesan, S. Jasmine, V.S. Kakati and M.M. Meiyappan

Analyses of the fish eggs and larvae collected from the Andaman sea during the cruises of FORV *Sagar Sampada* and 213 samples collected from the west coast have been completed. Study on the onshore and offshore zonation of ostracods in the Arabian Sea has been carried out. The abundance and distribution of scyphomedusae of the Lakshadweep sea have been studied.

The *Lucifer* components from 278 samples of 20 cruises were sorted out for their qualitative and quantitative distribution. Their size composition, sex ratio and maturity stages were studied. The developmental stages of 4 species were also studied.

Ecological Investigations on the Inter-Tidal and Surf Zones of The Kerala and Kanyakumari Coasts in Relation to Finfish and Shellfish Seed Resources (FEM/ES/6)

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

The work was carried out at Cochin, Calicut and Vizhinjam. Water temperature in the surf region ranged from 25.8°C to 30.8°C at Calicut, 26-31°C at Cochin and 28.5 to 31.5°C at Vizhinjam. In the surf region, salinity ranged from 5.17 ppt to 36.15 ppt for the whole area, while in the backwaters the minimum values came down to

0.27 ppt during June-July. Dissolved oxygen in the surf region ranged from 2.0 to 4.72 ml/l with the low values recorded at Korapuzha and Panathurai estuarine systems during September- October. Higher values were recorded in April.

Among nutrients, phosphates showed 2 peaks, one during August-September and another during December with range of 0.627 to 2.76 µg at/l in the surface waters. The values were generally high during south west monsoon period. Nitrites showed 2 peaks, one in June and another in April and values ranged from 0.06 (October) to 0.74 µg at/l (June). Nitrate values ranged from 0.92 to 3.76 µg at/l. Net primary production in the surface region ranged from 0.03 to 1.34 gC/m^3/day with the lowest recorded in October at Cochin and highest in June at Calicut. In the backwaters, the minimum was 0.115 gC/m^3/day in July at Calicut and June at Cochin.

Zooplankton samples from surf regions showed large numbers (94-173 Nos/m^3) of fish eggs during October-November at Cochin. Decapod larvae were also maximum (40 nos/m^3) during October.

Analysis of fish and prawn samples from Cochin backwaters showed large numbers of young ones of *Etroplus maculatus* and *E. suratensis* (22-30 mm) and *Ambassis sp.* during June-September indicating their breeding season in the backwater. During October-December, juveniles of economically important fishes such as *Ambassis sp., Etroplus sp., Siganus sp.* and *Leiognathus sp.* were found in the catches. Among prawns, *M. dobsoni* was dominant, contributing about 90% during November-December. Juveniles of *P. indicus* and *P. monodon* were rare.

Seaweed Investigations - Resources Assessment of Seaweeds And Their Culture (FEM/SW/1)

V.S.K. Chennubhotla and N. Kaliaperumal

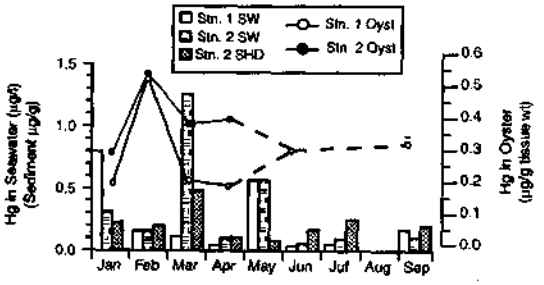
The work was carried out at Visakhapatnam and Mandapam. Maximum growth and biomass of carrageenan yielding red algae, *Hypnea valentea, Acanthophora spicifera* and *Laurencia papillosa,* growing at Puthumadam and edible green algae, *Caulerpa racemosa, Ulva lactuca* and *Enteromorpha compressa,* growing at Kilakarai occurred during the months of July and August.

Culture experiments on *Gracilaria edulis* conducted in cement tanks in running seawater along with green mussel *Perna viridis* and groupers at Mandapam showed a growth rate of 73 gm per day; 1 kg of seed material introduced in the tank attained a weight of 4.3 kg in 45 days. Experiments conducted for salinity tolerance of *Hypena, Ulva* and *Acanthophora* showed tolerance level from 15 to 45 ppt.

MARINE POLLUTION (FEM/MP/1)

V.K. Pillai, C.P. Gopinathan, P.K. Krishnakumar, D.C.V. Easterson, P. Kaladharan and M. Rajagopalan

Cochin: Low levels of dissolved oxygen were recorded at 10 and 20 m depths during June, July and August period (ie. 2.20 and 2.06 ml/l respectively) indicating upwelled water. Incidentally the lowest value of 1.15 ml/l was recorded at 20m (bottom) during August '95.



Seasonal variation of mercury concentration in sea water (SW), sediment (SED) and soft tissue of oyster (Crassostrea cucullata) (OYST) collected from two stations of a contaminated stream at Binaga, Karwar

Estuarine waters revealed higher levels of Ammonia during May and June (64 and 75 µg at/l) apparently indicating run off of polluted water from the upstream region. Nitrate levels were also comparatively higher during June and July period, the higher value recorded being 11.25 µg at/l.

Mangalore: In the seawater collected from Thanneer Bari near the point of effluent discharge by the Fertilizer factory (MCF), nutrient concentrations was higher when compared to the samples collected from Hejmadi. Mercury concentration at Thanneer Bari varied from 2.5 to 3.5 µg/l while at Hejmadi, it remained at 2.5 µg/l. Mercury concentration in the sediment from both the Centres was very low - below the detection limit.

Madras: Water samples collected from Bar-mouth and also 500 m and 1000 m away from the bar-mouth were analysed. Temperature ranged from 26.2 to 38.5°C, salinity from 1.7 to 32.7 ppt and dissolved oxygen from traces to 5.5 ml/l. The nutrients (ammonia, phosphates and nitrates) showed comparatively higher levels during December-January period.

Tuticorin: Mercury levels in the Dharangadhara Chemical Works lagoon varied between 0.23 and 0.34 µg/l and the sea-shore the values ranged between 0.07 and 0.09 µg/l. Under mussel watch programme, the survey showed absence of edible oysters north of Tuticorin and also from Tuticorin harbour, southward upto Triruchendur. At Valinokkam, live oyster beds observed a year ago close to the ship wrecking yard were found to be dead.

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

P.A. Thomas and Rani Mary George

Ninety species of sponges and 12 species of gorgonids were identified during this period. The magnitude of damage caused to 'sea-horse', gastropods, gorgonids and others was brought to the notice of Ministry of Environment and Forests; the need to investigate their chemical properties was brought to the notice of the Director, CDRI, IICT etc.

Susceptability of Heterotrophic Bacteria to Antibiotics And Their Characterisation (FEM/MB/1)

V. Chandrika

Antibiotic resistance pattern was studied in 4 types of predominent pigmented bacteria harbouring orange, pink, yellow and black pigments. All the 4 types were tested against 8 antibiotics. Orange and yellow pigmented forms showed more resistance to 5 types of various antibiotics tested, being sensitive only to Gentamycin (G^{10}), Chloromphenicol (C^{30}) and Chlorotetracycline (Ct^{30}) whereas pink and black pigmented forms were sensitive to Norfluaxin (Nx^{10}) and Sulpha menthazole (Sm^{30}).

All the 4 types of pigmented and predominant forms in both perennial and seasonal ponds are mass cultured in laboratory by mixing them with organic manure for use in aquaculture to increase fertility and purification.

Cultivation of Agar Yielding Seaweeds Under Green House Conditions (CMFRI/Spo./9)

N. Kaliaperumal

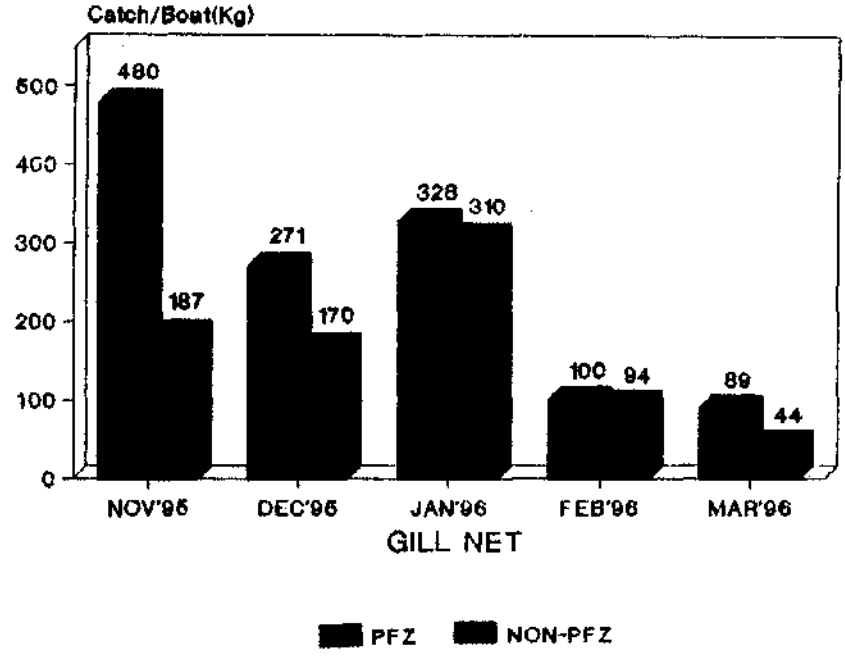
Experimental culture of agar yielding red alga *Gracilaria edulis* by vegetative propagation in continuous running seawater system in green house conditions was initiated in December 95. A steady increase in growth of plants was recorded and one kg of seed material gained a maximum weight of 1.95 kg with growth rate of 32 gm per day after 30 days of culture.

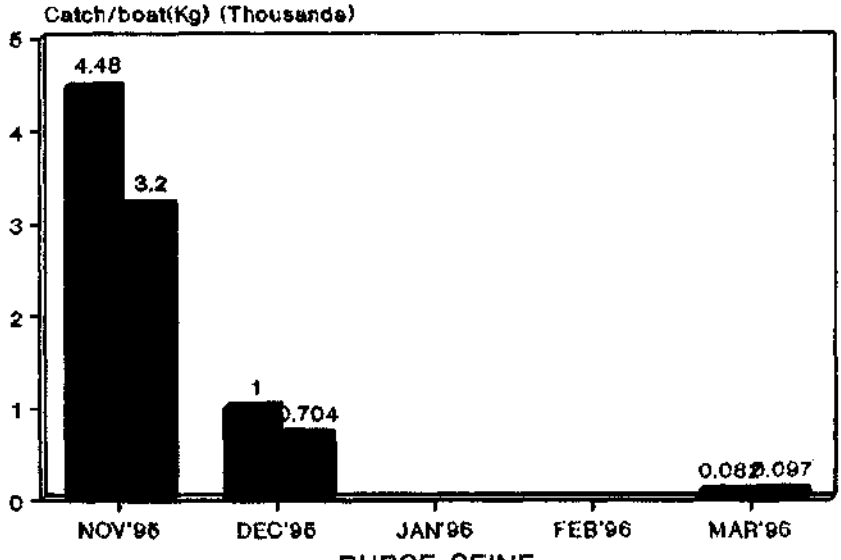
Application of Remote Sensing Technology In Marine Fisheries (CMFRI/Spo./11)

M.S. Rajagopalan, V.N. Pillai, C.P. Gopinathan, V.K. Pillai, K.G. Girijavallabhan, G.S. Daniel Selvaraj and G. Subbaraju

SST data collected at 6-hourly intervals in the southeastern Arabian Sea on board FORV *Sagar Sampada* (Cr. Nos. 134 and 134-A) during July and August for revalidation of infrared imageries received from NOAA Satellite at NRSA, Hyderabad, revealed a minimum of 24.05°C and maximum of 29.5°C.Presentations were given on 'Experience with PFZ validation' and ' Conventional fishery forecasting' at the one day Workshop on 'Satellite Remote Sensing' for locating PFZ - Status and future plans' organised by Space Application Centre at Ahmedabad on 8th September '95. A total of 10 potential fishing zone forecasts received from NRSA during the period November '95 to February '96 were dessiminated to active fishermen at Cochin, Quilandy, Chombala, Kannur, Neendakara, Beypore and Azhikode. Substantial increase in fish catches of PFZ areas when compared to non PFZ areas was observed at Cochin, Quilandy, Chombala and Kannur for gill netting, purse seining, ring seining and trawling activities. Appreciable difference in fish catches was not observed in respect of bottom trawling activities. It is quite possible that the PFZ forecast based on sea surface temperature are more relevant to pelagic column fishing activities as revealed by the increase in catches obtained by gill-netting, purse-seining, ring seining and trawling operations. The results of individual validation were reported to NRSA immediately on completion of each validation in order to improve upon the successive forecast released by them.

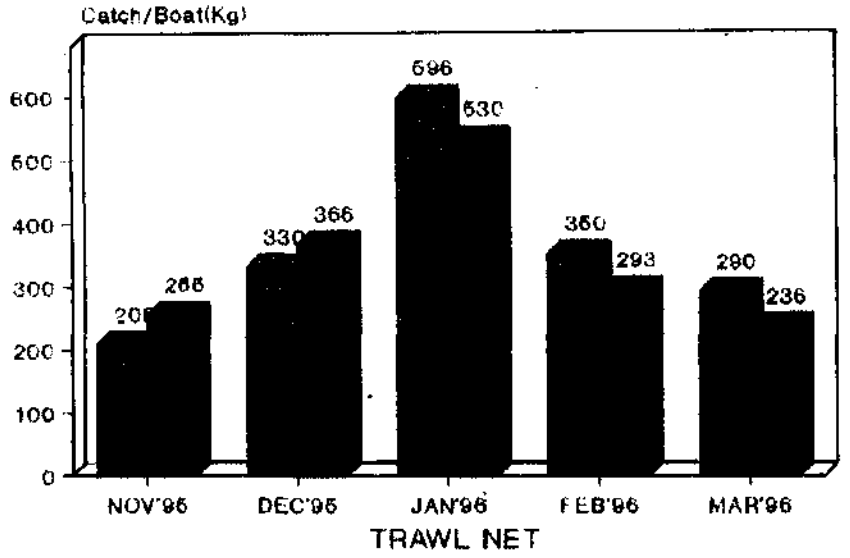
PFZ VALIDATION
COCHIN FISHERIES HARBOUR



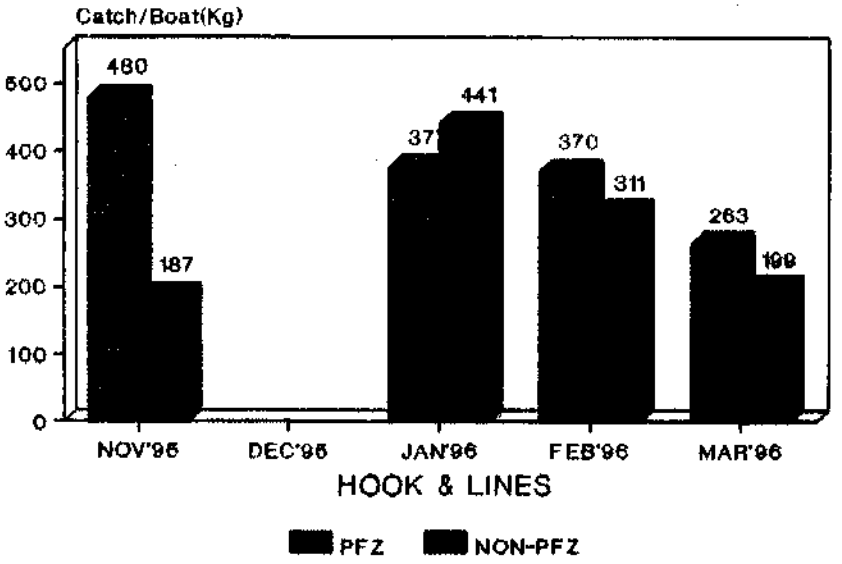


ANALYSIS BY MARSIS CENTRE, CMFRI

PFZ VALIDATION
COCHIN FISHERIES HARBOUR



TRAWL NET



HOOK & LINES

PFZ NON-PFZ

ANALYSIS BY MARSIS CENTRE, CMFRI

VII. Physiology, Nutrition And Pathology Division

The division carried out research in seven projects in genetics, pathology, biotechnology, endocrinology and nutrition. The progress of the work carried out in these projects is as follows. Besides, research in genetics was carried out through a funded project (USIF-INES-780).

Development of Feeds For Cultivable Marine Animals (PNP/35)

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

In order to identify suitable ingredients for the preparation of quality feeds for marine animals, an assessment of the raw material available in the country was made. Good quality fishmeal production is estimated to be less than 5000 t which includes good quality dry pulverised fish. Poor quality fish powder production is estimated to be 1,00,000 t. The potential of dry prawn heads is about 25,000 t, dry squilla 20,000 t, dry *Acetes* and small shrimp - 15,000 t, squid and cuttle fish waste meal 5000 t and clam meal 500 t.

Among the plant ingredients, soyabean cake production is about 1.25 million t, cotton seed cake 7.5 lakh t, sesame cake 2.7 lakh t, sunflower cake 2.4 lakh t, coconut oil cake 1.5 lakh t, rice bran oil cake 1.8 lakh t, rice bran 1.8 million t, wheat bran 2 million t, pulse waste 5 lakh t, millets 19 million t and tapioca 5.6 million t.

Assessment is also being made on the availability of silkworm pupae meal, mussel meal, crab meal, slaughter house waste, poultry waste, blood meal, acid and fermented silage, microbial protein sources (yeast,bacteria and algae) molasses, fish oil, vitamins, minerals and additives for indigenous production of feeds for marine animals.

A study has been initiated to design process for high quality protein mix production required for marine crustacean and finfish feeds.

Another study has been initiated to prepare a stable lipid mix for marine animal feeds.

In order to determine the optimum protein energy ratio (P/E) for *P. indicus* diets, one set of experiment was completed in which a diet with a P/E ratio of 108 (mg protein/kcal) produced best response. Another experiment has been designed with diets containing P/E ratios (mg protein/kcal) of 120.73, 114.62, 108.22, 113.42, 107.55 and 103.46.

A gross analysis of feed-derived wastes during a crop period of four months for shrimp farms was 4% during the first month, 17% during second month, 32% during third month and 47% during the fourth month in terms of organic matter, nitrogen and phosphorus.

At Tuticorin experiments were conducted to induce maturation in *Penaeus semisulcatus* through feed. The ingredients tried were clams *(Meretrix sp.)* and *Neries* (species not identified). In the first experiment conducted for 45 days, the prawns were fed with diets having 35% protein using whole fishmeal or whole clam meal (without removing oil) as the protein source. The clam meal fed group of animals moulted often with low assimilation efficiency and high conversion efficiency. In another experiment of the same duration oil free fishmeal and clam meal were used which did not show any significant difference when compared with the former experiment. Efforts are on to identify the active ingredient in clams and *Nereis* which have a crude lipid content of 3-7% and 1.5-2% respectively.

Two important parameters contributing to poor nutritive value and keeping quality of dry fish are high sand and silica content and high moisture content. A simple method of drying at 50-550C helped in removing moisture and further sieving helped in removing sand and silica. Moisture, sand and silica formed 32.5% of dry fish(*Stolephorus*) bought from market.

A feed has been prepared using dry fish powder, small shrimp powder, soyabean meal, wheat flour, codliver oil, cholesterol, vitamins and minerals and guargum as binder. Acceptability of the feed is being studied with juveniles (5.5 to 14.5g) of *Scylla serrata*.

Persistence of viral diseases in shrimp has prompted farmers to use additives to improve the health of shrimps. Addition of vitamin C @ 1g/kg feed did not improve the growth of prawns however addition of a commercial immunostimulant at the rate of 1-2g/kg feed per week resulted in a production of 1.75 tonnes/ha with an average size of 30g *P.monodon* with no disease problems.

Endocrinological Factors Influencing Maturation in Selected Penaeid Prawn *Penaeus indicus* (PNP/39)

M. Peer Mohamed and N. Sridhar

The characterisation of protein bands in the extracts of neuroendocrine centres from mature *Penaeus indicus* using molecular weight markers was carried out. Bioassay studies conducted with extracts of eyestalk elucidated the capacity for arresting moulting in premoult animals. Adult female specimens of *Penaeus indicus* (TL. 135-145mm; weight 15.65 to 17.77 g) were injected with thoracic ganglion extract at the rate of 50 µl (Protein concentration 861 µg). On the first and the 5th day of the experiment the ovary development was observed to be in stage II on the 5th day which remained thus till the 12th day. Bioassay experiments conducted with the lyophilised extracts of thoracic ganglion, brain and eyestalk revealed the stimulatory effect of thoracic ganglion and brain only at a protein concentration of 1.13 mg/100 µl and .67 mg/50 µl respectively. The ovary development advanced to stage II on 5th day with ova diameter in the range of 100 - 150 µm.

IDENTIFICATION OF GENETIC STOCKS IN INDIAN MACKEREL (*RASTRELLIGER KANAGURTA*) (PNP/41)

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

The objective of the project was to study the genetic variability in the Indian Mackerel *Rastrelliger kanagurta* by three independent methods like variations in protein, mitochondrial DNA and morphometrics. Multiphore gel electrophoretic techniques/methods for extraction, separation and detection of muscle protein patterns were standardized. Five zones of protein bands were observed in the individual specimens. Polymorphic banding pattern was detected in the fast moving zones. Population samples from Cochin, Mangalore, Neendakara and Goa were screened to estimate the genetic variability at four polymorphic loci. differences in the allele frequencies estimated between populations in the present study and differences noticed earlier in some enzyme loci need further confirmation.

Protocols for extraction of mtDNA from ovary/liver and detection of its heteroplasmic forms by agarose gel electrophoresis were standardised. The first screening showed two banded common haplotype and single and triple banded rare types, indicating presence of polymorphic mtDNA haplotypes within the species.

Measurements of body dimensions in mackerel samples from Cochin (45), Neendakara (10), Mangalore (9), Goa (10), Ambalapuzha (25) and Chavakkadu (30) were recorded for truss-network analysis of morphometric variability.

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

The following molluscans were tested for their salinity tolerance levels at 290C through four sets of experiments during the period under report. Their ranges of salinity tolerance and optimum salinities are,

Species and size	Tolerance range	Optimum
Crassostrea madrasensis (20-25mm)	5-45 ppt	30-35 ppt
Paphia malabarica (9-12mm)	5-30 ppt	10-15 ppt
Meretrix casta (35-40mm)	5-25 ppt	15 ppt
Meretrix casta (41-45mm)	5-30 ppt	15-20 ppt

Studies On Cryopreservation of Gametes And Embryos Of Penaeid Prawns (PNP/45)

A.D. Diwan, D. Kandasami and Mohan K. Zachariah

When Dimethylsulfoxide (DMSO) and glycerol was independently used as cryoprotectants, the viability of thawed embryos and nauplii of *Penaeus semisulcatus* was nil. The embryos did not hatch out and nauplii were dead; whereas in a mixture of DMSO and glycerol prepared in the grades of 5 to 20%, 40 to 50% of the embryos hatched out successfully to nauplii after 1, 2 and 4 hours of preservation. However, after 6 hours the percentage of hatching was only 5 percent. In higher grades ie., 25 to 30% twenty to thirtyfive percent embryos did not show any hatching.

Nauplii preserved in different grades of DMSO (5% to 30%) did not revive, whereas the nauplii preserved in 5% glycerol showed a revival rate of 5% after 2 hours of preservation. Revival rates were nil in all grades of glycerol after 4 and 6 hours. In a mixture (DMSO and glycerol) revival rate was more than 50% up to 4 hours. Whenever the revival of nauplii was observed, the growth was further monitored till they entered into PL. Composition of extender used, percentage of different cryoprotectants used, effect of cooling durations and cryodiluents on hatching rate of eggs and effect of different percentages of cryodiluents and cooling conditions on survival rate of nauplii were also tabulated.

Disease Investigations in Marine Shellfishes (PNP/46)

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

White spot syndrome was identified in two places in farms around Cochin - in Chellanam and Andhakaranazhi. There was mass mortality in Chellanam. The farmer in Andhakaranazhi was adviced to harvest his crop after detection of white spots. Examination of *P. monodon* revealed characteristic white spots on the carapace of the prawns. White spots spread to other areas of shell when affected prawns were monitored for 3 days in the laboratory. Histological analysis is going on in *P. indicus* collected from the adjacent pond which had high mortalities indicated high infestation of blue green algae on the gills. The gills were also infested with Zoothamnium and had rare black lesions also. The space between basal membrane and cuticle was swollen, filled with a fluid.

Mortality of *P. indicus* at a farm at Pallithode was investigated and found to be due to sudden drop in salinity to freshwater level due to heavy rains. No pathogenic organisms could be implicated in this mortality.

Few prawns collected from Narakkal were found infected with a microsporean parasite. Infection was not severe and was confined to lower abdominal segments. Infected tissue appeared whitish. Histopathological

examination confirmed the presence of microsporidian spores in tissues.

Prawn samples have been collected from various farms, both estuary/creek based and sea water based in Nagai Qaid-e-millath district of Tamilnadu in September 1995. Mortalities were reported in one of the extensive prawn farms in Velankanni. Zeolite, lime and some bacteriological preparations were used to clean water after the outbreak of disease. This did not help in reducing mortality. Use of disinfectants like Benzalconium chloride (BKC) and Iodofores and antibiotics (Oxytetracycline) at other farms through feed hastened the mortality. It was reported from Nagapattinam Quaid-E-Millath District that in one of the farms, which used an immunostimulant from the start of culture onwards, the survival was better.

A survey of the bacterial flora of sea water, estuaries and creeks and culture ponds and their outlets of various shrimp farms were conducted in May- June in the Nagapattinam Quaid-E-Millath District of Tamil Nadu and Karaikkal in Pondicherry as part of an environmental assessment study.

A 'red disease' was recorded in spiny lobster *Panulirus ornatus* in one of the lobster holdings in Madras. Gram negative smears were recorded in the smears of haemolymph and hepatopancreas of the diseased lobsters. Bacteria have been isolated from haemolymph, hepatopancreas and shell lesions. 39 CFU/ml bacteria was recorded in the haemolymph of the lobster with the red disease while the normal lobster had only 1 CFU/ml. The isolated bacteria have been subcultured and preserved for proper identification and for infectivity and antibiotic sensitivity studies.

Formulation of Nutritional Strategies For The Management of Aquaculture Wastes (NSMAW) Through Low Pollution Diets For Shrimp (PNP/47)

Manpal Sridhar, M. Peer Mohamed and P. Vijayagopal

The aquaculture waste management is approached through diet formulation, improvement in feed utilisation and adoption of feeding regimes designed for specific farming operations. Reduction in output of organic matter, nitrogen and phosphorus is expected to reduce aquaculture waste greatly as well as potential eutrophication effects in receiving water bodies.

Feed ingredients of animal and plant origins screened for their phosphorus to nitrogen ratios were fishmeal (dried unsalted anchovies), shrimp meal, clam meal, groundnut oil cake and tapioca flour. The ratios of all the feed stuffs except tapioca flour had the desirable quality of low P/N ratio for low pollution diet formulation.

Six diets formulated for another experiment to deduce the optimum protein to energy ratios for juveniles of *Penaeus indicus* were also analysed for their P/N ratios. Low P/N values (0.37 in

fish meal to a maximum of 0.54 in ground nut oil cake) were observed in conventional shrimp feed ingredients with the exception of tapioca flour which had a high value of 7.74. Of the six experimental diets prepared for *Penaeus indicus* juveniles P/N ratios ranged from 0.59 to 0.94 which was well within the acceptable range.

P/N values of two farm made feeds were found to be 1.65 and 0.93 respectively; the former was prepared utilising non-conventional feed ingredients viz. bone/meat meal. Analysis of N and P in water from the ponds where these feeds were being applied showed values ranging from 0.89 to 0.92 mg/l and 0.18 to 0.106 mg/l respectively during a period of 60 days.

Genetic Studies On Marine Prawns (CMFRI SP0./12)

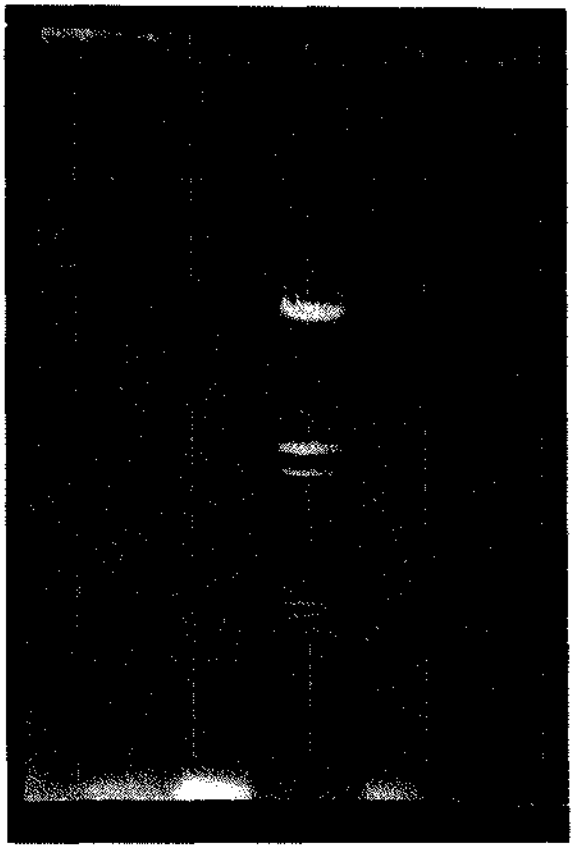
M.K. George, P.C. Thomas and N.K. Verma

The objectives of the project were the study of intraspecies variations in *Penaeus indicus*, *Penaeus monodon* and *Penaeus semisulcatus*; identification of genetically heterogenous stocks/strains within each species and detection of correlation between genetic traits and growth/body weight differences.

Variations within *Penaeus indicus* were studied by the method of gel electrophoresis of seven enzymes (AO, ALD, ODH, HEX, AK, GPDH and SDH) and morphometric measurements. Polymorphic phenotype/genotype patterns of the enzymes were screened in population samples of *Penaeus indicus* from Cochin, Madras, Chavakkadu and Kaipamangalam. Allelic frequencies were also estimated from the identified genotypes. Allelic frequency differences indicated at some loci between regions (Cochin/Madras) need further confirmation.

Statistical analysis of morphometrics including truss-network analysis of body dimensions have not been completed.

Due to the resignation of two of the three full-time research fellows during 1994/1995, the project could not progress to the desired extent. The request for extension of the project is under active consideration.



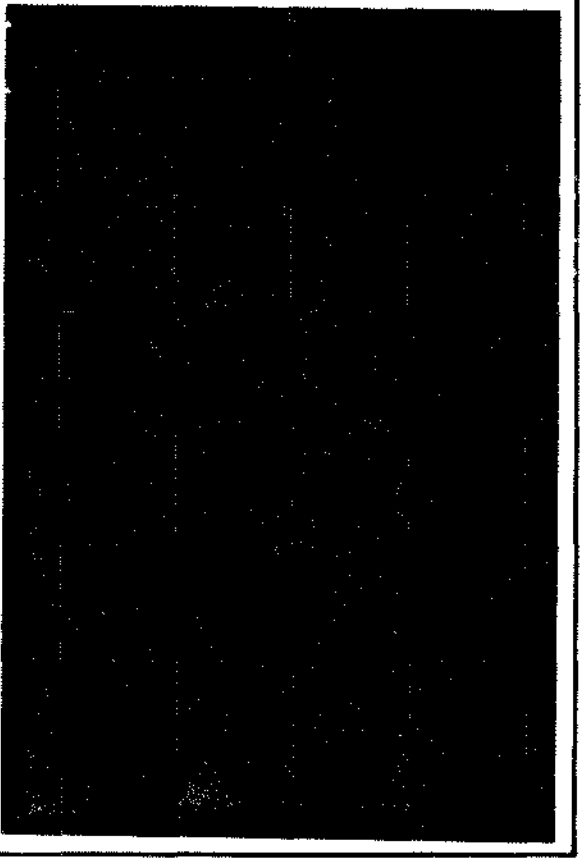
Mitochondrial DNA patterns in *S. longiceps* Lane from left to right:

1. Electrophoretic pattern of uncut mt. DNA
2. - do - Pst I enzyme cut pattern showing two banded fragment
3. Control
4. ECOR-I enzyme cut pattern showing four banded fragment.

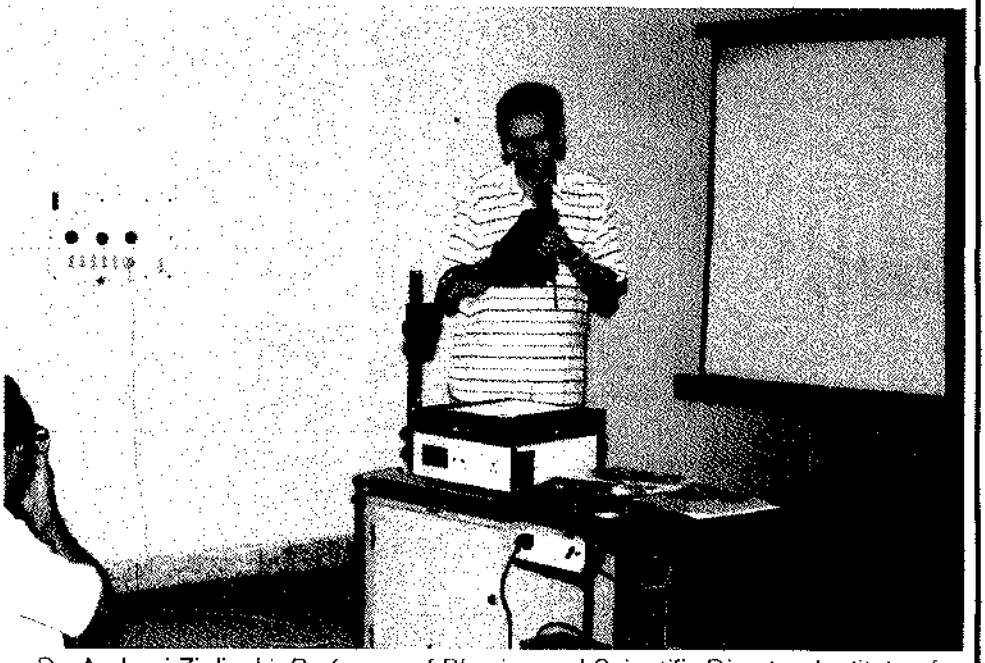
Mitochondrial DNA patterns in *R. kanagurta* Lane from left to right:

1. One banded uncut mt. DNA

2-4 Two banded uncut mt. DNA.



Parliamentary Standing Committee on Agriculture headed by Shri Nitish Kumar visiting the Krishi Vigyan Kendra of the Institute at Narakkal on 20th August 1995



Dr. Andrzej Zielinski, Professor of Physics and Scientific Director, Institute of Oceanography, Polish Academy of Science giving a seminar in CMFRI Cochin on ``Role of the Aerosols in the Transportation of Marine Bacteria into the Beaches'' on 7-12-1995

VIII. Socio - Economic Evaluation and Technology Transfer Division

A Study on the Bio-Economic Performance of Trawlers In Karnataka (FE & E/24.1)

R.Narayana Kumar and R.Sathiadhas

The collection of costs and earnings data from the sample units was completed from Mangalore, Malpe and Karwar landing centres by December 1995. Analysis of data revealed that the average initial investment of the trawler ranged from Rs.6.73 lakh at Karwar to Rs.9.16 lakh at Malpe. The average annual revenue worked out to Rs.7.77 lakh at Mangalore, Rs.8.13 lakh at Malpe and Rs.4.90 lakh at Karwar. Prawns accounted for 35% of the gross revenue. The average annual operating cost worked out to Rs.3.96 lakh at Mangalore, Rs.4.09 lakh at Malpe and Rs.2.25 lakh at Karwar. The average annual net profit worked out to Rs.95,205 at Mangalore, Rs.1,01,000 at Malpe and Rs.43,327 at Karwar. The rate of return for trawlers was estimated at 23 - 29% and the pay back period ranged from 4 to 5 years. The average cost of production per kg of fish was Rs.13 and the value realised per kg of fish was Rs.15. The analysis of the utilisation pattern revealed that about 30-35% of the catch goes for export and the remaining for domestic consumption and drying. The project is completed and the final report is under preparation.

Modelling And Evaluation of Extension Strategies for The Development of Fishing Community (FE & E/31)

Krishna Srinath R.Sathiadhas, Sheela Immanuel and R.Narayana Kumar

Empowerment of coastal women through transfer of technologies

The *mahima* feed production technology was transferred to four more groups sponsored by Auxilium Centre, Palluruthy, KSWDC, Karunagapally, DWCRA Nayarambalam and PMRY, Kumbalanghi. The Palluruthy unit commenced production in June and the Nayarambalam unit became operational. The feed was marketed in Ernakulam, Thrissur and Alapuzha districts of Kerala and to some farmers in Karnataka and Andhra Pradesh.

Integrated Farming

Fifteen women were trained in mushroom production with the help of KVK. Chellanam village vegetable and fruit producers' Society was formed to promote ornamental fish culture with horticulture. Three women sponsored by Rotary Club of Cochin East and Innerwheel Club of Cochin were trained in ornamental fish culture at the Fisheries College. The programmes of net making and *balawadi* were continued.

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, Sheela Immanuel, A.C.C. Victor, D. Sivalingam, P.V. Srinivasan, Vijayakumaran, G. Syda Rao, G. Mohanraj, K. Vijayakumar, N. Ramachandran, Krishna Pillai, R. Sathiadhas, Krishna Srinath, P. Kaladharan, P.S. Kuriakose, K.K. Appukuttan, C. Muthiah, Prathibha Rohit, M.E. Rajapandian, K. Preetha.

Under this project, the transfer of technology programme for mussel culture was initiated at Mandapam Camp, Madras, Visakhapatnam and Karwar centres.

Fish farmers Meets

"Monthly Fishermen-Farmers-Industry-Institution Meets" were organised and the state of affairs on a) management for sustainable fisheries development, b) mussel farming, c) crab farming, d) fish diseases, e) oyster culture, f) *Mahima* shrimp feed, g) pearl culture, h) artificial fish habitats, i) small scale shrimp farming, j) sustainable prawn farming, k) clam farming and l) composite fish culture were discussed. Literature pertaining to the above subjects was published in Kannada, Malayalam, Tamil and Telugu besides Hindi and English and distributed to the participants. These Meets helped to narrow down the gap between the technology generation system and the technology users'system. As a result, lot of correspondence from individuals and groups has been received seeking training on various technologies.

Resource Management And Socio-Economic Survey of Small Scale Fisheries In Lakshadweep Islands (FE & E/33)

R. Sathiadhas, Krishna Srinath and R. Narayana Kumar

Data on the socio-economic factors from secondary sources have been collected. Currently there are about 7500 households in 10 inhabited islands. The fish production in 1994-95 from Lakshadweep islands is about 10,000 tonnes of which tuna accounts for 80%. Necessary schedules were prepared to conduct the socio-economic survey and costs and earnings data collection from sample units. The Lakshadweep administration was contacted and the Fisheries Department has agreed to collaborate in executing the field work.

संपन्न कार्यों का मुख्य अंश

मछली उत्पादन का आकलन

भारत में वर्ष 1995 का मछली उत्पादन 2.26 मिलियन टन आकलित किया गया जो वर्ष 1994 की अपेक्षा 3.9% कम है. पिछले वर्षों की तुलना में पेनिआइड झींगों, बांगडे, फीतामीन, क्रोकेर्स और बंबिलों के अवतरण में घटती हुई फिर भी करंजिडों और तारलियों का अवतरण बढ़ गया.

तारलियों का आकलित अवतरण 57,000 टन था, जो पिछले वर्ष की अपेक्षा 10,000 टन अधिक था. बांगडों के अवतरण में 29,000 टन और बंबिलों के अवतरण में 17,000 टन की घटती हुई. पेनिआइड झींगों का अवतरण 187,000 टन था जो पिछले वर्ष की अपेक्षा 38,000 टन कम था. करंजिडों और तारलियों का आकलित अवतरण क्रमश:197,000 टन और 128,000 टन था.

कुल पकड में यंत्रीकृत बोटों (बिना बोर्ड इंजन के बोटों को शामिल करके) का योगदान 87.3% और अयंत्रीकृत बोटों का योगदान 12.7% था.

कुल अवतरण का 5.1% उत्तर पूर्व क्षेत्र (पश्चिम बंगाल और उडीसा) का योगदान था. दक्षिण पूर्व तट (आंध्रा प्रदेश, तमिलनाडु और पोंडिचेरी) से 25.8%, दक्षिण पश्चिम तट (केरल, कर्नाटक और गोवा) से 31.4% और उत्तर पश्चिम क्षेत्र (महाराष्ट्र और गुजरात) से भारत के कुल समुद्री मछली अवतरण का 36.2% प्राप्त हुआ. आन्डमान और लक्षद्वीप संघ राज्य क्षेत्रों का योगदान लगभग 1.5% था.

मात्स्यिकी और संपदा विशेषताओं का अध्ययन

वर्तमान विदोहन के क्षेत्र से उत्पादन किए जाने के संदर्भ में अनुकूलतम स्तर से उत्पादन बढ़ाने और जारी रखने के उद्देश्य से संस्थान ने प्रग्रहण मात्स्यिकी में अनुसंधान परियोजनाओं के द्वारा अनुसंधान के डाटाबेस विकसित करने के प्रयास जारी रखे.

पेलाजिक फिनफिश: तारली, बांगडा, श्वेतबेट, सीरफिश, ट्यूना, बिलफिश, बंबिल और फीतामीनों पर अध्ययन किया गया और इस पर संबंधित सभी आंकडे संग्रहित किए गए. तारलियों के अवतरण में इस वर्ष पश्चिम तट के केन्द्रों में कुछ वृद्धि हुई है. अवतरण में घटती की प्रवणता देखी गई. तारलियों में वर्ष के दौरान पुनरुज्जीवन महसूस हुआ. इस जाति के अवतरण का श्रृंगकाल मांगलूर में सितंबर से जनवरी तक और कोचीन में सितंबर से नवंबर तक था. बांगडों के अवतरण में पश्चिम तट में कोष संपाश और वलय संपाश और पूर्व तट में ट्रालर और गिलजाल मुख्य गिअर थे. कोष संपाशों का प्रयास कम होने की वजह से मांगलूर और कोचीन में इस जाति का कम अवतरण हुआ. पकड का लंबाई रेंच 55-279 मि मी था. बोट संपाश की अपेक्षा कोष संपाश द्वारा लंबी मछलियों की प्राप्ति हुई. नवंबर और फरवरी के दौरान मांगलूर में, मई और जून के दौरान कोचीन में, अप्रैल और मई के दौरान काकिनाडा में और अप्रैल और जनवरी के दौरान विशाखपट्टणम में 100 मि मी से कम लंबाई वाली मछलियों की पकड हुई. टूटिकोरिन में ज़्यादा मत्स्यन दबाव हुआ और इसलिए जालाक्षियों के आकार और प्रयास में नियंत्रण लाना पडा.

कोष संपाश, वलय संपाश और ट्रालरों द्वारा श्वेतबेटों का अवतरण किया जाता है. विदोहन की गई जातियों में *एस. बटाविएन्सिस* का लंबाई रेंच 40-114 मि मी, *एस. डेवीसी* का 40-99 मि मी, *एस. माक्रोप्स का* 55-84 मि मी और *एस. बुक्कानीरी* का 60-94 मि मी था.

सीरफिश की मात्स्यिकी में मांगलूर और कालिकट को छोडकर सभी केन्द्रों में सराहनीय प्रगति दिखाई पडी. अवतरण का श्रृंगकाल मद्रास में अप्रैल, टूटिकोरिन में अगस्त, विशाखपट्टणम, कोचीन और कालिकट में सितंबर, मांगलूर और बंबई में अक्तूबर और वेरावल में सितंबर और दिसंबर था. दक्षिण केन्द्रों में अवतरण की मुख्य जाति *स्कोम्बेरोमोरस कमेर्सन* और उत्तर के केन्द्रों में *एस. गट्टाटस* थी. कांटा डोर, बडी जालाक्षि वाले गिल जाल, ट्राल जाल और छोटी जालाक्षि वाले गिल जाल द्वारा पकडी गई पहली जाति का लंबाई रेंच क्रमश: 58-114 से मी, 48-66 से मी और 14-66 से मी था और *एस. गट्टाटस* का लंबाई रेंच 20-48 से मी था.

मुख्य भूमि में ट्यूना और बिलफिशों के विदोहन का प्रमुख गिअर गिल जाल था और लक्षद्वीप में लंबी डोर भी. वेरावल और माल्प से प्राप्त मुख्य ट्यूना *थन्नस टोंगोल*, विषिंजम से *ऑक्सिस रोचेई* और अन्य केन्द्रों से प्राप्त ट्यूना *यूथिनस एफिनिस* था. लंबी डोर द्वारा स्किपजैक और येलोफिन ट्यूनाओं को भी प्राप्त हुआ.

बंबिलों के अवतरण में महाराष्ट्र में थोडी सी वृद्धि हुई लेकिन गुजरात में कमी महसूस हुई. बंबई में सभी महीनों में 74 मि मी से कम आकार वाली छोटे बंबिलों को प्राप्त हुआ. फीतामीनों की पकड में सारे के सारे केन्द्रों में घटती देखी गई. *ट्राइक्यूरस लेप्ट्यूरस* अवतरण की मुख्य जाति थी.

तलमज्जी फिनफिश: विदोहन की गई तलमज्जी फिनफिश संपदाओं जैसे इलास्मोब्रांक, बडे पेर्च, शिंगटी, सूत्रपख ब्रीम, मुल्लन, क्रॉकेर्स, चपटी मछली, फ्लाटहेड्स, गोटफिश, थ्रेडफिन, तुंबिल और श्वेतमछली पर संस्थान ने अनुसंधान किया. इलास्मोब्रांक के अवतरण का मुख्य गिअर ट्रालर था जिसके बाद लंबी डोर और बोटम सेट जाल आते हैं. मद्रास से प्राप्त मुख्य जाति *रिनोप्टीरा जावानिका* और *डासियाटिस जेन्किन्सी* थी जिनका लंबाई रेंच क्रमश: 20-169 से मी और 20-140 से मी था. मंडपम की मुख्य जाति 84-122 से मी आकार रेंच की *डासियाटिस अर्नाक* थी. कोचीन से प्रति एकक द्वारा 213 कि ग्रा अवतरण हुआ. बंबई में बोटम ट्रालर द्वारा प्राप्त 2656 टन इलास्मोब्रांकों के अवतरण में पिछले वर्ष की तुलना में 19% की घटती दिखाई पडी. इलास्मोब्रांकों में 73 % सुराएं थे और *एस. लाटिकॉड्स* प्रमुख जाति थी.

ट्रालरों द्वारा बडे पेर्चों की भारी पकड हुई. विषिंजम और टूटिकोरिन से कांटा डोर द्वारा इस जाति का अवतरण हुआ. मद्रास से भी कांटा डोर द्वारा बडे पेर्चों का अवतरण हुआ.

बडे पेर्चों के अवतरण का श्रृंगकाल बंबई में अक्तूबर-दिसंबर था और *एपिनिफेलस डयाकांतस* प्रमुख जाति थी और इसका लंबाई रेंच 12-44 से मी था.

कोचीन में पेर्च मात्स्यिकी की मुख्य जातियाँ *ई. डयाकांतस* और *प्रिस्टिपोमोइड्स टाइपस* थी जिनके अवतरण का श्रृंगकाल अगस्त और सितंबर था और पकड का आकार रेंच पहली जाति का 20-45 से मी और दूसरी जाति का 30-62 से मी था.

विषिंजम से प्राप्त मुख्य जातियाँ *लेथ्रिनस लेन्ट्जन*, *लूटजानस* और *एपिनिफेलस अन्डुलोसस*

थी. टूटिकोरिन में बडे पेर्च के अवतरण का श्रृंगकाल जुलाई-सितंबर था. मद्रास में इस मात्स्यिकी की मुख्य जाति *एपिनिफेलस टॉविना* थी, जिसका लंबाई रेंच 25-110 से मी था.

शिंगटियों के उत्पादन में उत्तर पश्चिम तट में वृद्धि दिखाई पडी. बंबई की प्रमुख जातियाँ *टैकिस्युस डसुमेरी, टी. सीलाटस, टी. सोना* और *ओ. मिलिटारिस* थी. सितंबर में उच्चतम पकड प्राप्त हुई. कोचीन में गिलजालों के प्रति एकक की पकड दर 3.3 कि ग्रा थी. इस केन्द्र में अगस्त और सितंबर के दौरान प्रौढ *टी. सेराटस* को प्राप्त हुआ. मद्रास में शिंगटियों की अधिकतम पकड अगस्त में हुई और *टी. डसुमेरी* मुख्य जाति थी.

वेरावल में सूत्रपखब्रीमों में *नेमिप्टीरस जापोनिकस* की प्रचुरता दिखाई पडी. बंबई में मत्स्यन के दौरान *एन. जापोनिकस* की मृत्यु दर अधिकतम देखी गई और पिछले वर्ष की अपेक्षा पकड थोडी सी कम थी. मांगलूर में *एन. जापोनिकस* की अधिकतम वहनीय प्राप्ति 4947 टन थी. कोचीन में सूत्रपखब्रीमों के अवतरण में 76% की घटती हुई. मद्रास में सूत्रपखब्रीमों का अवतरण अधिकतम वहनीय प्राप्ति की दर से 10% अधिक था.

मद्रास, काकिनाडा और विशाखपट्टणम में मुल्लनों की पकड की मुख्य जातियाँ *लियोग्नाथस बिन्डस* और *सेक्यूटर इन्सिडियाटर* थी.

भारत के दोनों तटों के *क्रॉकेर्स* की प्रमुख जातियों का अध्ययन किया गया. तुंबिलों में *सॉरिडा तुंबिल* और *एस. अंडोस्क्वामिस* प्रमुख जातियाँ थी. तुंबिलों का लंबाई रेंच विभिन्न केन्द्रों में विभिन्न था.

ट्राल जाल द्वारा थ्रेडफिन्स की पकड में वेरावल में 16% और मांगलूर में 21.2% की वृद्धि हुई. पकड प्रयास में वेरावल में 8% घटती और मांगलूर में 6.5 % वृद्धि दिखाई पडी.

मांगलूर में चपटी मछलियों की प्रमुख जाति *साइनोग्लोसस माक्रोस्टोमस* थी, जिसकी पकड पूर्णत: ट्रालरों द्वारा हुई. कालिकट में भी *सी. माक्रोस्टोमस* प्रमुख जाति थी और अप्रैल, मई और जून अवतरण का श्रृंगकाल था. कोचीन से अप्रैल-दिसंबर के दौरान प्राप्त *सी. माक्रोस्टोमस* प्रौढ़ावस्था में थे.

मद्रास में अप्रैल-सितंबर के दौरान गोटफिश के अवतरण में पिछले वर्ष की अपेक्षा घटती हुई.

लक्षद्वीप में आलंकारिक मछली संपदाओं पर किए गए सर्वेक्षण के दौरान गिलजाल, वलयजाल और ड्राग जाल परिचालन से 115 जातियों के 3695 नमूनों को प्राप्त हुआ. 30 प्रमुख जातियों के जीवविज्ञान के आंकडे संग्रहित किए गए और 4 मुख्य जातियों के बढ़ती अनुपात और मृत्यु दर का आकलन किया गया.

क्रस्टेशियन कवचप्राणी: वर्ष 1995 के दौरान देश के वार्षिक समुद्री अवतरण के 3.6 लाख टन उत्पादन का 15.86% क्रस्टेशियन था. क्रस्टेशियन मात्स्यिकी का 51.89% पेनिआइड झींगे था जिसके बाद नोन-पेनिआइड (20.58%), स्टोमाटोपोड्स (18.45%), कर्कट (8.54%) और लोब्स्टेर्स (0.54%) आते है. पेनिआइड झींगों, लोब्स्टेर्स और स्टोमाटोपोड्स के अवतरण में क्रमश: 12.13%, 29.13% और 32.35% घटती हुई बल्कि कर्कट के अवतरण में 6.10% वृद्धि हुई. नोन-पेनिआइड झींगों में भी 0.68% वृद्धि हुई.

कुल पेनिआइड झींगों की पकड का 82% ट्रालरों द्वारा प्राप्त हुआ. इसकी पकड में पिछले वर्ष की तुलना में महाराष्ट्र में 23.82% गोवा में 29.19%, कर्नाटक में

7.54%, केरल में 39.86%, तमिलनाडु में 7.09%, पोंडिच्चेरी में 41.66% और आंध्राप्रदेश में 11.64% की घटती महसूस हुई. गुजरात में 56.94%, पश्चिम बंगाल में 168.81% और उडीसा में 112.30% की बढ़ती हुई.

वेरावल और मांगलूर को छोडकर पश्चिम तट के सारे केन्द्रों की ट्राल मात्स्यिकी में *पैरापेनिओप्सिस स्टाइलिफेरा* का प्रमुख स्थान था. वेरावल और मांगलूर में *सोलेनोसीरा क्रासिकोर्निस* और *मेटापेनिअस मोनोसिरस* मुख्य जातियाँ थी. पूर्व तट के टूटिकोरिन में *पेनिअस सेमीसुल्काटस*, पाम्बन में *पैरापेनिओप्सिस माक्सिल्लिपेडो*, मंडपम में *मेटापेनिओप्सिस स्ट्रिडुलन्स*, मद्रास में *मेटापेनिअस डोबसोनी*, काकिनाडा और विशाखपट्टणम में मेटापेनिअस मोनोसिरस और पारादीप में *पैरापेनिओप्सिस* मुख्य जातियाँ थी.

हाल के वर्षों में भारत के दोनों तटों में ट्रालिंग में किए गए परिवर्तनों के परिणामस्वरूप पेनिआइड झींगों की अपरंपरागत संपदाओं का आविर्भाव भी होने लगा. इनमें प्रमुख बंबई और मंडपम में *मेटापेनिओप्सिस स्ट्रिडुलन्स*, मांगलूर और शक्तिकुलंगरा में *ट्रैकिपेनिअस*, टूटिकोरिन, पाम्बन और मद्रास में *पैरापेनिओप्सिस माक्सिल्लिपेडो*, मंडपम और पाम्बन में *ट्रैकिपेनिअस पेसडोरेन्सिस* और विशाखपट्टणम और पारादीप में *सोलेनोसीरा* जाति थे.

पिछले पांच वर्षों के दौरान दक्षिण पूर्व तटों के डाटाओं के विश्लेषण से यह व्यक्त होता है कि मात्स्यिकी में *पेनिअस सेमिसुल्कैटस* की क्रमिक घटती हुई है. मंडपम में बडे आकार वाले ग्रीन टाइगर झींगों के स्थान में छोटे आकार वाले झींगे जैसे *पैरापेनिओप्सिस माक्सिल्लिपेडो* और *ट्रैकिपेनिअस पेसाडोरेन्सिस* का आविर्भाव हुआ. काकिनाडा में अति विदोहन की वजह से *पी. मोनोडोन*, *पी. इंडिकस* और *मेटापेनिअस मोनोसिरस* के आकार में कडी घटती हुई. बडे आकार वाले झींगों के स्थान में छोटे आकार वाले झींगों की अधिकता हुई.

मानसून अवधि के दौरान शक्तिकुलंगरा-नींडकरा क्षेत्र से प्राप्त *पी. स्टाइलिफेरा* की कुल पकड 11968 टन में पिछले वर्ष की अपेक्षा 92% की वृद्धि हुई. केरल के तटों में छोटे ट्रालरों के विस्तृत परिचालन के कारण *पी. स्टाइलिफेरा* के किशोरों का भारी नाश हुआ. छोटे ट्रालरों के परिचालन द्वारा प्राप्त झींगों का 50% से ज़्यादा छोटे आकार वाले थे. इस गिअर द्वारा की गई कुल वार्षिक झींगा पकड का 15% केरल तटों का योगदान था. पिछले वर्ष की अपेक्षा इस वर्ष में इस गिअर के परिचालन में 97% वृद्धि हुई.

टूटिकोरिन का गभीर सागर झींगा अवतरण प्रति एकक परिचालन में 438 कि ग्रा के साथ1856 टन आकलित किया गया. मात्स्यिकी में *मेटापेनिओप्सिस* और *हेटेरोकार्पस* प्रमुख थे. अवतरण में पिछले वर्ष की अपेक्षा चार गुनी वृद्धि हुई.

मांगलूर और माल्प में किए गए कोष संपाश अवतरण द्वारा 126 टन झींगा प्राप्त हुआ जो पिछले वर्ष की अपेक्षा 158% अधिक था.

देश की नॉन पेनिआइड झींगों की मात्स्यिकी गुजरात और महाराष्ट्र में अधिक दिखाई पडी. गुजरात की मात्स्यिकी में पिछले वर्ष की तुलना में 6% वृद्धि और महाराष्ट्र में 9.6% घटती हुई. महाराष्ट्र में डोल नेट द्वारा 77% नॉन पेनिआइड झींगों का अवतरण किया गया. गुजरात में ट्रालरों द्वारा 83% पकड हुई. वेरावल में *असेटस* और बंबई में *नेमाटोपालमन टेन्यूपस* प्रमुख जातियाँ थी.

महाचिंगटों का उत्पादन गुजरात (64.2%) में सबसे अधिक था जिसके बाद महाराष्ट्र (14.8%) और केरल (4.98%) आते हैं. देश के महाचिंगटों के

अवतरण का 67% ट्रालरों द्वारा प्राप्त हुआ. वेरावल में महाचिंगट मात्स्यिकी का प्रमुख भाग *थन्नस ओरिएन्टालिस* (56%) और *पैन्युलिरस पोलिफागस* (44%) था और बंबई में *पी. पोलिफागस* मुख्य जाति थी. अतिविदोहन के कारण बंबई समुद्र में रेत महाचिंगट *थन्नस ओरिएन्टालिस* को दिखाई नहीं पडता है.

दक्षिण पश्चिम तट की कारीगरी मात्स्यिकी में *पी. होमारस* प्रमुख थे जबकि टूटिकोरिन में *पी. ओर्नाटस* और *पी. होमारस* अवतरण की प्रमुख जातियाँ थी. मद्रास में ट्रालर अवतरण का 81% *थन्नस ओरिएन्टालिस* का योगदान था. टूटिकोरिन से गभीर सागर मत्स्यन में पोतों द्वारा 29 टन गभीर सागर महाचिंगट *प्यूरुलस सीवेली* प्राप्त हुआ.

भारत की कर्कट मात्स्यिकी में तमिलनाडु (37.7%), गुजरात (33.9%) और आंध्राप्रदेश (9.7%) का योगदान अधिक था. देश के कर्कट अवतरण का 75% ट्रालरों द्वारा प्राप्त हुआ. वेरावल में *कारिब्डिस लूसिफेरा*, बंबई, माल्प और मांगलूर में *कारिब्डिस क्रूसियाटा* प्रमुख जातियाँ थी. मद्रास और काकिनाडा के ट्राल अवतरण का मुख्य भाग *पोर्ट्नस सन्क्विनोलेन्टस* था. मद्रास से गभीर सागर कर्कट *कारिब्डिस स्मिथी* अधिक मात्रा में प्राप्त हुआ.

मोलस्क कवचप्राणी: देश का वार्षिक शीर्षपाद उत्पादन 116841 टन आकलित किया गया जिसमें पिछले वर्ष की अपेक्षा 2900 टन की वृद्धि दिखाई पडी. मात्स्यिकी में *सेपिआ फारोनिस, एस. एक्युलेटा, एस. एल्लिप्टिका, सेपिएल्ला इनेर्मिस, लोलिगो डुआसेली*, डोरिट्यूथिस जाति और *ओक्टोपस* जाति शामिल थी.

मलबार के तट में हरित शंबू का 2472.4 टन अवतरण हुआ जिसमें पिछले वर्ष की अपेक्षा 1252.6 टन की घटती दिखाई पडी. विषिंजम, मुल्लूर, पुलिंकुडी, कोलच्चल और इनयम में भुरा शंबु का अवतरण 397.2 टन था. काकिनाडा उपसागर में सीपी उत्पादन 889.5 टन आकलित किया गया जिसमें *एनडारा ग्रैनोसा, मेरेट्रिक्स मेरेट्रिक्स, एम. कास्टा, पैफिआ मलबारिका* और *काटेलिसिया ओपिमा* शामिल थे. मुल्की ज्वार-नदमुखी से 239 टन और कारवार उपसागर से 8.38 टन उत्पादन हुआ. *विल्लोरिटा साइप्रिनोइड्स* का उत्पादन 56400 टन था, जो पिछले वर्ष की अपेक्षा 1102 टन की घटती दिखाता है.

टूटिकोरिन पोताश्रय के उत्तर पूर्व भाग के पुलिपुन्डु पार से कुल 104 प्रशंखों का संग्रहण किया गया जिनका टैगन करके खुले समुद्र में छोडे गए.

काकिनाडा उपसागर से 1143 टन गास्ट्रोपोडों का अवतरण किया गया जिनमें सेरेथिडियम (34.7%), टेलिस्कोपियम (14.3%), अम्बोनियम (6.9%) और थायिस (0.4%) शामिल थे. मद्रास से 14.9टन गास्ट्रोपोडों का अवतरण हुआ जिनमें *बरसा, रपना बकबोसा, हेमिफ्यूसस पुगिलिनम, बाबिलोनिआ स्पाइरेटा, फिकस फिकस, टरिटेल्ला* जाति, *ओलिवा* जाति और *थायिस* जाति भी शामिल थी. मंडपम में 10,000 प्रशंखों का संग्रहण किया गया. रामेश्वरम में "चंक माडी" नाम से जानने वाले रूपांतरित श्रिंप ट्राल द्वारा प्रशंखों का सीधा विदोहन किया गया जो करीब 1.5 लाख आकलित किया गया.

मात्स्यिकी पर्यावरण का मॉनीटरन

कोचीन पोताश्रय की निकर्षण प्रक्रियाओं के पर्यावरण प्रभाव के निर्धारण पर किए गए अध्ययनों से यह व्यक्त हो गया कि एक वर्ष के आंकडों के अनुसार जल में पोषक स्तर, आविलता, तेल और ग्रीस के अनुपात में परिवर्तन है और जल के निचले भाग के तलछट में भारी लोहों का जमाव है.

इंडियन रेयर .एर्थ्स लिमिटड के पास के खान खोदने क्षेत्र के चारों ओर स्थित 7 महासमुद्रवैज्ञानिक केन्द्रों में एक वर्ष का क्रमिक मॉनीटरन विशेष प्रकार की तटीय अवस्था व्यक्त करता है.

दूर संवेदन और शक्य मत्स्यन मेखला: राष्ट्रीय दूर संवेदन प्राधिकरण, हैदराबाद द्वारा नवंबर, 1995 और मार्च, 1996 के दौरान केरल तट के कुल 15 अवतरण केन्द्रों से संग्रहित शक्य मत्स्यन मेखला के पूर्वानुमान की प्रामाणिकता यह साबित करती है कि शक्य मत्स्यन मेखला के पूर्वानुमान और चुनी गई वेलापवर्ती मत्स्यन प्रक्रियाओं के बीच अच्छी तरह का सह-संबंध है. वेलापवर्ती मत्स्यन मेखला से कोष संपाश और गिलजाल द्वारा अच्छी पकड प्राप्त होने की साध्यताएं भी व्यक्त हो गई. नितलस्थ ट्रालिंग प्रक्रिया में नवंबर-जनवरी महीनों के दौरान कोई विशेष संबंध नहीं दिखाया पडा।

समुद्री संवर्धन तकनोलजी: *पोर्ट्नस पेलाजिकस* कर्कट के बीजों पर किए गए परीक्षणों से यह व्यक्त हो गया है कि एक टन क्षमता वाले एफ आर पी टैंकों में ज़ोइया का पालन करने पर इनका रूपांतरण होकर 20-12 दिनों के अंदर छोटे कर्कट की अवस्था तक आ गए. ज़ोइया को खाद्य के रूप में क्लोरेल्ला, *रॉटिफर* और प्रोन एग कस्टार्ड दिए गए और प्राथमिक परीक्षणों में 8-9% अतिजीविता आकलित की गई.

टूटिकोरिन की मोलस्क स्फुटनशाला में 19 अंडजनन से खाद्य शुक्ति के 1.49 लाख कलचलेस स्पाट और 2 लाख संलग्न स्पाट का उत्पादन किया गया.

मुक्ता शुक्ति *पिंक्टाडा फ्यूकेटा* का 10 अंडजनन होने पर भी जल की कम गुणवत्ता के कारण स्पाटों का जमाव नहीं हुआ. जनवरी महीने में आन्डमान से लाए गए *पी.मारगारिटिफेरा* का अत्यधिक अंडजनन हुआ फिर भी स्पाटों का जमाव नहीं हुआ. जनवरी में *पी. सुगिलेटा* का अंडजनन हुआ लेकिन स्पाटों का जमाव नहीं हुआ.

सीपी स्फुटनशाला में *पैफिआ मलबारिका* के दो सफल अंडजनन से 7.11 लाख स्पाटों का उत्पादन किया गया. अंडजनन का समय नहीं होने पर भी इस जाति ने अप्रैल महीने में अंडजनन किया, जो एक दिशेष घटना है. *पी. मलबारिका* के पालन केलिए 25x25 से मी आकार वाले वेलन स्क्रीन बैग में 1000 की दर अनुकूलतम देखी गई.

विषिंजम उपसागर में एक रैफ्ट में एक-में-दो पंजर का प्रयोग किया गया. इस पंजर में मुक्ता शुक्ति के स्पाटों का जमाव और वाणिज्यिक प्रमुख मछलियों और महाचिंगटों की उपस्थिति की रिपोर्ट की गई.

टूटिकोरिन में मुक्ता शुक्ति के ऊतक संवर्धन की स्फुटनशाला और कालिकट में शंबू की स्फुटनाशाला स्थापित की गई.

द्विकपाटी संवर्धन केलिए अनुयोज्य स्थान का चयन

विशाखपट्टणम: काकिनाडा की "एस आइ आर आइ एस" स्फुटनशाला (एक निजी स्फुटनशाला) के सिमेंट टैंकों में डाली गई मुक्ता शुक्तियों को विशाखपट्टणम पोताश्रय में लाया गया. जून, 95 में 82 मुक्ता शुक्तियों में केन्द्रक का रोपण किया गया, जिनमें 35 शुक्तियों ने केन्द्रक का अस्वीकार किया. बाकी में केवल तीन शुक्तियों ने अच्छी गुणता वाले मोत्तियों का उत्पादन किया. संवर्धन द्वारा भारत के उत्तर पूर्व तटों से अच्छी गुणता वाले मोत्तियों का उत्पादन पहली घटना है.

मद्रास: पोंडिच्चेरी के पास चुन्नम्बरु में रोपण की गई 21 मि मी आकारवाली शुक्तियों में अच्छी बढ़ती और

प्रौढता देखी गई लेकिन इस क्षेत्र में स्पाटों का जमाव नहीं हुआ.

टूटिकोरिन: जून महीने में रोपण की गई 500 मुक्ता शुक्तियों और 30 मादा शुक्तियों को काकिनाडा तक परिवहन किया गया. उच्च तापमान के कारण परिवहन के वक्त की मृत्यु दर भी अधिक थी. अक्तूबर में तटीय मुक्ता संवर्धन के लिए कुल 6000 मुक्ता शुक्तियों को मंडपम और 1000 शुक्तियों को मद्रास लाया गया.

कोचीन: अष्टमुडी झील में *क्रासोस्ट्रिया माड्रासेंसिस* शुक्ति का अच्छा स्पाट उत्पादन हुआ और 8 महीनों के अंदर ये विपणन योग्य आकार तक पहुँच गए. इन में से 2-4 टन शुक्तियों और 240 कि ग्रा मांस का संग्रहण किया गया.

कोचीन के अंधकारनषी में पंजरों में पालन किए गए 16 मि मी आकरवाले मुक्ता शुक्ति बीजों की अच्छी बढ़ती रिकार्ड की गई. इस क्षेत्र के मुक्ता संवर्धन से 33.3% मुक्ता उत्पादन हुआ.

टूटिकोरिन से 450 मुक्ता शुक्ति स्पाटों और 89 प्रौढ शुक्तियों को अंधकारनषी तक लाया गया.

ताल में मुक्ता शुक्तियों के पालन की रीति के अंदर जनवरी, 96 के दौरान मुनंबम के एक ताल में 327 मुक्ता शुक्तियों को प्रतिरोपित किया गया जिनमें 176 शुक्तियों में फरवरी, 96 में रोपण किया गया.

कोचीन के अंधकारनषी में 10 मी गहराई में 400 स्क्वायर मीटर क्षेत्र में लंबी डोर शंबू फार्म स्थापित किया गया. इस फार्म में 4.5 से 6 मी लंबाई रेंच में बीजोंवाली 100 रस्सियाँ लटकाई गई. 4 महीनों में भुरे शंबू की बढ़ती 66.03 मि मी और औसत भार 17.5 ग्रा और हरित शंबू की बढ़ती 56.76 मि मी और भार 9.75 ग्रा आकलित किया गया.

कालिकट: टूटिकोरिन से पुतियापा उपसागर तक लाई गई मुक्ता शुक्तियों में छः महीनों के पश्चात रोपण किया गया और इनमें से 10% अच्छी गुणता के मोती प्राप्त हुए.

तकनोलजी का उन्नयन, स्थान चयन और स्थानांतरण

टूटिकोरिन पोताश्रय में रैफ्टों में 5940 मुक्ता शुक्तियों का रोपण किया गया और इनमें से 77.49 ग्रा भार वाले 534 मोत्तियों का उत्पादन किया गया, जिन्हें 45,550 रु को बेच दिया गया. वालिनोक्कम का फार्म रेत के अपसरण के कारण बंद किया गया.

तटीय मुक्ता संवर्धन तकनोलजी स्वीकार करते हुए एक निजी स्फुटनशाला द्वारा मुक्ता शुक्ति स्पाटों के पालन का प्रयास किया गया. इस उद्देश्य के लिए 22,475 मुक्ता शुक्तियों को मंडपम, मद्रास, काकिनाडा, विशाखपट्टणम और कोचीन को भी लाया गया. मंडपम में समुद्र के पंजरों और तटीय टैंकों में 450 शुक्तियों का रोपण और पालन किया गया.

टूटिकोरिन में मुक्ता संवर्धन पर तीन प्रशिक्षण कार्यक्रम चलाए गए.

आंडमान से 200 ब्लेक लिप मुक्ता शुक्ति *पिंक्टाडा मारगरिटिफेरा* को मंडपम और टूटिकोरिन को लाया गया. टूटिकोरिन में इनकी मृत्यु दर ज़्यादा होने के कारण इन्हें मंडपम को ही ले गया.

केरल तट में मुक्ता संवर्धन तकनोलजी का प्रचार और स्थानांतरण

अष्टमुडी ज्वारनदमुखी के दलवपुरम में नवंबर, 1994 में रैक एंड रेन तरीके से 0.22 हेक्टयर क्षेत्र में प्रदर्शन के लिए एक फार्म सजाया गया. अगस्त, 95 में ये शुक्तियाँ संवर्धन योग्य आकार तक पहुँच गई और 2.4 टन शुक्तियों का संग्रहण किया गया.

खाद्यशुक्ति तकनोलजी के इस प्रदर्शन से दलवपुरम के छः कृषक, मुनंबम का एक, ट्रिच्चूर के चेटुवाय का एक कृषक खाद्य शुक्ति कृषि शुरू करने के लिए प्रेरित हो गए.

इस प्रकार कण्णूर के धर्मडम में आयोजित प्रदर्शन द्वारा एक किसान को कासरगोड के पडन्ना में खाद्यशुक्ति एवं शंबू कृषि शुरू करने को प्रेरणा मिली.

समुद्री संवर्धन तकनोलजी का सदुपयोग

पोषण: पोषकों का सूत्र बनाने केलिए सघन आहार, भोजन की चीज़ों और तैयार किए गए भोजन का परीक्षण किया गया. इसमें यह देखा गया कि मछली चूर्ण, सीपी चूर्ण, मुँगफली खली और श्रिंप चूर्ण में फोस्फरस/नाइट्रजन का अनुपात एक से कम है. कसावा चूर्ण में यह अनुपात 7.74 देखा गया.

अंतःस्राव-विज्ञान: अणु-भार चिह्नक का प्रयोग करके प्रौढ़ *पेनिअस इंडिकस* के न्यूरोएंडोक्राइन के सार में प्रोटीन पट्टियों की विशेषताओं का अध्ययन किया गया. नेत्रवृंत सार के जैव आमापन अध्ययन से पूर्व निर्मोक जीवों में निर्मोक रोकने की क्षमता स्पष्ट हो गई. वक्षीय गुच्छिका और मस्तिष्क के लयोफिलाइस्ड पाउडर को उपयुक्त करके किए गए जैव आमापन अध्ययन से अंडाशय विकास की प्रेरणा व्यक्त हो गई. अंडाशय विकास दूसरी अवस्था तक देखा गया.

शरीरक्रिया विज्ञान: चार परीक्षणों द्वारा 29°C में मोलस्कों की लवणता सह्यता की जांच की गई. उनकी लवणता सह्यता और अनुकूलतम लवणता के रेंच इस प्रकार हैं.

जाति और आकार	सह्यता रेंच	अनुकूलतम लवणता
क्रासोस्ट्रिआ माड्रासेन्सिस (20-25 मि मी)	5-45 पी पी टी	30-35 पी पी टी
पैफिआ मलबारिका (9-12 मि मी)	5-30 पी पी टी	10-15 पी पी टी
मेरिट्रिक्स कास्टा (35-40 मि मी)	5-25 पी पी टी	15 पी पी टी
मेरिट्रिक्स कास्टा (41-45 मि मी)	5-30 पी पी टी	16-20 पी पी टी

बयोतकनोलजी: पेनिआइड झींगों के गैमीट और भ्रूण के क्रयोप्रोटक्शन केलिए डीमीथाइलसल्फोक्साइड और ग्लिसरोल का प्रयोग अलग और मिश्रित रूप में किया गया. नोप्ली का पुनरुज्जीवन जहाँ कहाँ देखा गया, वहाँ उपयोग किए गए विस्तारक का मिश्रण, उपयुक्त क्रयोप्रोटक्टन्टों का प्रतिशत, क्रयोडयलुएन्टों की विभिन्न प्रतिशतता के प्रभाव और अतिजीवितता दर पर शीतन स्थिति का अवलोकन किया गया.

रोगविज्ञान: कोचीन और चारों ओर के खेतों में वाइट स्पोट रोग के सिन्ड्रोम देखे गए. मृत्युता रिपोर्ट की गई तालों में जूताम्नियम और नील हरित शैवाल द्वारा गिल का ग्रसन देखा गया. कई मामलों में क्लोमावरक भागों में फुलाव दिखाया पडा. नारक्कल से संग्रहित कुछ नए झींगों में लघुबीजाणुओं का संक्रमण देखा गया.

वेलांकण्णी के पास के खेतों में मृत्युदर की अधिक रिपोर्ट की गई. डिसइन्फेक्टन्ट और एन्टीबयोटिक के उपयोग से मृत्युदर में कुछ हद तक रोक लाने सका.

पर्यावरण के प्रभाव निर्धारण के अध्ययन के भाग के रूप में नागपट्टणम और कारैकल के समुद्र जल, ज्वारनदमुखी और संवर्धन तालों के जीवाणु वनस्पतिजातों का अध्ययन किया गया.

शूली महाचिंगट *पैन्युलिरस अर्नाटस* के "रेड डिसीस" का अध्ययन करने पर हीमोलिंफ और हेपाटोपानक्रियास में ग्राम नेगटीव जीवों की उपस्थिति देखी गई. आइसोलेटड जीवाणुओं पर आगे अध्ययन किए जा रहे हैं.

आनुवंशिकी का अध्ययन: *रॉस्ट्रेलिगर कानागुर्टा* के पेशी के प्रोटीन नमूनों के निष्कर्षण, पृथक्करण और पहचान केलिए मल्टीफोर इलक्ट्रोफोरेटिक तरीकों का मानकीकरण किया गया. अलग नमूनों में प्रोटीन पट्टियों के पांच स्तर देखे गए. तीव्र गति के स्तर में पोलिमोर्फिक प्रोटीन फीनोटाइप का पहचान हुआ. मांगलूर, नींडकरा और गोवा से प्राप्त नमूनों में प्रकट चार पोलिमोर्फिक लोसी में आनुवंशिक विभिन्नता

दिखाई पडी. अंडाशय और जिगर के एम टी डी एन ए के सार केलिए प्रोटोकोल और एगरोस जेल इलक्ट्रोफोरसिस द्वारा इनके पहचान का मानकीकरण किया गया. नमूनों में उपस्थित एम टी डी एन ए की जांच करने पर इस जाति में पोलिमोर्फिक हाप्लोटाइप्स की उपस्थिति भी देखी गई.

मोर्फोमेट्रिक विभिन्नता के ट्रस नेटवर्क विश्लेषण केलिए नमूनों के शरीर की लंबाई-चौडाई भी रिकार्ड की गई.

पेनिअस इंडिकस और *पी. मोनोडोन* के अंतराजातीय आनुवंशिक बहुरूपता पर अध्ययन जारी रखा. कोचीन, चावक्काडू, कैपमंगलम और मद्रास से प्राप्त *पेनिअस इंडिकस* के नमूनों के एनज़ाइमों में पोलिमोर्फिक इलक्ट्रोफोरेटिक नमूनों की जांच की गई. तुलना की गई छः लोसियों में दो में अलीलिक बारंबरता आकलित की गई. मद्रास और कोचीन से प्राप्त नमूनों से मोर्फोमेट्रिक डाटा भी संग्रहित किया गया.

मात्स्यिकी अर्थशास्त्र का अध्ययन

मांगलूर, माल्प और कारवार के अवतरण केन्द्रों से प्राप्त लागत और कमाई के आंकडों के अध्ययन से व्यक्त हो गया कि ट्रालर की औसत प्रारंभिक पूंजी कारवार में 6.73 लाख रु और माल्प में 9.16 लाख रु थी. औसत वार्षिक राजस्व मांगलूर में 7.77 लाख रु, माल्प में 8.13 लाख रु और कारवार में 4.90 लाख रु आकलित किया गया. सकल राजस्व का 33 प्रतिशत झींगों से प्राप्त हुआ. औसत वार्षिक परिचालन लागत मांगलूर में 3.96 लाख रु, माल्प में 4.09 लाख रु और कारवार में 2.25 लाख रु आकलित किया गया. औसत वार्षिक लाभ मांगलूर में 95,205 रु, माल्प में 1.01 लाख रु और कारवार में 43,327 रु आकलित किया गया. ट्रालरों के परिचालन से प्राप्त लाभ 23 से 29 प्रतिशत और ऋण की वसूली की अवधि 4 से 5 वर्ष आकलित किया गया. प्रति कि ग्रा मछली का औसत उत्पादन लागत 13 रु और प्रति कि ग्रा मछली का मूल्य 15 रु आंका गया. उपयोगिता की रीति का विश्लेषण करने पर मालूम पडा कि पकड के लगभग 30-35% का निर्यात किया जाता है और बाकी मछली घरेलू उपयोग और सुखाने के लिए उपयुक्त की जाती है.

तकनोलजी का स्थानांतरण

महिमा खाद्य की उत्पादन तकनोलजी ऑक्सीलियम सेन्टर, पल्लुरुत्ती; के एस डब्लियू डी सी, करुनागपल्ली; डी डब्लियू सी आर ए, नायरम्बलम और पी एम आर वाइ, कुम्बलंगी द्वारा प्रायोजित चार ग्रूपों को दी गई. पल्लुरुत्ती एकक में जून महीने में उत्पादन शुरू किया गया और नायरम्बलम एकक का परिचालन शुरू करने वाला है. खाद्य का विपणन केरल के एरनाकुलम, त्रिशूर और आलप्पुषा जिलों में किया गया और कर्नाटक और आंध्राप्रदेश के कुछ किसानों को भी बेच दिया गया.

प्रायद्वीपीय भारत में लघु पैमाने की मात्स्यिकी के साथ लघु पैमाने में समुद्री संवर्धन के एकीकरण कार्यक्रम में हर महीने में मछुआ-कृषक-उद्योग-संस्था बैठकों का आयोजन किया गया और कई विषयों यानी वहनीय मात्स्यिकी विकास, शंबू कृषि, कर्कट कृषि, मछली रोग, शुक्ति कृषि, *महिमा* झींगा खाद्य, मोती संवर्धन, कृत्रिम मछली आवास, लघु पैमाने की श्रिंप कृषि, वहनीय झींगा कृषि, सीपी कृषि और मिश्रित मछली संवर्धन पर चर्चा की गई. उपर्युक्त विषयों प र अंग्रेज़ी, हिन्दी और स्थानीय भाषाओं (कन्नड, मलयालम, तमिल, तेलुगु) में छप्पे गए लेख भागीदारों को प्रदान किए गए.

प्रशिक्षण और शिक्षा कार्यविधियाँ

पिछले वर्षों के समान इस वर्ष में भी सी एम एफ आर आइ ने कृषि विज्ञान केन्द्र (के वी के), प्रशिक्षक

प्रशिक्षण केन्द्र (टी टी सी) और समुद्री संवर्धन में स्नातकोत्तर कार्यक्रम द्वारा प्रशिक्षण और शिक्षा कार्यक्रम में महत्वपूर्ण भाग निभाया. पी जी पी एम के अंदर संस्थान के वैज्ञानिक एम. एससी और एम. एफ. एससी के छात्रों और पीएच. डी अध्येताओं के अध्यापन केलिए 2200 मानव घंटे में लगे हुए. स्नातकोत्तर कार्यक्रम के अंदर 13 वां सत्र के 9 छात्रों ने तीसरा सेमस्टर पूरा किया और वे शिक्षा के विशिष्टीकरण के शोध प्रबंध तैयार करने केलिए चौथे सेमेस्टर में कार्यरत हैं. 14 वां सत्र में 10 छात्रों ने डेफिश्यन्सी कोर्स पूरा किया और उनका प्रथम सेमेस्टर शुरू हो गया. इस सेमेस्टर में बी.एफ.एससी का एक छात्र भी आ गया. रिपोर्टाधीन अवधि के अंदर चार छात्र वर्ष 1995 में एम. एफ.एससी कार्यक्रम में शामिल हुए और उन्होंने डेफिश्यन्सी कोर्स का प्रथम सेमेस्टर पूरा किया. पीएच.डी कार्यक्रम के अंदर 5 अध्येताओं को विज्ञान एवं तकनोलजी का कोचीन विश्वविद्यालय द्वारा डॉक्टरी उपाधि प्रदान की गई. छः अध्येताओं ने अपने थिसीस का कार्य पूरा किया और उपाधि के लिए कोचीन विश्वविद्यालय को प्रस्तुत किया. कोचीन विश्वविद्यालय के पंजीकरण के अंदर चार वरिष्ठ अध्येता अपने अनुसंधान कार्य पूरा करने की कोशिश में लगे हुए हैं. समविश्वविद्यालय के अंदर 12 वां सत्र के पीएच. डी. कार्यक्रम में शामिल हुए चार छात्रों ने कोर्स कार्य पूरा करके अनुसंधान कार्य शुरू किया. 13 वां सत्र के 5 छात्रों ने कोर्स कार्य शुरू किया.

वर्ष के दौरान संस्थान द्वारा विकसित समुद्री संवर्धन और डिंभकोत्तर तकनोलनी पर प्रशिक्षक प्रशिक्षण केंन्द्र द्वारा 9 प्रशिक्षण कार्यक्रम और एक कार्यशाला आयोजित किए गए. राज्य मात्स्यिकी विभाग, एन जी ओ और उद्योगों के कुल 121 व्यक्तियों ने इन कार्यक्रमों में भाग लिया.

संस्थान के के वी के द्वारा विभिन्न विषयों पर 35 पाठ्यक्रम चालए गए और 737 व्यक्तियों ने इनमें भागँ लिया.

परामर्श तथा आर एंड डी सहायता

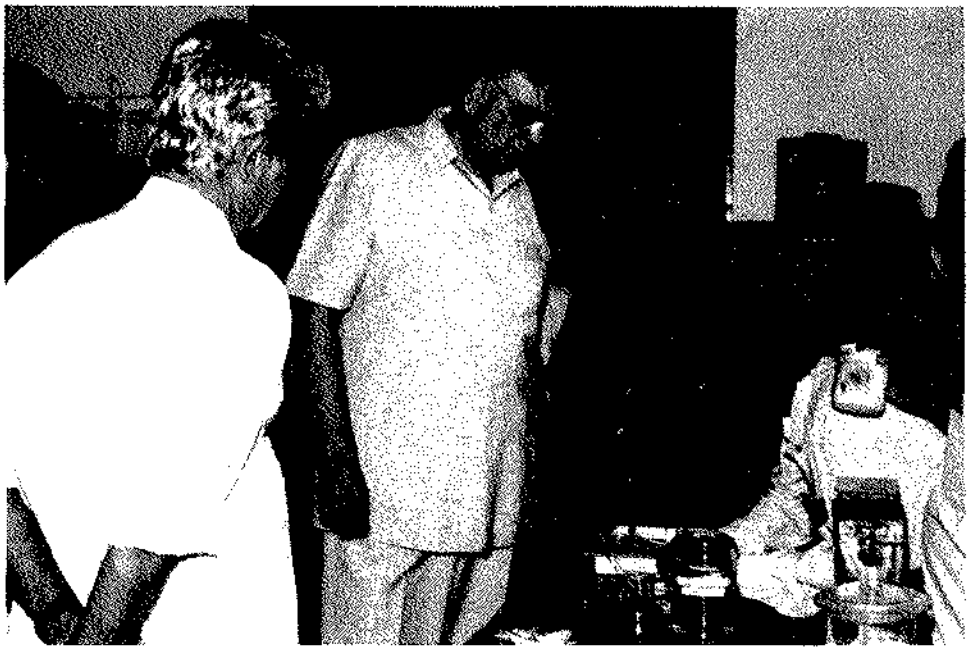
वर्ष 1996 के दौरान प्रदान की गई / हस्ताक्षर की जाने वाली परामर्श सेवाएं

क्र.सं.	*उद्यमी का नाम*	*स्थान एवं कार्य*	*राशि (रु)*
1.	श्री. के. जगदेश्वर राव	विशाखपट्टण मोती संवर्धन	45,000
2.	श्री वी. सरला	विशाखपट्टणम मोती संवर्धन	45,000
3.	मेसेर्स. एन.सी.सी. ब्लूवाटर प्रोडक्ट्स लिमिटेड	चन्दनाडा (आ.प्र) मोती संवर्धन	84,000
4.	मेसेर्स. बालाजी बयो-टेक लिमिटड, नेल्लूर	तुपिलिपालम मोती संवर्धन	1,66,250
5.	मेसेर्स. एक्वा प्राइम इन्टरनाशनल (इंडिया) लिमिटड	नेल्लूर मोती संवर्धन	2,01,350
6.	मेसेर्स. जेम होलिडे रिसोर्ट्स लिमिटड	मद्रास मोती संवर्धन	4,30,750
7.	मेसेर्स. स्टेरलिंग श्रिंप्ड (पी) लिमिचड	चिरला (आ.प्र) मोती संवर्धन	--
8.	मेसेर्स. कलिंगा एक्वाटिक्स लिमिटडं	भुवनेश्वर (उडीसा) कर्कट कृषि	--
9.	मेसेर्स. पिंक गोल्ड ब्रिटीश एक्स्पोर्ट्स लिमिटड	राइगड (महाराष्ट्र) कर्कट कृषि	1,94,000

Shri M. M. Meiyappan, Sr. Scientist, Madras Research Centre receiving the trophy from Dr. (Ms.) Rajendrakumari Bajpai, Lt. Governor of Pondicherry for excellent Hindi implementation among the autonomous bodies in southwest Region.

Dr. M. Peer Mohamed, Principal Scientist receiving TOLIC trophy for implementing Hindi as official language at CMFRI

Dr. Balram Jakhar, Union Minister of Agriculture, Govt. of India inaugurating the laboratory building of Visakhapatnam Research Centres of CMFRI and CIFT on 17th September, 1995



Dr. Balram Jakhar, Hon'ble Minister for Agriculture, Govt, of India witnessing the nucleus implantation process for pearl production at Molluscan Laboratory, Cochin on 1-10-1995

अनुसंधान परिणामों का प्रकाशन

पिछले वर्षों की तरह संस्थान द्वारा किए गए अनुसंधान कार्यों के परिणाम राष्ट्रीय एवं अंतर्राष्ट्रीय वैज्ञानिक पत्रिकाओं और परिचर्चाओं/कार्यशालाओं / संगोष्ठियों के कार्यवृत्तों में छप्पे गए. इनके अतिरिक्त संस्थान द्वारा वर्ष 1995-96 के दौरान निम्नलिखित प्रकाशन जारी किए गए.

1. समुद्री मात्स्यिकी सूचना सेवा, टी व ई श्रेणी सं. 136-139
2. सी एम एफ आर आइ न्यूजलेटर सं. 65-67
3. सी एम एफ आर आइ विशेष प्रकाशन सं 61-64
4. सी एम एफ आर आइ बुलेटिन सं. 48
5. सी एम एफ आर आइ वार्षिक रिपोर्ट 1994-95
6. अनुसंधान मुख्य अंश 1994-95
7. सी एम एफ आर आइ विवरणिका (अंग्रेज़ी और हिन्दी)
8. समुद्री जीव विविधता परिरक्षण और प्रबंधन (पुस्तक)
9. आंध्रा प्रदेश की समुद्री मात्स्यिकी में आर एंड डी के लिए सी एम एफ आर आइ का योगदान
10. शंबु संवर्धन पत्रक (हिन्दी)

RESEARCH PAPERS PUBLISHED

AMEER HAMSA, K.M.S., H.M. KASIM AND G. ARUMUGAM 1994. The fishery, biology and stock assessment of *Nemipterus delagoae* Smith off Tuticorin. Gulf of Mannar. *Bull. Cent. mar. Fish. Res. Inst.*, 47: 112-120.

AMEER HAMSA, K.M.S. AND H.M. KASIM 1994. The perch fishery by traditional traps at Kilakarai (Gulf of Mannar) and some aspects of biology of *Lethrinus nebulosus* (Forskal). *Ibid.*, 47: 98-105.

AMEER HAMSA, K.M.S., H.M. KASIM AND S. RAJAPACKIAM 1994. Length weight relationship of *Lutianus rivulatus* off Tuticorin, Gulf of Mannar. Ibid., 47: 128-129.

ANILKUMAR, P. AND N. SRIDHAR 1996. Characterisation of Phenol oxidase of *P. indicus*. *Indian J. Fish.* 40(4): 251-255 (1993).

ANNIGERI, G.G., K. NARAYANA KURUP, M. KUMARAN, MADAN MOHAN, G. LUTHER, P.N. RADHA KRISHNAN NAIR, PRATHIBHA ROHIT, G.M. KULKARNI, J.C. GNANAMUTHU AND K.V. NARAYANA RAO 1992. Stock assessment of oil sardine, *Sardinella longiceps* Val., off west coast of India. *Indian J. Fish.* 39(3,4): 125-135.

APPUKUTTAN, K.K. AND C.M. ARAVINDAN 1995. Studies on the biochemical composition of the short neck clam *Paphia malabarica* from Ashtamudi estuary, south-west coast of India. *Seafood Export Journal*, 26 (5): 17-21.

APPUKUTTAN, K.K., T.S. VELAYUDHAN AND R. SATHIADAS 1995. Edible Oyster Farming. CMFRI Technology transfer series. 7 (Pamphlet).

APPUKUTTAN, K.K. 1996. Marine molluscs and their conservation. *Marine Biodiversity, Conservation and Management.* (eds) N.G. Menon and C.S.G. Pillai. CMFRI, Cochin: 66-79.

APPUKUTTAN, K.K. 1996. Recent developments in Molluscan Aquaculture in India. *Seafood Export Journal*, 27(1): 13-20.

APPUKUTTAN, K.K. AND P.MUTHIAH 1996. Technology of edible oyster culture. *Bull. Cent. Mar. Fish. Res. Inst.*, 48: 64-69.

ARAVINDAKSHAN, M. AND J.P. KARBHARI 1994. Studies on the fishery and biology of *Solenocera choprai* Nataraj off Maharashtra coast. *J. Mar. biol. Ass. India* 36(1&2): 96-99.

ARAVINDAKSHAN, M. 1995. The fishery for flammingo shrimp *Parapenaeus longipes* (Alcock) at Sassoon Dock, Bombay. *Fishing Chimes*, 14(12): 33.

ARAVINDAKSHAN, M. 1995. Fishing of Kuruma shrimp *Penaeus japonicus* Bali off Maharashtra coast. Ibid., 15(10) : 22.

ARAVINDAKSHAN, M., A.Y. MESTRY AND M. SHRIRAM 1995. A fishery for southern Rough Shrimp *Trachypenaeus curvi rostris* off Bombay coast. Ibid., 15(3) : 35.

BABU PHILIP AND K.K. APPUKUTTAN 1995. A check-list of gastropods landed at Sakthikulangara-Neendakara area. *Mar. Fish. Inf. Serv.*, T&E Ser., 138: 9-10.

BALASUBRAMANIAN, T.S., S. RAJAPACKIAM, H. MOHAMAD KASIM AND K.M.S. AMEER HAMSA 1995. Emergence of hand jigging for cephalopods along Tuticorin coast. Ibid., 137: 13-16.

BALASUBRAMANIAN, T.S., S. RAJAPACKIAM, K.M.S. AMEER HAMSA AND H. MOHAMAD KASIM 1995. On the bumper catch of balistids from Tuticorin with notes on length-weight relationship and gut contents. *Ibid.*, 137: 18-19.

BENSAM, P. AND N.G. MENON 1995. On conservation of certain commercially exploited groundfish resources of India. CSIR, STEC, ANRT, Spices Board & IRE. Proc. 4th *Swadesi Sci. Congr* : 8-12.

BENSAM, P. AND N.G. MENON 1996. Conservation of marine mammals. In: *Marine Biodiversity conservation and Management.* (eds.N.G. Menon and C.S.G. Pillai), CMFRI, Cochin: 133-142.

CHAKRABORTY, S.K. 1995. Growth, mortality and yield per recruit of threadfin bream *Nemipterus japonicus* (Bloch) off Bombay. *Indian J. Mar.* Sci. 24: 107-109.

CHAKRABORTY, S.K. 1995. Growth, mortality and stock assessment of *Nemipterus mesoprion* (Bleeker) from Bombay waters. *Indian J. Fish.*, 43(2): 11-17.

CHENNUBHOTLA, V.S.K. 1995. Seaweed culture and its prospects in India. Proceedings of the Seminar on Fisheries - A multibillion dollar Industry, Madras: 111-113.

CHENNUBHOTLA, V.S.K 1995. Seaweeds and their importance. *Bull. Cent. Mar. Fish. Res. Inst.*, 48: 108-109.

DESHMUKH, V.D. 1993. Status of non-penaeid prawn fishery in India and Stock Assessment of *Acetes indicus Milne Edwards of Maharashtra. Indian J. Fish.*, 40(1, 2): 50-62.

DEVARAJ, M. AND S. ANSARI 1995. Intersectoral Conflicts in Marine Fisheries in Kerala, India. Asian Fisheries Forum, Commemoration Volume : 24 pp.

DEVARAJ, M. 1996. Coastal Biodiversity-Conservation and sustainable Management. *Marine Biodiversity Conservation and Management.* (eds. N.G. Menon and C.S.G. Pillai), CMFRI, Cochin: 177-192.

DEVADOSS, P. 1996. Shark fishing in India - Proceeding of Seminar on Fisheries - A Multi Billion Dollar Industry, Aqua- culture Foundation of India, Madras. p. 6-11.

GOPINATHAN, C.P., J.X. RODRIGO, H. MOHAMED KASIM AND M.S. RAJAGOPALAN 1994. Phytoplankton pigments in relation to primary production and nutrients in the inshore waters of Tuticorin, southeast coast of India. *Indian J. Mar. Sci.*, 23: 209-212.

GOPINATHAN, C.P. 1996. Live Feed Culture - Micro algae. CMFRI Bulletin No. 48 : 110-116.

GOPINATHAN, C.P. AND G.S.D. SELVARAJ 1996. The Mangroves - importance, conservation and management - In: Marine Biodiversity Conservation and Management, pp. 4-15.

JAMES, D.B. 1995. Taxonomic studies on the species of *Holothuria* (Linnaeus 1767) from the seas around India. Part I. *J. Bombay Nat. Hist. Soc.*, 92(1): 43-62.

JAMES, D.B. 1995. Taxonomic studies on the species of *Holothuria* (Linnaeus, 1767) from the seas around India. Part 2. Ibid., 92(2): 190-204.

JAMES, D.B. AND M. BADRUDEEN 1995. Deep water red fish a new resource for the Indian Beche-de-mer industry. *Mar. Fish. Infor. Serv., T&E Ser.*, 137: 6-8.

JAMES, D.B. 1996. Culture of sea cucumbers. *Bull. Cent. Mar. Fish. Res. Inst.*, 48: 120-126.

JAMES, D.B. 1996. VII. Conservation of sea cucumbers. In: N.G.Menon and C.S.G.Pillai (Eds)., *Marine Bio-diversity Conservation and Management.* Central Marine Fisheries Research Institute, Cochin-14, pp. 80-88.

JAMES, D.B. 1996. Prospects for the culture of sea cucumbers in India. In: Sustainable Aquaculture. Proc. National Conference (Ed.) S. Ramachandran. Anna University, Madras : 189-199.

JAMES, D.B. 1996. Prospects for hatchery and culture of sea cucumbers in India. Proceedings of the Seminar on Fisheries - A multibillion dollar industry. Aquaculture Foundation of India and the Fisheries Technocrats Forum, Madras.

JAMES, D.B., A.J. LORDSON, W.G. IVY AND A.D. GANDHI 1996. Experiments on rearing of the juveniles of *Holothuria scabra* Jaeger produced in the hatchery. Proc. Sym. Aquaculture for 2000 A.D. (Ed.) Samuel Paul Raj, Madurai Kamaraj University, *Madurai, pp.* 1-9.

JAMES, P.S.B.R., P.P. PILLAI, A.A. JAYAPRAKASH, T.M. YOHANNAN, PON SIRAIMEETAN, C. MUTHIAH, G. GOPAKUMAR, N.G.K. PILLAI, S. REUBEN, R. THIAGARAJAN, K.P. SAID KOYA, G.M. KULKARNI, M.V. SOMARAJU, K.N. KURUP AND T.V. SATYANANDAN 1992. Stock assessment of tunas from the Indian seas. *Indian J. Fish.* Vol.39(3,4): 260-277.

JAMES, P.S.B.R. AND P. BENSAM 1995. Present status and further scope

for development of oceanic fisheries in India. *Indian Hydrobioloy.*, 1(1): 19-26.

KALADHARAN, P., K. VIJAYAKUMARAN AND V.S.K. CHENNUBHOTLA 1996. Optimization of certain physical parameters for the mariculture of *Gracilaria edulis* in Minicoy lagoon of Laccadive Archipelago. *Aquaculture* 139(1996): 265-270.

KALIAPERUMAL, N., S. KALIMUTHU AND J.R. RAMALINGAM 1995. Economically important seaweeds. CMFRI *Spl. Publ.* 62: 1-36.

KALIAPERUMAL, N., V.S.K. CHENNUBHOTLA, S. KALIMUTHU, J.R. RAMALINGAM, S. KRISHNA PILLAI, K. SUBBARAMAIAH, K. RAMA RAO AND P.V. SUBBHA RAO 1995. Distribution of seaweeds off Kattapadu - Tiruchendur coast, Tamil Nadu. *Seaweed Res. Utiln.*, 17: 183-193.

KALIMUTHU, S., N. KALIAPERUMAL AND J.R. RAMALINGAM 1995. Distribution of algae and seagrasses in the estuaries and backwaters of Tamilnadu and Pondicherry. *Seaweed Res. Utiln.*, 17 (1&2): 79-86.

KASIM, H.M., K.M.S. AMEER HAMSA, P. SAM BENNET, S. RAJAPAKIAM AND G. ARUMUGAM 1994. Exploitation of perch fishery resource off Tuticorin by small mechanised trawlers with an account on the biology of *Scolopsis bimaculatus Ruppell. CMFRI Bulletin No.* 47: 106-111.

KASIM, H.M., R. MARICHAMY, T.S. BALASUBRAMANIAN, K.M.S. AMEER HAMSA AND S. RAJA PACKIAM 1994. On the accidental stranding, rescue and return of Hump back Dolphins at Tuticorin Harbour area. *Mar. Fish Infor. Serv. T&E Ser.*, 128: 14-15.

KASIM, H.M. AND K.M.S. AMEER HAMSA 1994. Carangid fishery and population dynamics of component species *Caranx carangus* (Bloch) and *Caranx leptolepis* (Cuvier and Valenciennes) from Tuticorin waters. *J. mar. biol. Ass. India.* 36 (1&2): 63-71.

KEMPARAJU, S., B. SHRIDHARA, H.S. MAHADEVASWAMY AND P.U. ZACHARIA 1995. Unusual landing of catfish by purse seine at Malpe, Dakshina Kannada. *Mar. Fish. Infor. Serv., T&E Ser.*, 137: 20.

KIZHAKUDAN, J.K. AND K.A. NARASIMHAM 1995. Observations on the population characteristics of the corbiculid clam *Villorita cyprinoides* (Gray) in the Chitrapuzha portion of the Vembanad lake. *CMFRI Spl.Publ.*, 61: 83-87.

KRIPA, V., K. PRABHAKARAN NAIR AND MATHEW JOSEPH 1995. The cephalopod fishery at Cochin, Kerala. *Mar. Fish. Infor. Serv., T&E Ser.*, 139: 1-5.

KRISHNAKUMAR, P.K., E. CASILLAS AND U. VARANASI 1995. Effects of environmental contaminants on the health of *Mytilus edulis* from Puget

sound, Washington, USA. II. Cytochemical detection of subcellular changes in the digestive cells. *Mar. Biol.*, 124: 251-259.

KRISHNA SRINATH, 1995. Use of traditional media for fisheries. *Communicator, Jan-March* 1995, p. 48-49.

KRISHNA SRINATH AND P. RAJEEV 1995. Use of sea safety measures by fishermen. *Mar. Fish. Infor. Serv., T&E Ser.*, 139: 8-9.

KRISHNA SRINATH, P.N.R. KARTHA AND A.N. MOHANAN 1996. Group farming for sustainable prawn culture. CMFRI Transfer of Technology Series 10(B) : 10 pp.

KURIAKOSE, P.S. AND R. SATHIADHAS 1995. *Mussel culture. Ibid.*, I. 8pp.

KURIAKOSE, P.S. AND K.K. APPUKUTTAN 1996. Technology of mussel culture. *Bull. Cent. Mar. Fish. Res. Inst.*, 48: 70-75.

KURIAN, A. AND K. NARAYANA KURUP 1992. Stock assessment of Bombay-duck *Harpodon nehereus* (Ham.) off Maharashtra coast. *Indian J. Fish.* 39(3,4): 243-248.

LIPTON, A.P., A.D. DIWAN, A. REGU NATHAN AND C. KASINATHAN 1995. Frequent strandings of dolphins and whales along the Gulf of Mannar coast. *Mar. Fish. Infor. Serv. T&E Ser.*, 138: 11- 14.

LUTHER, G., K.V. NARAYANA RAO, G. GOPA KUMAR, C. MUTHIAH, N. GOPALA KRISHNA PILLAI, PRATHIBHA ROHIT, K. NARAYANA KURUP, S. REUBEN, P. DEVADOSS, G. SYDA RAO, P. SAM BENNET AND N.S. RADHAKRISHNAN 1992. Resource characteristics and stock assessment of white baits. *Indian J. Fish.* 39(3,4): 152- 168.

MANPAL SRIDHAR AND R. NARAYANAKUMAR 1995. *MAHIMA* - The CMFRI shrimp feed. CMFRI Technology Transfer Series VI, 8pp.

MARICHAMY, R. AND S. RAJAPACKIAM 1995. Ecological monitoring of marine pollution along Tuticorin coast. *Proc. Nat. Symp. on Electrochemistry in Marine Environment,* CECRI and DOD : 44-52.

MARICHAMY, R., H.M. KASIM, K.M.S. AMEER HAMSA AND S. RAJAPACKIAM 1995. Survival of fish and prawn to industrial effluents with special reference to mercury. *Ibid.*, 114-119.

MARICHAMY, R. 1996. Crab farming potential in India. Proc. of the Seminar on Fisheries - A multibillion dollar industry, Aquaculture Foundation of India : 115-122.

MARICHAMY, R. 1996. Mud crab culture and hatchery. *Bull. Cent. Mar. Fish. Res. Inst.*, 48: 103-107.

MEIYAPPAN, M.M., M. SRINATH, K. PRABHAKARAN NAIR, K. SATYANARAYANA RAO,

R. SARVESAN, G. SYDA RAO, K. SUNILKUMAR MOHAMED, KUBER VIDYASAGAR, K.S. SUNDARAM, A.P. LIPTON, P. NATARAJAN G. RADHA KRISHNAN, K.A. NARASIMHAM, K. BALAN, V. KRIPA AND T.V. SATHIANANDAN 1993. Stock assessment of the Indian squid *Loligo duvauceli* Orbigny. *Indian J. Fish.*, 40 (1,2): 74-84.

MENON, N.G., P. BENSAM, K. BALACHANDRAN AND J. ANDREWS 1995. Coastal bottom trawling and environmental biodegradation (in Malayalam). CSIR, STEC, ANERT, Spices Board & TRE. Proc. 4th *Swadeshi Sci. Congr* : 87-93.

MENON, N.G. AND N.G.K. PILLAI 1996. The destruction of young fish and its impact on inshsore fisheries. In : *Marine Biodiversity Conservation and Management* (Ed. N.G. Menon and C.S.G. Pillai) : 89-96.

MOHAMED, K.S. 1995. Probiotics - An emerging concept in aquaculture nutrition and disease control. *Seafood Exp. J.*, 26(7): 5-9.

MOHAMED, K.S. 1996. Estimates of growth, mortality and stock of the Indian squid *Loligo duvauceli* Orbigny, exploited off Mangalore, southwest coast of India. *Bull. Mar. Sci.*, 58(2): 393-403.

MOHAMMAD ZAFAR KHAN, K.N. KURUP AND A.P. LIPTON 1992. Status of Bombay duck *Harpodon nehereus* (Ham.) resource off Saurashtra coast. *Indian J. Fish.* 39(3,4): 235-242.

MOHAMMAD ZAFAR KHAN, M. KUMARAN, A.A. JAYAPRAKASH, K.S. SCARIAH, V.M. DESHMUKH AND M.H. DHULKHED 1992. Stock assessment of pomfrets off west coast of India. *Indian J. Fish.* 39(3,4): 249-259.

MOHAPATRA, B.C. AND K. RENGA RAJAN 1995. A Manual on Bioassays in the Laboratory and their Techniques. *CMFRI Spl. Publ.*, 64: 1-75.

MURTY, V. SRIRAMACHANDRA 1996. Marine Ornamental Fishes of India. Proc. Seminar *"Fishery - A Multibillion Dollar Industry"*. Aquaculture Foundation of India and Fishery Technocrats Forum, Madras, 17-19 August, Madras : p. 23-34.

MURTY, V. SRIRAMACHANDRA AND P. VEDAVYASA RAO 1996. Marine Fishery Resources of India - Present Status and Management Concerns. In : *Marine Biodiversity Conservation and Management.* (eds. N.G. Menon and C.S.G. Pillai), CMFRI, Cochin: 103-125.

NAIR, K. PRABHAKARAN, M. SRINATH, M.M. MEIYAPPAN, K. SATYA NARAYANA RAO, R. SARVESAN, KUBER VIDYASAGAR, K.S. SUNDARAM, G. SYDA RAO, A.P. LIPTON, P. NATARAJAN, G. RADHAKRISHNAN, K. SUNIL KUMAR MOHAMED, K.A. NARASIMHAM, K. BALAN, V. KRIPA AND T.V. SATHIANANDAN

1993. Stock assessment of Pharooh cuttlefish *Sepia pharaonis* Ehrenberg. *Indian J. Fish.*, 40 (1,2): 85-94.

NAMMALWAR, P. 1995. Pollution problems of coastal ecosystems in India. Proceedings of National Symposium on Electrochemistry in Marine Environment, Central Electro-Chemical Research Institute, SAEST Madras Chapter, 7-8 Feb, 1995, pp. 64-70.

NAMMALWAR, P. 1995. Ecotoxicological effects of industrial pollution on the estuarine grey mullets with reference to Aquaculture along the Madras coast. Proceedings of Fourth National Symposium on Environment, Madras, 7-10 Feb, 1995, pp. 25-26.

NARASIMHAM, K.A. 1995. Technology of Mollusc Culture. Proceedings of the Seminar on Fisheries - A multibillion dollar industry, Aquaculture Foundation of India, Madras August 1995 : 105-110.

NARASIMHAM, K.A. AND P. LAXMI LATHA 1996. Clam culture. *Bull. Cent. Mar. Fish. Res. Inst.* 48: 76-87.

NASSER, A.K.V. 1995. Protect our coral reefs. Lakshadweep times (Minicoy), 22 November 1995, p. 2.

NOBLE, A., G. GOPAKUMAR, N. GOPALAKRISHNA PILLAI, G.M. KULKARNI, K. NARAYANA KURUP, S. REUBEN, M. SIVADAS AND T.M. YOHANNAN 1992. Assessment of mackerel stock along the Indian coast. *Indian J. fish.* 39 (3,4):119-124.

PAULRAJ, R. 1995. Availability of raw material and marketing of various aqua feeds. Presented at the interaction meeting on Aqua Feeds, Department of Biotechnology, New Delhi, October 14, 1995, 11 p.

PHILIPOSE, K.K., E. VIVEKANANDAN AND P. DEVADOSS 1995. Artificial Fish Habitats. Technology Transfer Series No. 8, CMFRI (in English and Malayalam).

PHILIPOSE, K.K. 1995. Artificial reefs, habitat enhancement and increasing fisheries potential, *Bull. Cent. Mar. Fish. Res. Inst.*, 48: 4-7.

PILLAI, S. KRISHNA, A.A. JAYA PRAKASH, C. KASINATHAN AND N. RAMAMOORTHY 1995. On the sea whale *Balaenoptera borealis* stranded along the Palk Bay coast near Pamban Light House. *Mar. Fish. Infor. Serv., T&E Ser.*, 139: 11.

PILLAI, P.P. 1992. An overview on the present status and future prospects of pelagic finfish resources of India. *Indian J. Fish.* 39(3,4): 278-285.

PILLAI, V.K. AND K.K. VALSALA 1995. Seasonal variations of some metals in bivalve molluscs *Sunetta scripta* from the Cochin coastal waters. *Indian J. Mar. Sci.*, 24 : 113-115.

PILLAI, V.K. 1996. Marine pollution in the coastal waters of India. *In*: Menon, N.G. and C.S.G. Pillai (Eds). *Marine Biodiversity Conservation and Management.* CMFRI, Cochin: 143-151.

PILLAI, V.K. AND K.A. NARASIMHAM 1996. Environmental impacts of coastal aquaculture development. Ibid., 152-160.

PRATHIBA ROHIT AND S. KEMPARAJU 1995. Heavy landings of mackerel by trawlers at Mangalore Bunder. *Mar. Fish. Infor. Serv., T&E Ser.*, 139: 12.

RADHAKRISHNAN, E.V. AND M. VIJAYAKUMARAM 1995. Early larval development of spiny lobster, *Panulirus homarus* (Linnaeus 1758). *Crustaceana*, 68 (2): 151-159.

RADHAKRISHNAN, E.V. 1996. Lobster Farming in India. *Bull. Cent. Mar. Fish. Res. Inst.*, 48: 96-98.

RAJAGOPALAN, M. 1996. The marine turtles and their conservation. *In Marine Biodiversity Conservation* and *Management*. N.G.Menon and C.S.G. Pillai (eds), CMFRI, Cochin : 126-132.

RAJAPACKIAM, S., T.S. BALA SUBRAMANIAN, K.M.S. AMEER HAMSA AND H.M. KASIM 1994. On the landing of large sized Hammer head shark *Sphyrna lewini* at Tuticorin. *Mar. Fish. Infor. Serv., T&E Ser.*, 127: 13-15.

RAJAPACKIAM, S., T.S. BALA SUBRAMANIAN, K.M.S. AMEER HAMSA AND H.M. KASIM 1994. On the unusual landings of lesser devil ray *Mobula diabolus* (Shaw) from Gulf of Mannar. *Ibid.*, 129: 20-21.

RAJEEV, P. AND KRISHNA SRINATH 1995. Farmers' participation of group action in prawn farming and an action plan for group farming. *Ibid.*, 137: 8-10.

RAJE, S.G. AND V.V. SINGH 1994. Fishing fleet maintenance of Versova - An example of emancipation through cooperation. *Fishing Chimes* 14(11): 42-44.

RAO, G. SUDHAKARA 1995. Fishery for *Penaeus indicus* in Indian waters. *Fishing Chimes*, 15(1): 89-94.

RAO, G. SYDA, K.R. SOMAYAJULU AND P. ACHAYYA 1995. Prospects for developing culture of edible oyster *Crassostrea madrasensis* and green mussel *Perna viridis* along the Kakinada coast, Andhra Pradesh. *Mar. Fish. Infor. Serv., T&E Ser.*,135:1-5.

RAO, K. SATYANARAYANA, M. SRI NATH, M.M. MEIYAPPAN, K. PRABHAKARAN NAIR, R. SARVESAN, G. SYDA RAO, P. NATARAJAN, KUBER VIDYA SAGAR, K.S. SUNDARAM, A.P. LIPTON, G. RADHA KRISHNAN, K.A. NARASIMHAM, K. SUNILKUMAR MOHAMED, K. BALAN, V. KRIPA AND T.V. SATHIANANDAN 1993. Stock assessment of the needle cuttlefish *Sepia aculeata* D Orbigny. *Indian J. Fish.*, 40(1,2): 95-103.

RAO, K. SATYANARAYANA. 1996 Cephalopod fishing. Proceedings of the Seminar on Fisheries - A Multibillion Dollar Industry, *ACF India, Madras, p.* 12-20.

RENI, K. AND P. BENSAM 1995. Observations in the ecology and feeding habits of the pearl-spot *Etroplus suratensis* (Bloch). *CMFRI Spl. Publ.*, 61: 41-44.

REUBEN, S., S.S. DAN, M.V. SOMARAJU, V. PHILIPOSE AND T.V. SATHIANANDAN 1992. The resources of *Hilsa* shad, *Hilsa ilisha* (Hamilton), along the northeast coast of India. *Indian J. Fish.* 39(3,4): 169-181.

REUBEN, S., H.M. KASIM, S. SIVAKAMI, P.N. RADHAKRISHNAN NAIR, K.N. KURUP, M. SIVADAS, A. NOBLE, K.V. SOMASEKHARAN NAIR AND S.G. RAJE 1992. Fishery, biology and stock assessment of carangid resources from the Indian seas. *Indian J. Fish.* 39(3,4): 195-234.

SAM BENNET, P., P.N. RADHA KRISHNAN NAIR, G. LUTHER, G.G. ANNIGERI, S. SRINIVASA RANGAN AND K.N. KURUP 1992. Resource characteristics and stock assessment of lesser sardines in the Indian waters. *Indian J. Fish.* 39(3,4): 136-151.

SANHOTRA, M.K. AND M. PEER MOHAMED 1995. Significance of farm- made feeds on the Indian context. *Fishing Chimes* 15(4): 45-46.

SANHOTRA, M.K. AND S. PEREIRA 1996. A nutritional evaluation of some imported and indigenous shrimp feed. *Fish Technol.* 33(1): 28-35.

SHEELA IMMANUEL, 1995. Knowledge level of fishermen and women in seaweed collection, utilisation and cultivation, Journal of Extension Education, 6 and 7 (4): 1285-1287.

SHEELA IMMANUEL, 1995. Training programme for fishewomen on preparation of food from seaweed - An evaluation study. *Mar. Fish. Infor. Serv. T&E Ser.*, 137: 11-13.

SHRIRAM, M., C.J. JOSEKUTTY AND JAYADEV HOTAGI 1994. A note on a Whale Shark *(RHINCODON TYPUS)* landed at Cooperage landing centre, Bombay. *Ibid.*, 126: 16.

SRIDHAR MANPAL, R.J. NAIR AND N. SRIDHAR 1995. Trypsin activity with regard to ration size in P. indicus, H. Milne Edwards. *Indian J. mar. Sci.* 24: 110-112.

SRIDHAR MANPAL 1995. Towards practical shrimp feed formulations. *Fisheries World* 2(10): 24-27.

SRIDHAR, N. AND M. PEER MOHAMED 1995. Protein secretory pattern of neuroendocrine centres of shrimps. Proceedings of National Symposium on Technological Advancements in Fisheries 5-7 December, 1995.

SRIDHAR, N. AND M. PEER MOHAMED 1995. Neuroendocrine factors influencing maturation in shrimps. *Mar. Fish. Infor. Serv. T&E Ser.*, 140 : 4-5.

SUKUMARAN, K.K., V.D. DESHMUKH, G. SUDHAKARA RAO, K. ALAGARAJA AND T.V. SATHIANANDAN 1993. Stock assessment of the penaeid prawn

Metapenaeus monoceros Fabricius along the Indian coast. *Indian J. Fish.* 40(1,2): 20-34.

SUKUMARAN, K.K., K. ALAGARAJA, C. SUSEELAN, K.N. RAJAN, D.B. JAMES, T. SUBRAMONIAN, V.S. KAKATI, G. NANDAKUMAR, N.S. KURUP, P.T. SARADA AND T.V. SATHIANANDAN 1995. Stock assessment of the penaeid prawn *Metapenaeus dobsoni* (Miers) along the Indian coast. *Ibid.*, 40 (1&2): 35-49.

SUSEELAN, C., K.N. RAJAN AND G. NANDAKUMAR 1993. Some observations on the prawn fishery of Cochin. ibid 40: 213-224.

SUSEELAN, C., R. MARICHAMY, M.K. ANIL AND R. SATHIADAS 1995. Mud crab culture. Central Marine Fisheries Research Institute, Technology Transfer Series. 3.

SUSEELAN, C. 1996. Crustacean biodiversity conservation and management. In: *Marine Biodiversity conservation and management.* (eds. N.G. Menon and C.S.G. Pillai) CMFRI, Cochin. p. 41-64.

SUSEELAN, C. 1996. Crab culture and crab fattening. *Bull. Cent. mar. Fish. Res. Inst.*, 48: 99-102.

THIAGARAJAN, R., S. LAZARUS, Y. APPANNA SASTRY, M. ZAFAR KHAN, H. MOHAMAD KASIM AND K.S. SCARIAH 1992. Stock assessment of the ribbonfish, *Trichiurus lepturus* Linnaeus, from the Indian waters. *Indian J. Fish.* 39(3,4): 182-194.

THOMAS, P.A. 1996. The gorgonid resources and their conservation in India. *In: Marine Biodiversity Conservation and Management* (N.G. Menon and C.S.G. Pillai, Eds) CMFRI, Cochin : 32-40

VELAYUDHAN, T.S., S. DHARMARAJ, A.C.C. VICTOR AND A. CHELLAM 1995. Colour and thickness of nacre in four generations of Indian Pearl Oyster *Pinctada fucata* (Gould) produced in the hatchery. *Mar. Fish. Infor. Serv., T&E Ser.*, 137: 3-6.

VELAYUDHAN, T.S., V. KRIPA AND K.A. NARASIMHAM 1995. Experimental culture of the Indian oyster, *Crassostrea madrasensis* (Preston). *Seafood Export Journal,* 26(B): 5-13.

VICTOR, A.C.C., A. CHELLAM, S. DHARMARAJ AND T.S. VELAYUDHAN 1995. Manual on pearl oyster seed production, farming and pearl culture. CMFRI *Spl. Publ.*, 63, TTC manual series No.1 : 1- 53.

VIJAYAKUMARAN, K. 1995. Book Review - Threatened Fishes of India. *Fishing Chimes,* 14(12): 57.

VIJAYAKUMARAN, K. 1995. Book Review - Handbook on Design construction and equipment in coastal Aquaculture (Shrimp farming). *Fishing Chimes,* 15(5): 53 & 56.

VIJAYAKUMARAN, K., B. NARAYANA RAO AND K. RADHAKRISHNA 1996. Surface Productivity and related hydrography off Visakha

patnam during pre-monsoon and winter months of 1987-89. *Indian J. Mar. Sci.*, 25: 29-34.

VIJAYANAND, P.E. AND N.G.K. PILLAI 1995. Studies on some aspects of biology and ecology of coral reef fishes of Lakshadweep with observation on other coral reef ecosystems of India. *CMFRI Spl. Publ.*, 61: 99-111.

YOHANNAN, T.M., A.A. JAYAPRAKASH, M. SRINATH, R. THIAGARAJAN, P. LIVINGSTON, H. MOHAMAD KASIM AND G. LUTHER 1992. Stock assessment of *Scomberomorus commerson* along the Indian coast. *Indian J. Fish.* 39 (3,4): 111-118.

ZACHARIA, P.U., ALLI C. GUPTA AND H.S. MAHADEVASWAMY 1995. Exploitation of juveniles of the spiny cheek grouper, *Epinephelus diacanthus* by multi-day trawlers along Dakshina Kannada coast. *Mar. Fish. Infor. Serv., T&E Ser.*, 139: 5-8.

MEETINGS, CONFERENCES, SYMPOSIA, WORKSHOPS ATTENDED

Name & Designation	Meeting/Symposium/ Workshop etc.	Organisation, place	Date/s
Dr. M. Devaraj, Director	Academic Council Meeting of CIFE	Bombay	16 May 1995
	DOD meeting on *Sagar Sampada* cruises for 1995-97	Delhi	26 June 1995
	Discussion on the NEERI's report on impact of aquaculture in the coastal areas of Andhra Pradesh and Tamil Nadu convened by the Fisheries Development Commissioner	New Delhi	7 July 1995
	The Mid-year Review meeting of of the Directors of ICAR Institutes	New Delhi	10-14 July 1995
	Meeting on application and transfer of technology for the benefit of traditional and small scale coastal fisheries organised by Dept. of Ocean Development	NIO, Goa	25-27 July 1995
	BOBP Workshop on management of the coastal trawl fishery and of coastal aquaculture	Madras	28-29 July 1995
	Meeting on scientific data collection to support the validation of potential fishing zone programme organised by the Secretary, DOD	NRSA, Hyderabad	31 July 1995
	Meeting on Antarctic krill resources assessment	Bombay	7 August 1995
	Academic Council Meeting	CIFE, Bombay	18-19 August 1995
	Meeting of the task force Department of Biotechnology	New Delhi	21 August 1995
	Working group functioning for the formulation of a strategy for human resource development in the field of marine science and technology	DOD, New Delhi	6 October 1995

	Workshop on Training and Research for community Aquaculture	Kanyakumari	15 November 1995
	ICAR Fisheries Expert Panel Meeting	New Delhi	12-13 December 1995
	R.V. *Skipjack* meeting	ICAR, New Delhi	1-2 January 1996
	Meeting of the Expert Committee for preparation of Ten-year Profile on the activities to be undertaken by the DOD in the areas of Marine Environment and coastal zone	DOD, New Delhi	12 January 1996
	Seminar on Financing Deep sea Fisheries Development in Karnataka	College of Fisheries, Mangalore	30 January 1996
	Twelfth Task Force Meeting on Aquaculture and Marine Biotechnology	Dept. of Biotechnology, New Delhi	6 February 1996
	Meeting of the Expert Committee to review the work done by Fisheries College, & Research Institute, Tuticorin	Tuticorin	9-10 February 1996
	Meeting of the DOD Expert Group on Marine Living Resources - Drugs and Chemicals	New Delhi	12 February 1996
	First meeting of the Working Group on Fisheries for Ninth Five Year Plan of the Dept. of Agriculture & Cooperation, Ministry of Agriculture	New Delhi	19 February 1996
	ICAR Directors' Conference	New Delhi	26 February 1996
Dr. K.A.Narasimham Principal Scientist	Seminar on AQUAFAIR 95. Gave a talk on "Prospects for developing mollusc culture along the Andhra coast	Kakinada	22 April 1995
	Seminar on Fisheries - A Multi-billion Dollar Industry. Presented a paper on "Technology of Mollusc Culture"	Madras	18 August 1995

	Symposium on Technological Advancements in Fisheries. Presented a paper on "Aspects of Hatchery Production of Bivalve Seed"	Cochin	5 December 1995
	Gave a talk on 'Mollusc Culture' to the trainees of the Prawn Farm Project of the MPEDA	Vallarpadam	31 January 1996
	Gave a talk on 'Mollusc Culture' to the students of Sacred Heart College	Cochin	19 February 1996
	Gave a talk on 'Mariculture of Pearls' at a Seminar on Emerging Trends in Aquaculture organised by the Fisheries College	Panangad	24 February 1996
Dr.V.S.R.Murty, Sr.Scientist	Meetings of the committee to review the Deep sea fishing policy:		
	Fourth meeting	New Delhi	9 August 1995
	Fifth meeting	New Delhi	25 August 1995
	Seventh meeting	New Delhi	31 October 1995
	Eightth meeting	New Delhi	16-17 November 95
	Tenth meeting	New Delhi	29 November 1995 1 December 1995
	Eleventh meeting	New Delhi	12-13 December 1995
	Thirteenth meeting	New Delhi	24 January 1996
	Fourteenth meeting	New Delhi	6 February 1996
	Consultative group Meeting of Fishery Survey of India	Cochin Zonal Base, Cochin	26 May 1995
	Meeting of the Project Management Committee for the Establishment of Oceanarium at Goa	DOD, New Delhi	14 November 1995 22 January 1996
	Meeting of Parliamentary committee on Petitions regarding Deep sea Fishing	CIFT, Cochin	8 January 1996
	Meeting of Working Group of the Project on Ecology of Ornamental fishes of Export value in the Gulf of Mannar	Mandapam	15 February 1996
	Meeting of Committee for preparing the status report on Ecologically Sensitive Areas around the coastal regions of India	DOD, New Delhi	29 February 1996

	National Workshop on Fish Resources in the Indian EEZ and Deep sea Fishing	CIFT, Cochin	24 June 1995
	Seminar on "Fisheries- A multi-billion dollar industry" organised by Aquaculture Foundation of India and Fishery Technocrats Forum; presented a paper on "Marine ornamental fishes of India" and worked as a Rapporteur for the session on "Fisheries Management"	Madras	17-19 August 1995
	Workshop on Status of Scientific Data Base on Lakshadweep Islands and presented a paper on "Ornamental Fish Resources of Lakshadweep"	Cochin	6-7 December 1995
Dr.K.Rengarajan, Sr.Scientist	Inauguration of the Zoology Association and delivered a talk on 'Mysteries and Marvels of Electron Microscope'	Maharaja's College, Ernakulam	17 February 1996
	National Symposium on Technological Advancements in Fisheries and its impacts on Rural Development of Science & Technology, Cochin	Dept. of Industrial Fisheries, Cochin, University	5-7 December 1995
	National Seminar on Ecologically Sensitive Coastal Ecosystems sponsored by DOD, DBT & DST Annamalai University	CAS in Marine Biology,	22-23 March 1996
Dr.D. Noble Sr.Scientist	VIIth National Workshop on KVKs and TTCs and presented the report of KVK, Narakkal for the period 1989 to March 1995.	Thirupathi	9-12 September 1995
	Training course on Manpower Planning in Agriculture	NAARM, Hyderabad	14-23 September 1995
Dr. V.K. Pillai Sr. Scientist	National Workshop of KVK and TTC	Thirupathi	9-12 September 1995
Dr.R.Sathiadhas, Sr. Scientist	Seminar on Possibilities of fish/ prawn culture in Karunagappally	Kerala State Womens Development Corpn., Karunagappally	24 April 1995

	Workshop on the status of Scientific data base on Lakshadweep Islands Trivandrum	Geological Survey of India,	6-7 December 1995
	Workshop on Exports-Imports contracts	Trade & Industrial Development Centre, Trivandrum	6 January 1996
Dr.R.Sathiadhas, Dr.Krishna Srinath Sr.Scientists	Second Congress on Traditional Sciences and Technologies of India	Anna University, Madras	27-31 December 1995
Dr.Krishna Srinath Sr.Scientist	National Workshop on technology transfer for sustainable shrimp farming	CIBA,Dept. of Agriculture, MPEDA and MSSRF, Madras	8-9 January 1996
	Seminar on women's struggle for survival in fisheries	National Workers' Forum,Cochin	24 June 1995
	Participated as a panel member the International Seminar on Women 2001	CUSAT, Cochin	26 August 1995
	Attended the training programme for senior women extension managers	National Institute of Agricul ural Extension Management, Hyderabad.	16-23 October 1995
Shri R.Narayanakumar, Scientist	Training course on Quantitative Techniques for policy analysis in Agricultural economics IARI, New Delhi	CAS in Agril. Economics,	27 November to 9 December 1995
Dr.P.Kaladharan Scientist (SS)	Workshop on scientific data base on Lakshadweep islands and presented a paper entitled Seaweed Resources of Lakshadweep - a review	Cochin	6-7 December 1995

	National Symposium on algal resources and its utilization presented a paper entitled Productivity of seaweeds in the lagoon of Minicoy atoll of Laccadive Archipelago	American College, Madurai	26-29 December 1995
	Attended training programme on Remote Sensing application to Coastal Zone Management	IIRS, Dehradun	12-23 June 1995
	Attended training programme on Acoustic methods for fish detection and estimation of abundance	CMFRI, Cochin	14-26 August 1995
	Attended training programme on Research and utilization of marine Cyanobacteria	NFMC, Bharathidasan University, Tiruchirapalli	19-29 February 1996
Shri P. Radhakrishnan, Technical Officer	Training programme on Tropical Horticultural crops	IIHR, Bangalore	22-27 May 1995
Shri K.A.Unnithan Technical Officer	Delivered a talk on sustainable farming of prawns at the Fishermen-Farmers-Industry-Institution Meet organised by SEETTD	CMFRI, Cochin	24 February 1996
	Krishi Mela organised by the Dept. of Agriculture, Govt. of Kerala and delivered a talk on prawn farming	Elamkunnapuzha in Vypeen Block	27 January 1996
	Valedictory function held in connection with training programme in Wasteland Development organised by the Fisheries Station of Kerala Agricultural University. Delivered the felicitation talk focussing on "Integrated development of brackish- water areas in coastal villages	Puthuvyppu in Vypeen Block	
Dr. P.P. Pillai Principal Scientist Dr. P.N.R. Nair Dr. N.G.K. Pillai Sr. Scientists	Workshop on the status of scientific data base on Lakshadweep	Geological Survey of India,Cochin	6-7 December 1995

Dr.P.P. Pillai Principal Scientist Dr.P.N.R. Nair Dr. N.G.K. Pillai Sr. Scientists	National Symposium on Technological Advancements in fisheries and its impact on rural development	Dept.of Industrial Fisheries, CUSAT,Cochin	5-7 December 1995
Dr.N.G.K. Pillai Shri Manmadhan Nair, Shri P.E. Sampson Manickam Sr. Scientists	Seminar on Integrated Farming for upper Kuttanad areas of Kerala	Fish Farmers Development Agency, Kottayam	16 March 1996
Dr. V.N. Pillai Principal Scientist	Attended the Standing Committee on Ocean Resources - Working Group meeting on Sea truth	DOD, New Delhi	25-27 February 1996
Dr.N.N. Pillai Sr.Scientist	Attended the Workshop on establishment of biotechnology application centre and presented a paper on Technology and present status of backyard freshwater prawn hatchery	Bhopal 1995	14-18 September
	Attended National Symposium on Technological advancement in fisheries and its impact on rural development by Dept. of Industrial Fisheries	CUSAT, Cochin	5-7 December 1995
Dr.C.Suseelan Sr. Scientist	Attended the National Symposium on Technological Advancements in Fisheries and its impact on Rural Development and presented a paper on the Prospects of crab for rural development	Cochin	5-7 December 1995
Shri P.E.Sampson Manickam, Sr. Scientist	Attended the workshop on Freshwater prawn/fish culture conducted by M.P. Council of Science and technololgy and presented a paper on "A model backyard hatchery for both shrimp and prawn	Raipur	5-6 November 1995
Dr. A. Regunathan Sr. Scientist	Participated in the meeting of Experts Committee on Policy decision for fisheries development in Tamil Nadu, organised by the Tamilnadu Fisheries	Rameswaram	5 March 1996

Dr.N.Kaliaperumal Sr. Scientist	Participated in the National Symposium on "Algal Potential and its exploitation"	American College, Madurai	27-29 December 1995
Dr. A.P. Lipton Sr. Scientist	Attended the meeting of panel of experts on shrimp diseases during the Workshop on "Water quality management for aquaculture ponds" organised by the Aquaculture Foundation of India	Madras	10-11 May 1995
	Gave lectures on "Problems of diseases in shrimps" to the KVK trainees	Cochin	9 January 1996
	Attended the Review meeting of D.O.E & F Research project on 'Chanks'	Paryavaran Bhavan, New Delhi	11-12 January 1996
	Participated in the "National Seminar on Diseases in Aquaculture organised by the Aquaculture Research and Training Centre of the Central Institute of Fisheries Education	Kakinada	5-6 March 1996
	Participated in the Seminar on Sensitive Coastal Ecosystem" organised by the CAS in Marine Biology, Annamalai University	Parangipettai	21-22 March 1996
Shri I.Jagadish Scientist	Participated in the training programme on "Ornamental fish culture	Fisheries College, Panangad	
Dr.V.S.K. Chennubhotla, Principal Scientist, Shri K.M.S. Ameer Hamsa, Sr. Scientist and Shri K. Vijayakumaran, Scientist.	National Seminar on Eco-restoration and Sustainable Development	Hotel Taj Residency, Visakhapatnam	7 October 1995
Dr. V.S.K. Chennubhotla, Principal Scientist	XVII consultative committee group meeting	FSI, Visakhapatnam	24 November 1995
	Workshop on Artificial Reef Structures and Seafarming Technology. Delivered a lecture on Seaweed, their utilization and culture	CMFRI, Cochin	22 January 1996

	Delivered a guest lecture on Seaweeds and their utilization	NBFGR, Lucknow	25 February 1996
Dr. V.S.K.Chennubhotla, Dr.G. Sudhakara Rao, Dr.G.Syda Rao, Shri K.M.S. Ameer Hamsa and Shri K. Vijayakumaran	Workshop on Fishery Resources of the upper east coast	FSI, Visakhapatnam	8 February 1996
Dr.G.Sudhakara Rao Senior Scientist	Meeting of the Central Board of Fisheries	Calcutta	2-3 November 1995
Shri K. Vijayakumaran, Scientist	National Symposium on Technological Advancement in Fisheries and its Impact on Rural Development. Presented a paper entitled On the Externalities, Sustainability and Rationality of Exploitation of the resources of Indian EEZ"	International Hotel, Cochin	5-7 December 1995
Dr.G.Syda Rao Sr.Scientist and Shri M.Prasada Rao	Training programme on Pearl culture technology	Tuticorin	23 December 1995 to 17 February 1996
Shri R. Marichamy Principal Scientist	Seafarming Workshop and presented paper on Mud crab culture and hatchery	CMFRI, Cochin	February 1996
	Delivered a special lecture in MAC School of Aquaculture	Tuticorin	April 1995
	Workshop on Ornamental fish culture	Kamaraj college Tuticorin	8 April 1995
	Participated and presented a paper on crab farming potential in India in the Seminar and Exposition on Fisheries - A multibillion dollar industry organised by Aquaculture Foundation of India	Madras	17-19 August 1995
	Gave a radio talk in All India Radio, Tirunelveli on 'Wonders of the Sea' on Mannar Valaigudavil Kadal Nandugal		22 March 1996
Dr.D.B.James Sr.Scientist	National Conference on Sustainable Aquaculture	Madras	6 April 1995

	organised by the Institute for Ocean Management, Anna University. Presented a paper entitled 'Prospects for culture of sea cucumbers in India'		
	Delivered the valedictory address for the Workshop on Ornamental fish culture	Kamaraj College, Tuticorin	8 April 1995
	Seminar on Fisheries - A multibillion dollar industry organised by the Aquaculture Foundation of India and the Fisheries Technocrat Forum. Presented a paper entitled Prospects for hatchery and culture of sea cucumbers in India'	Madras	18 August 1995
	Workshop on Traditional Fishing Technologies of Tamil Nadu organised by the M.S. University, Tirunelveli	Kanyakumari	15 November 1995
	National Symposium on Technological advancements in Fisheries and its impact on Rural Development organised by the Department of Industrial Fisheries, Cochin University of Science and Technology. Presented a paper entitled 'Recent developments in Indian Beche-de-mer industry'	Cochin	6 December 1995
	Gave a talk on Marine pollution on organisms at the Regional Seminar on Water pollution and Aquaculture management organised by the Dept. of Zoology, Kamaraj College	Tuticorin	8 March 1996
Shri S.Dharmaraj Scientist SG	Workshop on Training and Research for community centred Aquaculture under the auspices of M.S. University, Tirunelveli	Kanyakumari	6 September 1995
	Underwent Refresher training course in Tissue culture	National Facility for Animal tissue	18-30 September 1995

		and cell culture, Pune	
	National Symposium on Technological Advancements in Fisheries and its impact on rural development	Cochin	5-7 December 1995
	12th Task Force meeting of the Dept. of Biotechnology	New Delhi	6 February 1996
Shri G.Subbaraju Principal Scientist	Seminar on "Diseases in Aquaculture"	CIFE, Kakinada	5-6 March 1996
	Rural Programme advisory committee meeting of Farm & Home Unit	All India Radio, Visakhapatnam	5 September 1995
Dr.K.Satyanarayana Rao, Principal Scientist, Dr. R. Paul Raj, Dr. P. Devadoss and Dr. M. Rajagopalan, Sr. Scientists	Seminar on Fisheries - A multibillion dollar industry organised by Aquaculture Foundation of India	Madras	17-19 August 1995
Dr.R.Paul Raj and Dr.P.Nammalwar, Sr. Scientists	National Conference on Sustainable Aquaculture organised by the Anna University	Madras	5-6 April 1995
Dr.R.Paul Raj and Dr.E.Vivekanandan, Sr.Scientists	Workshop on Coastal Fisheries Management organised by the Bay of Bengal Programme (BOBP) of FAO. Presented the highlights of the Situation Analysis of the Coastal Fisheries along the East coast	Madras	28-29 July 1995
	Deep Sea Fishing Policy Parliamentary Sub-Committee meetings	Madras	September and October 1995
	Seminar on Fisheries Information needs of Bay of Bengal region organised by Bay of Bengal Programme (FAO)	Madras	March 1995
Dr.R.Paul Raj Sr.Scientist	Served as a member of the Marine Inland Fisheries Advisory Board of the Govt. of Tamil Nadu		January 1996
	Meeting organised by NABARD Regional Office on Fisheries	Madras	24 January 1996

	Development in the State of Tamil Nadu		
	Workshop on GIS as a tool in coastal aquaculture management Organised by Bay of Bengal Programme (FAO)	Madras	
Dr.R.Paul Raj, Dr.E.Vivekanandan and Dr. M. Vijayakumaran, Sr. Scientists	Tamil Nadu State Fisheries Policy meetings		March 1996
Dr.R.Paul Raj, Dr.E.Vivekanandan and Dr. M. Rajagopalan, Sr. Scientists	Brain Storming Session on Disease Management organised by Dept. of Ocean Development	IIT, Madras	30 January 1996
Dr.R.Paul Raj, Dr.M.Rajagopalan and Dr. M. Vijayakumaran, Sr.Scientists	Workshop on Climate Change and Food Security organised by M.S. Swaminathan Research Foundation and the Climate Institute	M.S. Swaminathan Research Foundation, Madras	4 December 1995
Dr.R.Paul Raj and Dr.M.Rajagopalan, Sr.Scientists	Workshop on Conservation and Sustainable Management of Coastal Biodiversity	-do-	31 May 1995
Dr.M.Rajagopalan and Shri M.M. Meiyappan, Sr. Scientists	Seminar on 'Marine Remote Sensing Applications'	Anna Uni-Versity, Madras	14 December 1995
	Regional Official Language Conference	Pondicherry	4 June 1996
Dr.M.Rajagopalan Sr. Scientist	Workshop on water quality bottom soil, effluent management for aquaculture ponds organised by Aquaculture Foundation of India	Madras	10-11 May 1995
Dr.M.Vijayakumaran Sr.Scientist	Training programme on shrimp diseases conducted by MPEDA Visakhapatnam	Andhra University	28-30 August 1995
Rani Mary George, K.Prabhakaran Nair, S.Krishna Pillai, S. Jasmine, K.K. Philipose, K. Ramakrishnan	Workshop on the Effect of Light-fishing organised by Programme for Community Organization (P.C.O)	Thiruvana-nthapuram	27 July 1995

Nair, T.G. Vijaya Warrier and T.A. Omana			
K.Prabhakaran Nair, K.K. Philipose, Rani Mary George, G.P.K. Achary and S. Jasmine	Workshop on Sea Rescue Operations organised by the Kerala Fisheries Society	Thiruvananthapuram	16 March 1996
K.K. Philipose, Scientist	Delivered a lecture on Mariculture potential on the Kerala coast	P.C.O. Centre, Thiruvananthapuram	24 November 1995
P.A.Thomas, K.K. Philipose and K.Prabhakaran Nair	Management Committee Meeting of the Centre for Development and Transfer of Mariculture Technologies	Thiruvananthapuram	29 December 1995
P.A. Thomas, Rani Mary George, G.P.K. Achary, K.K. Philipose and K.Prabhakaran Nair	Gave lectures on marine ecosystem, resources, fisheries, conservation and on allied topics to the students and Research Scholars of the Jawaharlal Nehru University organised by the UGC and the National Adventure Foundation, Thiruvananthapuram.	Rotary Centre, Kanyakumari	27 December 1995 and 3 January 1996
P.A. Thomas, G.P.K. Achary, S.Krishna Pillai, K.K. Philipose and S.G.Vincent	Workshop on Traditional Fishing Technologies of Tamil Nadu organised by the Institute for Coastal Area Studies, Nagarcoil Manonmaniam Sunderanar University, Thirunelveli	Kanyakumari	15 November 1995
Shri M.Sivadas, Scientist	Food festival 1995 organised by Agriculture Department and gave a talk on nutritive value of fish	Minicoy	October 1995
Dr.A.K.V.Nasser, Scientist	Workshop on the status of Scientific data base on Lakshadweep islands and presented a paper on Live bait resources - present status and management'	Cochin	6-7 December 1995
Dr.Kuber Vidyasagar Sr.Scientist	Consultative Group meeting	FSI, Bombay	27 March 1995
	Meeting on Draft Fisheries Policy for Maharashtra State	Taraporewala Aquarium, Bombay	3 February 1996

	National Seminar on Development of Aquaculture on the West coast of Indiam Ratnagiri, Maharashtra	College of Fisheries,	13-14 January 1996
Dr. Kuber Vidyasagar, Dr.S.K.Chakraborty, Dr.V.D. Deshmukh and Shri S.G.Raje	Workshop on 'Fisheries Development and Scope of deep sea fishing along Maharashtra coast' arranged by FSI, Mumbai for the fishermen of Satpati fishing village	Satpati	27 July 1995
Dr. Kuber Vidyasagar and Survey staff in Maharashtra	A three day Zonal Workshop arranged for Gujarat and Maharashtra states by FRAD	Veraval	
Dr. V.V.Singh Scientist (SS)	Two weeks training programme on Acoustic Methods for Fish Detection and abundance estimation for Fishery Scientists	CMFRI, Cochin	14-26 August 1995
	Consultative Group meeting	FSI, Bombay	15 May 1996
	National Seminar on Fisheries Education	CIFE, Bombay	23 May 1996
	National Seminar on Recent Advances in Biological Oceanography	NIO, Goa	29-31 May 1996
Shri S.G. Raje, Scientist (SS)	Delivered a lecture at Wilson College	Bombay	October 1995
	The Fisheries Development and Scope of deep sea fishing along Maharashtra coast	Malvan	December 1995
Dr.S.K.Chakraborty, Sr.Scientist	Management Committee Meeting of Indian Fisheries Association	CIFE, Mumbai	29 September 1995
Dr.V.D.Deshmukh Sr.Scientist	Murari Committee meeting on Permitting Foreign Trawlers for Deep Sea Fishing	Sassoon Dock, Bombay	27 September 1995
Dr.P.S.Kuriakose Principal Scientist and Dr. E.V.Radha-Krishnan, Sr. Scientist	Attended the Workshop on Artificial reefs and seafarming technologies and presented papers.	Cochin	

Shri M.Feroz Khan, Scientist	Undergone training course in Acoustic methods for fish detection and abundance estimation	CMFRI, Cochin	14-26 August 1995
	Participated in the Fifth National Conference in Hindi on Marine Living Resources and presented a Joint paper on Marine Living Resources and Coastal Zone Management	NIO, Goa	28-29 November 1995
	Presented a feature on story of whales (Thimingalangalude Katha) through AIR	Trivandrum	5 May 1995
Shri K. Soman Technical Officer	Presented a talk in Malayalam in All India Radio on 'Modern Fishing Devices'	Calicut	19 July 1996
Shri K.Nandakumaran, Technical Officer	Participated in the Workshop on fish and shellfish disease investigations	CMFRI, Mandapam	26 June to 10 July 1995
Shri V.G.Surendranathan, Technical Assistant	Underwent short term training course in Pearl Oyster seeding operation conducted by the Trainers' Training Centre	CMFRI, Calicut	22-27 May 1995
	Underwent the training programme in Shrimp Hatchery Management	CMFRI, Mandapam	4-18 December 1995

GUESTS

MANDAPAM

Parliamentary Standing Committee on Agriculture consisting of 15 MPs headed by Shri. Tara Singh

Shri. Lal Ran Sailo, Commissioner of Fisheries, Tamilnadu

A total of 4158 School/College students and public.

VERAVAL

Smt. Meena Barala, Assistant Director of Hindi, Bombay

Shri. Dilip Mehta, Managing Director, Pisces Aqua Venture Pvt. Ltd., Bombay

Shri. Dominic Jose, Manager, Koluthara, Export Ltd., G.I.D.C., Veraval

[redacted]

ology, Faculty of Science, University, Baroda

Shri R.R. Goswami, Aquatic Museum, Prabhas Patan

Ms. Vijayalaxmi R. Nair, Scientist E.II, R.C. of N.I.O., Bombay

Shri R. Venkata Ramanan, Principal, Dalamiya Public School, G.H.C.L. Sutrapada

Dr. W.S. Lakara, C.I.F.E., Bombay

Dr. Amish Dua, Zoology Department, G.N.D. University, Amritsar, Punjab

Prof. B.G. Paghre, Geetha Shetty Sridharth College of Art, Science & Commerce, Bombay

Dr. S.C. Pathak, Manager, NABARD, Ahmedabad

Shri G.S. Metha, Assistant General Manager, NABARD, Ahmedabad

Dr. K. Radhakrishna, Asstt. Director General (M.Fy), ICAR, Krishi Bhavan, New Delhi

Shri. Sanjeet Sahara, Hindustan Lever Ltd., Chorwad

Dr. S.K. Philip, Principal Scientific Officer, SPPERI, Vallabh Vidyanagar

[redacted]

Gold Coin Specialists, A.7, Aisa Deer Park, 101 Valacherry Road, Madras

Shri Jeffrey & Camina, Aqua Culturists, Gold Coin Specialists, A.7, Aisa Deer Park, 101 Valacherry Road, Madras

Shri H.C. Madankumar, Statistical Inspector, Directorate of Fisheries, Bangalore

Shri G.N. Kulkarni, Assistant Professor, College of Fisheries, Ratnagiri

Dr. A.E. Muthunayagam, Secretary, Department of Ocean Development, in discussion with Dr. M. Devaraj, Director, CMFRI, Cochin

Members of Australian team discussing with the Director at HQ, Cochin

Shri Arvind Netam, Hon'ble Minister of State for Agriculture, Govt. of India along with ministry officials on his visit to the Institute on 14-2-1996

Parliamentary Standing Committee of Ministry of Agriculture, headed by Shri. Tara Singh visited Mandapam Regional Centre of CMFRI, Mandapam Camp

GUESTS

MANDAPAM

Parliamentary Standing Committee on Agriculture consisting of 15 MPs headed by Shri. Tara Singh

Shri. Lal Ran Sailo, Commissioner of Fisheries, Tamilnadu

A total of 4158 School/College students and public.

VERAVAL

Smt. Meena Barala, Assistant Director of Hindi, Bombay

Shri. Dilip Mehta, Managing Director, Pisces Aqua Venture Pvt. Ltd., Bombay

Shri. Dominic Jose, Manager, Koluthara, Export Ltd., G.I.D.C., Veraval

Dr. B. Anoopkumar, Department of Zoology, Faculty of Science , University, Baroda

Shri R.R. Goswami, Aquatic Museum, Prabhas Patan

Ms. Vijayalaxmi R. Nair, Scientist E.II, R.C. of N.I.O., Bombay

Shri R. Venkata Ramanan, Principal, Dalamiya Public School, G.H.C.L. Sutrapada

Dr. W.S. Lakara, C.I.F.E., Bombay

Dr. Amish Dua, Zoology Department, G.N.D. University, Amritsar, Punjab

Prof. B.G. Paghre, Geetha Shetty Sridharth College of Art, Science & Commerce, Bombay

Dr. S.C. Pathak, Manager, NABARD, Ahmedabad

Shri G.S. Metha, Assistant General Manager, NABARD, Ahmedabad

Dr. K. Radhakrishna, Asstt. Director General (M.Fy), ICAR, Krishi Bhavan, New Delhi

Shri. Sanjeet Sahara, Hindustan Lever Ltd., Chorwad

Dr. S.K. Philip, Principal Scientific Officer, SPPERI, Vallabh Vidyanagar

MANGALORE

Shri N.G. Chee Kiat, Marketing Manager, Gold Coin Specialists, A.7, Aisa Deer Park, 101 Valacherry Road, Madras

Shri Jeffrey & Camina, Aqua Culturists, Gold Coin Specialists, A.7, Aisa Deer Park, 101 Valacherry Road, Madras

Shri H.C. Madankumar, Statistical Inspector, Directorate of Fisheries, Bangalore

Shri G.N. Kulkarni, Assistant Professor, College of Fisheries, Ratnagiri

Dr. A.E. Muthunayagam, Secretary, Department of Ocean Development, in discussion with Dr. M. Devaraj, Director, CMFRI, Cochin

Members of Australian team discussing with the Director at HQ, Cochin

Shri Arvind Netam, Hon'ble Minister of State for Agriculture, Govt. of India along with ministry officials on his visit to the Institute on 14-2-1996

Parliamentary Standing Committee of Ministry of Agriculture, headed by Shri. Tara Singh visited Mandapam Regional Centre of CMFRI, Mandapam Camp

Dr. L.C. Soans, Basel Mission Farm, Belvai - 574 213 D.K.

VISAKHAPATNAM

Shri C.P. Verghese, Director, CIFNET, Cochin

Shri V.R. Sabhapathi (Chairman), Shri Chandrakant Ballad, MLA (member), Shri Ravindranath, MLA (member) and Shri Dyavarappa MLA (member) of the Legislative subject committee on Agriculture, Horticulture, Animal Husbandary & Fisheries, Karnataka

Dr. G. Gopalakrishna and Dr. Ali, Senior Scientists, Inland Fisheries Training Centre, CIFE (ICAR), Barrackpore with 35 officer trainees

Shri K.V. Rao, IAS, Secretary to the Dept. of Industries and Commerce, Govt. of A.P.

Shri A.T. Krishna Murthy, Deputy Manager, Canara Bank, Visakhapatnam

Shri B.N. Hanumantha Roy, SBI Zonal Office, Bangalore, Shri Vidya Shankar and G.S. Murthy, Technical Officers. SBI Local Head Office, Bangalore and Dr. B.C. Suryanarayana, Deputy Manager, SBI Zonal Office, Hubli

Prof. (Dr.) Poitor Szefer, Dept. of Analytical Chemistry, Medical University of Gdanisk, Poland

Dr. P.S. Reddy, Professor of Zoology, Madras University

VIZHINJAM

Dr. Kailash Chandra, Deputy Director, Zoological Survey of India, Andaman & Nicobar Regional Station, Port Blair

Shri R.P. Saroj, Under Secretary, DARE, Krishi Bhavan, New Delhi

Dr. Alison Henley, Geography Department, University of London

Dr. B. Neelakantan and Dr. U.G. Bhat, Professors, School of Ocean Sciences, (Karnatak University), Karwar Wg. Cdr. S.K.J. Nair, National Adventure Foundation, Thiruvanan-thapuram

Shri S.A.T. Rizvi, IAS, Additional Secretary and Shri N.K.V. Rao, Industrial Advisor, Ministry of Industry, Govt. of India, New Delhi

Dr. B.M. Godeswaran, Assistant Director, Small Industries Promotion and Training Institute (Ministry of Industry, Govt. of India), Thiruvalla, Kerala

Dr. M.N. Shreevasthava, Central Drug Research Institute, Lucknow

Dr. Ch. Sreedhara, V.V.S. Swaroop Kumar and Dr. U. Ramachandra Raju, Department of Pharmaceutical Science, Andhra University

Dr. Fahmeeda Hanfee, World-wide Fund India, New Delhi

TUTICORIN

Dr. A.E. Muthunayagam, Secretary, D.O.D.

Dr. Koichi Bamba, Japan

Dr. David J. Currie, Central America

Dr. Babu Kaldate, New Delhi

Dr. Tarasingh, Convener of Standing Committee on Agriculture, New Delhi

Dr. S. Shanmugasundaram, Vice Chancellor, Tamil Nadu Agriculture University, Madras

Dr. P.N. Moorthy, Dept. of Atomic Energy

Dr. P.G. Thomas, Scientist, HWP

Shri T.Radha, IAS, Hyderabad

Dr. Yusuf Ali Famadar, Reader, Calcutta University

Dr. Rabindra Nath, Director of Fisheries, Port Blair

Shri M.M. Aftecher Mohiddin, Scientist, CIFE

Dr. Sina Laura Reis, Brasil

Dr. S. Vijayakumar, MPEDA, A.P.

MINICOY

Central team from Doordarshan

KARWAR

Prof. Misal, Prof. Jadhave, Prof. Abdar, Prof. Borate of K.N.P. College, Walwe of Sangli District, Maharashtra

Prof. Aravind C. Kumbhar of Shankarro Mohite Mahavidyalaya of Akluj of Solapur

Dr. A.M. Bhalerao, Department of Zoology, Modern College, Pune

Shri N.S. Kameswaran Rao and Party of Andhra University, Visakhapatnam

Shri R.N. Hegde, Manager, State Bank of India, Karwar

Dr. C.V. Pawaskar. private medical practitioner

Shri Ganapathi Bhat, General Manager, Karnataka Fisheries Marketing Federation

Shri Sridhar, District Conservator of Forest

Shri P.M. Tandel, Chairman, Karnataka Fisheries Marketing Federation

Shri M.L. Doddamani, Chief Executive Officer. BFDA, Karwar

Mrs. Dr. Kusuma Neelakantan, Reader, School of Ocean Sciences

Shri K.T. Tandel, President, Fishing Boat Owners Association

Capt. Ankolekar, a shrimp farmer

Shri Bashasaab, Curator, Marine Aquarium of Zilla Parishat

Shri Patawari, Assistant Director, State Fisheries

Prof. T.T. Tandel, Ankola College

COCHIN

Shri Bernard J. Zahuranec, Office of the Naval Research, Arlington, USA

Shri S.K. Dutt, US Embassy, New Delhi

Justice Chettoor Sankaran Nair, Vice Chairman, Central Administrative Tribunal, Ernakulam

Hon'ble Shri Ram Lal Rahi, Dy. Minister of Home Affairs

Shri Nitish Kumar, M.P., Chairman, Standing Committee on Agriculture

Shri Balram Jakhar, Hon'ble Agriculture Minister, Govt. of India.

Shri Arvind Netam, Minister of State for Agriculture, Govt. of India

Shri G.S. Sahni, IAS, Joint Secretary, Dept. of Agricultural Research & Education, New Delhi

Shri Bharat Bhushan, IAS, Director, Ministry of Commerce

KAKINADA

Shri. J.K. Prasad, Senior Scientist, CIFE, Kakinada with ARS Trainees

Shri. G.S. Raju, Chairman, SIRIS group, Vijayawada

Shri. K. Pulla Rao, Lecturer in Zoology, Sir C.R.R. Antoney College, Eluru

Shri. R.S. Sisodia, Assistant Commissioner (Fisheries), Ministry of Food Processing, Govt. of India, New Delhi

Shri. G.S.R.C.V. Prasad Rao, IAS, Director of Fisheries, Govt. of Andhra Pradesh, Hyderabad

Dr. K. Alagarswami, Director, CIBA, Madras

Dr. K. Radhakrishna, ADG (M.Fy), ICAR, New Delhi

Dr. R.J.Rao, Senior Lecturer, Jiwaji University, Gwalior, Madhya Pradesh

Dr. V. Narayana Rao (Director, Animal Husbandry Retd), Editor, "Annadata"-Farmers Monthly, Hyderabad

BOMBAY

Dr. K. Srinivasa Rao, Retired Head of Zoology Department, Andhra University

Dr. P.S.B.R. James, Retired Director of CMFRI

Shri. Bhai Bandarkar, Former MLA and President of Maharashtra Fishermen Committee and Executive Member of the National Fisheries Works Forum.

CMFRI STAFF

(Centre-wise; Not a gradation list)

COCHIN - HEAD QUARTERS AND ITS FIELD CENTRES

Director
Dr.M.Devaraj

SCIENTISTS

PS

Dr. M.Peer Mohamed
Dr. P. Bensam
Dr. K.A.Narasimham
Dr. C.S.Gopinatha Pillai
Dr. P.Parameswaran Pillai
Dr. V.Narayana Pillai

Sr.S

Dr. N.Neelakanta Pillai
Dr. C.Suseelan
Dr. V.Kunjukrishna Pillai
Dr. C.P.Gopinathan
Dr. K.J.Mathew
Dr. K. Rengarajan
Dr. (Mrs.) S.Sivakami
Dr. V. Sriramachandra Murty
Dr. N.Gopinatha Menon
Dr. (Mrs.) V.Chandrika
Dr. K.S.Scariah
Dr. N.Gopalakrishna Pillai
Dr. M.K.George
Dr. P.C.Thomas
Dr. (Mrs.) Krishna Srinath
Dr. P.N.Radhakrishnan Nair
Dr. R.Sathiadhas
Dr. (Mrs.) Mary.K.Manissery

S (SG)

Shri. R.N.Misra
Shri. D.B.S.Sehara
Dr. K.C.George
Shri K.Narayana Kurup
Shri G.S.Daniel Selvaraj
Shri G. Nandakumar
Shri K.G.Girijavallabhan
Shri K.V.Somasekharan Nair
Shri K.Balan
Shri K.R.Manmadan Nair
Shri K.N.Rajan
Shri P.E.Sampson Manickam
Shri M.Srinath
Shri A.A.Jayaprakash
Shri T.S.Velayudhan
Mrs. Grace Mathew
Shri S.Muthusamy
Dr. K.K.Appukuttan

S (Sr. Scale)

Dr. N.Sridhar
Dr. (Mrs.) Manpal Sridhar
Dr. Naresh Kumar Verma

S

Shri P.Vijayagopal
Mrs. T.S.Naomi
Mrs. K.Vijayalakshmi
Mrs. Molly Varghese
Mrs. V.Kripa
Shri T.V.Sathianandan
Shri R. Narayanakumar
Shri N.K.Sanil
Dr. P.Kaladharan
Mrs. Sheela Immanuel

PS: Principal Scientist, Sr. S: Senior Scientist, S. (SG): Scientist Selection Grade, S (Sr. Scale): Scientist (Senior Scale), S: Scientist

Dr. (Miss.) Laxmilatha
Mrs. K.S.Sobhana

TECHNICAL OFFICERS

T-9

Shri P.R. Leopold - Skipper

T-8

Shri P.K. Velayudhan - Mate

T-7

Shri Varghese Philipose
Shri P.K. Mahadevan Pillai
Shri V. Rajendran

T-6

Mrs. K.S. Leela Bhai
Shri P. Raghavan - Photographer
Shri A. Nandakumar

T-5

Shri P. Karunakaran Nair
Shri Varughese Jacob
Shri G. Krishnankutty Nair
Shri K. Thulasidas
Mrs. V.P. Annam
Shri V.K. Balachandran
Shri M. Ayyappan Pillai
Mrs. Geetha Antony
Shri Nirmal Mathews - Bosun
Shri N.B. Gopalakrishna Menon - Bosun
Shri B. Ramesh - Bosun
Mrs. C. Nalini
Shri K.N. Gopalakrishnan
Shri P.M. Aboobaker
Shri A.A. Thankappan
Shri V. Suresh
Shri R. Reghu
Shri K.L.K. Kesavan - Sr. Artist
Shri R. Vasanthakumar

SENIOR TECHNICAL ASSISTANTS

T-4

Mrs. A. Kanagam
Shri K. Balachandran
Shri A. Kanakkan
Shri V. Radhakrishnan Nair
Shri C.J. Prasad
Mrs. P.L. Ammini
Shri S. Haja Najmudeen
Shri N. Palaniswamy

TECHNICAL ASSISTANTS

T-II-3

Smt. P. Ammajee - Sr. Lib. Asst.
Smt. S. Girijakumari - Sr. Lib. Asst.
Smt. P. Geetha - Sr. Lib. Asst.
Mrs. K. Ramani
Shri Mathew Joseph
Shri V.A. Narayanan Kutty
Shri L.R. Khambadkar
Shri D. Pugazhendi
Shri N. Viswanathan - Civil Engineer
Shri K. Ramadoss Gandhi
Mrs. K.K. Valsala
Shri J. Narayanaswamy
Shri C.D. Davis - Motor Driver
Shri S. Yadaviah - Motor Driver
Shri M.N. Appukuttan Nair - Motor Driver
Shri M.K. Gopalakrishnan - Sr. Deckhand
Shri C.S. Xavier - Motor Driver
Shri K.K. Soman - Motor Driver
Shri K.K. Sankaran - Artist
Shri K.K. Bose - Driver (Boat)
Shri K.P. Vijayan - Sr. Deckhand
Shri K.J. Mathew - Motor Driver

T-I-3

Shri K. Chellappan
Shri M.N. Kesavan Elayathu
Shri K. Chacko - Projector Operator
Shri M.A. Vincent - Driver (Boat)

Shri K.S. Leon - Sr. Deckhand
Shri A.K. Unnikrishnan - Cook
Shri K.K. Prabhakaran - Cook
Shri P.M. Hariharan - Deckhand

PUNCH CARD OPERATORS

T-I-3

Shri M. Ramachandran
Shri M.B. Seynudeen
Shri P.P. Pavithran
Mrs. Lata Khambadkar
Mrs. P.T. Mani
Shri K.P. George
Mrs. M.R. Beena
Shri K. Anandan

TECHNICAL ASSISTANTS

T-2

Shri G. Subbaraman - Punch Card Operator
Shri K.C. Devassy - Deckhand
Shri P.K. Baby
Shri V. Mohan - Jr. Lib. Asst.
Mrs. Suvarna Mahesh - Jr. Lib. Asst.
Shri K.M. Venugopalan
Mrs. P.K. Seetha
Mrs. P.M. Geetha - Museum Asst.
Shri K. Solamon
Mrs. K.P. Salini
Shri V.R. Arunachalam
Shri A. Udayakumar
Shri K.N. Pushkaran
Shri V.K. Suresh
Shri Thomas Kuruvila
Shri K.C. Pradeep Kumar

FIELD ASSISTANTS

T-I

Shri N.P. Ramachandran
Miss. G. Chitra
Mrs. K.V. Rema
Shri S. Nandakumar Rao
Shri N.K. Harshan
Miss. Sindhu K. Augustine
Shri P.S. Alloycious
Shri D. Prakasan
Mrs. T.N. Anandalakshmy

ADMINISTRATION

Sr. Adm. Officer
Shri P. Bapaiah

Sr. Fin. & Accounts Officer
Shri M.P. Chandrasekharan

Asst. Fin. & Accounts Officer
Shri K.U.K. Menon

Adm. Officer
Shri P.S. Sudersanan

Asst. Adm. Officers
Shri P. Aithappa Naik
Shri S. Subramanian

Asst. Director (O.L.)
Mrs. P.J. Sheela

Superintendents
Shri A. Narayanaswamy
Shri P.J. Davis
Mrs. T.K. Ponnamma
Shri P. Ganesan
Shri C. Balamamundinathan
Shri K. Nagarajan
Shri C. Yohannan
Smt. P.V. Mary
Shri K.S. Sreekumaran (on deputation)

Assistants

Shri N. Govindan
Shri N. Gopinathan
Shri T.N. Padmanabha Kurup
Mrs. K. Vijayalakshmi
Mrs. T. Madhavi
Shri V. Mohanan
Shri S. Abdulla
Shri K.L.K. Padmanabhan
Shri M.J. John

Shri K. Arumugham
Shri V.V. Lakshminarayanan
Mrs. K.M. Annamma
Mrs. M. Suscela
Shri B.D. Puthran

Sr. Stenographer

Miss. M.A. Seetha
Shri K.M. Surendran

Stenographers

Mrs. A.K. Omana
Shri C.N. Chandrasekharan
Mrs. N. Ambika
Shri C.G. Thomas
Mrs. N. Yesoda

Junior Stenographers

Mrs. N.R. Letha Devi
Mrs. K.V. Sajitha
Mrs. K.J. Malathi Devi
Shri R. Chandrakesa Shenoy
Shri K.N. Murali
Shri K. Faisal

Senior Clerks

Mrs. K.C. Girija
Shri V.P. Unnikrishnan
Shri M.K. Abdulla
Mrs. P.K. Sreedevi
Mrs. K. Santha
Shri P.V. Devassy
Mrs. V. Parukutty
Shri V. Chandrasekharan
Shri Thomas Joy
Mrs. M.O. Leela
Mrs. Christina Joseph
Mrs. Alice Valooran
Mrs. M.M. Teresakutty
Mrs. A.K. Kunjipennu
Mrs. K.C. Karthiayani
Shri A.P. Balakrishnan
Mrs. A. Ranjini
Mrs. V.K. Sobha
Mrs. N.S. Sarala
Shri P.M. Bhaskaran
Mrs. P.S. Sumathy
Shri K. Sadanandan

Junior Clerks

Shri K.J. Mathew
Mrs. K. Balamani - Hindi Typist
Shri P.P. Anilkumar
Shri C.K. Sivadas
Mrs. Gouri Hareendran
Mrs. M.G. Chandramathy
Shri V.C. Antony
Shri D. Augustin Julin Raj
Shri K.M. Joseph
Mrs. I.M. Baby Rajalakshmi
Mrs. P.K. Mary
Mrs. Lalithambika Amma
Mrs. Binny Cherian
Mrs. N.G. Supriya
Mrs. K.N. Meera
Shri Rishikesh Andi
Miss. N.M. Ponnamma
Shri V.C. Subhash
Mrs. G. Ambika
Mrs. N.K. Suseela
Shri K. Baburajan
Shri K. Ramadasan
Mrs. V. Jayalakshmi
Mrs. K.K. Kousallia
Shri P.K. Ravindran
Shri V. Purandara Shetty
Mrs. T.C. Chandrika

AUXILIARY STAFF

Mrs. E.K. Uma - Sr. Hindi Translator
Mrs. E. Sasikala - Hindi Translator
Shri V.A. Surendran - Motor Driver
Shri A. Rajan - Driver
Shri K.G. Radhakrishnan Nair - Driver
Shri A. Ravindranathan Nair - Sr. Gestetner Operator
Shri M. Krishnan - Binder
Shri M.R. Bharathan - Deckhand
Shri K.U. Raman - Driver
Shri P.M. Varghese - Coffee/Tea Maker

Shri P.V. George - Bearer
Shri M.K. Subramanian - Clerk (Coupon/Kitchen)
Shri M.V. Devassikutty - Bearer
Shri P.K. Purushan - Wash boy/Dish cleaner
Shri C.N. Radhakrishnan Pillai - Halwai

SUPPORTING STAFF

SSG-IV

Shri P.A. Vasudevan -	Lab attendant
Shri M.L. Antony -	"
Shri K.P. Joseph -	"
Shri M.K. Peethambaran -	Fieldman
Shri T.A. John -	Khalasi
Mrs. N. Leela -	Daftry

SSG-III

Shri K.S. Vaidyalingam -	Fieldman
Shri E.F. Francis -	Watchman
Shri A.P. Sebastian -	Peon
Shri T.A. Vijayan -	"
Shri N.T. Velappan -	"

SSG-II

Shri K.T. Rajappan -	Watchman
Shri P.K. Achuthan	"
Shri K. Velayudhan	"
Shri G. Vijayan	"
Shri G. Mithralal	"

SSG-II

Shri B. Zainudheen -	Messenger
Shri T. Vijayakumar	"
Shri M.P. Mohandas	"
Shri T.M. Abdul Aziz	"
Shri K.C. Hezhakiel	"
Shri T. Sreedharan	"
Shri G. Gopinathan	"
Mrs. R. Devalakshmi	"
Miss B. Savithri	"
Shri K.C. Rajappan	
Shri C.O. Viswambaran -	Safaiwala
Mrs. K.K. Kalliani	"
Shri V.C. Gopi	"
Shri N.P. Mohanan	"
Shri E.J. James -	Watchman
Shri V.T. Ravi	"
Shri K. Velayudham	"
Shri P.K. Chellappan	"

SSG-I

Shri Justin Joy K.M. -	Watchman
Shri P. Satheesh Kumar -	Messenger
Shri P.V. Gopalan	"
Shri V. Krishnan	"
Mrs. Pennamma Joseph	"
Shri V.A. Kuttappan	"
Shri R. Ravindranathan Nair	"
Shri M. Radhakrishnan	"
Mrs. V.S. Savithri	"
Mrs. S. Seethalakshmi	"
Mrs. K.T. Prakashini	"
Shri S.P. Prasad	"
Miss. P.P. Sheela	"
Mrs. S. Usha	"
Shri T.P. Aboobacker	"
Miss. K. Sujatha	"
Shri T.I. Soman -	Helper
Shri V .H. Venu -	Binder
Mrs. J. Sudhadevi -	Cane Weaver
Shri T.K. Antony -	Lift Operator
Shri S. Mohanan -	Lift Operator
Shri S. Narayanan Achari -	Lab. attendant
Shri N.V. Thambi -	Lab. attendant
Shri M.K. Anil Kumar -	Fieldman
Shri P.V. Joy	"
Shri P.B. Jeevaraj	"
Shri P.V. Sunil	"
Shri A.K. Shaji	"
Shri M.N. Sathyan	"
Shri K.S. Ajith	"
Shri P.M. Gireesh	"
Shri P.D. Karunakaran -	Safaiwala
Miss. A. Latha	"
Mrs. M.P. Shyamala	"
Shri M.T. Vijayan	"
Shri K.M. Sreekumar	"
Mrs. P.K. Usha	"
Miss. K.K. Sujatha	"
Shri K. Sankaran -	Gardeners
Shri K.G. Jayaprasad	"

KRISHI VIGYAN KENDRA/TRAINERS' TRAINING CENTRE
NARAKKAL

SCIENTISTS

Sr. S

Dr. D. Noble

TECHNICAL OFFICERS

T-8

Shri. K. Asokkumaran Unnithan
Dr. P.K. Martin Thompson

T-5

Shri. P. Radhakrishnan
Shri. A.N. Mohanan

T-4

Shri. B. Suresh Kumar

T-II-3

Shri. P.J. Sebastian

ADMINISTRATION

Superintendents

Shri. B. Vijayakumar
Mrs. D. Geetha

Junior Stenographers

Shri. C.D. Manoharan
Mrs. P.K. Anitha

Senior Clerk

Mrs. G. Ponnamma

Junior Clerks

Shri. M.J. Tomy Prince
Shri. N.K. Mohanan

SUPPORTING STAFF

SSG-III

Shri K.P. John (Fieldman)
Shri N.K. Asokan (Fieldman)
Shri K. Ganesan (Fieldman

SSG-II

Shri K.G. Bhaskaran Nair (Messenger)
Shri K.N. Balan (Fieldman)

SSG-I

Mrs. Chinnamma Anjalo (Safaiwala)

CHAVAKAD FIELD CENTRE

FIELD ASSISTANT

T-2

Shri. K.G. Baby

QUILON FIELD CENTRE

TECHNICAL OFFICER

T-5

Shri S.B. Chandrangathan
Shri M. Babu Philip

FIELD ASSISTANT

T-2

Shri K. Sasidharan Pillai

ALLEPPEY FIELD CENTRE

FIELD ASSISTANT

T-2

Shri A.Y. Jacob

MANDAPAM CAMP - REGIONAL CENTRE AND ITS FIELD CENTRES

Sr.S

Dr. N. Kaliaperumal
Dr. A.P. Lipton
Dr. A. Reghunathan

S(SG)

Shri D. Kandasami
Shri V. Gandhi
Shri R. Thiagarajan

S(SS)

Dr. P. Jayasankar

S

Dr. Mohan K. Zachariah
Mrs. Reeta Jayasankar
Shri Maheswarudu Gidda
Mrs. Joseline Jose
Shri I. Jagadish

TECHNICAL OFFICERS

T-5

Shri S. Kalimuthu
Shri M. Badruddin
Shri C. Kasinathan - Curator
Shri P. Thankappan - Foreman

T-4

Dr. K. Muniyandi
Shri A. Ganapathy
Shri S. Palanichamy
Shri V. Edwin Joseph - Sr. Lib. Asst.
Shri T.K. Sudhakaran - Bosun

TECHNICAL ASSISTANTS

T-II-3

Shri K. Muthiah
Shri M.R. Arputharaj
Shri J.R. Ramalingam

Shri S. Mohan
Shri A. Muniyandi - Artist
Shri D. Muthukaruppan - Motor Driver
Shri M. Bose

T-I-3

Shri R. Subramanian
Shri A. Ramakrishnan
Shri P.M.A. Muheedu
Shri M. Rengan - Cook (Boat)
Shri Mohammed Jaffer - Driver (Boat)
Shri S. Mohideen Meerasa - Sr. Deckhand
Shri R. Sekhar - Deckhand
Shri M. Ibrahim - Deckhand
Shri P. Munisamy - Deckhand

JUNIOR TECHNICAL ASSISTANTS

T-2

Shri K. Alagirisamy - Motor Driver
Shri V. Sathiyanesan - Jr. Lib. Asst.
Shri N. Ramamurthy - Museum Assistant
Shri A. Gandhi
Shri V. Sethuraman
Shri K. Jayabalan

T-1

Shri A. Shanmughavelu
Shri A. Viramani
Shri A. Palanichamy
Shri M. Shanmughavelu - Refrigeration Mechanic

AUXILIARY

T-1

Shri A. Srinivasan - Motor Driver

ADMINISTRATION

Asst. Adm. Officer

Shri R. Kuppuswamy

Superintendent

Shri M. Ramakrishnan

Assistants

Shri A. Kajendran
Shri S. Nagarajan
Shri K. Maragathavadivelu
Shri V. Chandran
Shri S. Jayachandran
Shri P. Selvaraj

Senior Clerks

Shri A. Yagappan
Shri N. Natarajan

Junior Stenographer

Mrs. N. Gomathi

Junior Clerks

Mrs. S. Parisa
Mrs. M. Rameswari
Shri S. Muthumari

SUPPORTING STAFF

SSG-IV

Shri A. Muniasamy - Lab Attendant
Shri A. Raman - Fieldman

SSG-III

Shri M. Chinnasamy -	Lab Attendant
Shri S. Muthuramalingam	"
Shri M. Ibrahimsa	"
Shri R. Nagan -	Fieldman
Shri A. Subramanian	"
Shri S. Mani	"
Shri S. Pitchai -	Daftry
Shri K. Vellayan -	Watchman
Shri M. Govindaraj	"
Shri G. Saivadurai	"
Shri K. Munisamy	"
Shri P. Karuppiah	"
Shri M. Ramu	"
Shri R. Sonal	"
Shri K. Muthiah	"
Shri K. Gurusami -	Safaiwala
Shri R. Alagon	"

Shri A. Mari "
Shri M. Muthu "
Shri R. Savugan "
Shri V. Santhanam "
Shri K. Kuruvan "
Shri M. Thangavelu - Watchman

SSG-II

Shri S. Arumugan - Safaiwala
Shri R. Somaimuthu "
Mrs. J. Kondamma "
Shri G. Ankaiah "
Mrs. S. Nagammal "
Shri L. Sathan "
Shri S. Murugan "
Shri P. Ramu - Watchman
Shri S. Arulsamy "
Shri K. Thangavelu - Fieldman
Shri M. Kubera Ganesan "
Shri Hameed Sulthan - J. Pump Driver
Shri Y. Balu - Oilman
Shri M. Athimoolam - Cook

SSG-I

Shri T. Thananjayan - Fieldman
Shri Sikkender Patcha S.M. "
Shri F. Arul Pragasam - Binder
Shri K. Govindan - Khansama
Shri M. Shanmughavelu - Messenger
Shri G.K. Rajan - Pump Driver
Shri M. Shahul Hameed - Messenger
Shri V. Narashimma Bharaty - Daftry
Shri K. Shanmughanathan - Lab Attendant
Shri M. Seeni "
Sshri V. Munisamy "
Shri T. Syed Sadiq "
Shri M. Bareen Mohamed "
Shri K. Jeevanathan "
Shri E. Natarajan "
Shri C. Ramadass "
Shri S. Murugaboopathy "
Shri N. Ramakrishnan "
Shri M. Sarvana Kumar - Safaiwala
Mrs. Subbalakshmi "
Shri N. Nagamuthu "
Shri U. Rajendran "
Shri K. Chandran "
Shri K. Ganesan "
Shri K. Anandan "
Shri N. Rajavelu - Watchman
Shri S. Balakrishnan "
Shri V. Alagan "

NAGAPATINAM FIELD CENTRE

TECHNICAL ASSISTANTS

T-II-3

Shri V. Thanapathy
Shri V. Sivaswami

T-I-3

Shri R. Somu

PATTUKOTTAI FIELD CENTRE

TECHNICAL ASSISTANT

T-II-3

Shri A. Kumar

T-I-3

Shri Vaithianathan N.
Shri P. Palani

FIELD ASSISTANT

T-I

Shri B. Thangaraj

VERAVAL RESEARCH CENTRE AND ITS FIELD CENTRES

SCIENTISTS

Sr. S

Dr. S. Lazarus - on deputation to M.S. University

S

Dr. K.K. Joshi
Shri P.P. Manojkumar
Shri B. Manoj Kumar
Shri A.P. Dinesh Babu

TECHNICAL ASSISTANTS

T-II-3

Shri H.K. Dhokia
Shri Y.D. Savaria
Shri G.N. Chudasama - Motor Driver

T-I-3

Shri B.P. Thumber
Shri M.S. Zala

JUNIOR TECHNICAL ASSISTANTS

T-2

Shri Polara Jamnadas Premji
Shri Bharada Arjan Panchabhai
Shri Ladani Amrutlal Arjanbhai
Shri J.D. Vanvi

FIELD ASSISTANT

T-I

Shri Chudasma Ramji Raja
Shri V. Mohana Rao

ADMINISTRATION

Senior Clerk

Shri J.N. Jambudiya

Junior Clerk

Shri M.M. Vanvi

SUPPORTING STAFF

SSG-II

Shri H.M. Bhint - Messenger
Shri A. Abubin Mehsan - Watchman
Shri L.M. Waghale - Watchman

SSG-I

Shri Makwana Somapitha
Shri H.K. Makwana

JAMNAGAR FIELD CENTRE

JUNIOR TECHNICAL ASSISTANT

T-2

Shri B.V. Makadia

BOMBAY RESEARCH CENTRE AND ITS FIELD CENTRES

SCIENTISTS

Sr. S

Dr. Kuber Vidyasagar
Dr. Alexander Kurian
Dr. S.K. Chakraborty
Dr. V.D. Deshmukh

S(SG)

Shri M. Zaffar Khan

S(SS)

Shri S.G. Raje
Dr. Veerendra Veer Singh

S

Shri M. Aravindakshan

TECHNICAL OFFICER

T-5

Shri M. Shriram

TECHNICAL ASSISTANTS

T-II-3

Shri K.B. Waghmare
Shri R. Dias Johny
Shri A.D. Sawant
Shri P.S. Gadenkush - Motor Driver

T-I-3

Shri J.D. Sarang
Shri C.J. Josekutty
Shri B.B. Chavan
Shri K.G. Kalbate

JUNIOR TECHNICAL ASSISTANTS

T-2

Shri S.D. Kamble

T-I

Shri J.S. Motagi
Shri P. Villan
Shri Thakur Das
Shri S.K. Sujit

ADMINISTRATION

Senior Clerks

Ms. P.V. Shanbhag
Shri M.R. Wadadkar

Junior Clerk

Ms. A.A. Sawant

Junior Stenographer

Shri R.D. Medar

AUXILIARY

Shri S.R. Yadav - Driver for light vehicle

SUPPORTING STAFF

SSG-IV

Shri B.T. Talpade - Lab Attendant

SSG-II

Shri S.M. Tandel - Watchman
Shri K.G. Tawade - Watchman

SSG-I

Mrs. R.S. Tumbe - Messenger
Mrs. Urimila Suresh Valmiki - Safaiwala
Shri M.P. Jadhav - Watchman
Shri D.D. Jangam - Watchman
Shri K.K. Baikar - Fieldman
Shri P.S. Salvi - Messenger

RANDER FIELD CENTRE

T-I

Shri S.V. Subha Rao

DHAHANU FIELD CENTRE

FIELD ASSISTANT

T-2

Shri Suresh Krishna Rao Kamble
Shri A.Y. Mestry

JANGIRAMURUD FIELD CENTRE

JUNIOR TECHNICAL ASSISTANT

T-2

Shri Ramesh B. Kamble
Shri D.G. Jadhav

RATNAGIRI FIELD CENTRE

TECHNICAL ASSISTANTS

T-I-3	**T-2**
Shri Baban N. Katkar	Shri D.D. Sawant

MALVAN FIELD CENTRE

JUNIOR TECHNICAL ASSISTANTS

T-2

Shri Kishor Reghunath Mainkar
Shri Bharamu S. Melinmani

KARWAR RESEARCH CENTRE AND ITS FIELD CENTRE

SCIENTISTS

Sr. S

Dr. V.S. Kakati

S

Miss Preetha Kochaniyan

TECHNICAL ASSISTANTS

T-II-3

Shri V. Varadaiah - Motor Driver

T-I-3

Shri N. Chennappa Gowda
Shri C.K. Dinesh
Shri Maruthi S. Naik
Shri T.B. Harikantra

JUNIOR TECHNICAL ASSISTANTS

T-2

Shri K.C. Pandurangachar
Shri V.M. Dhareshwar
Shri S. Satyanarayan V. Pai
Shri U.V. Arghakar

FIELD ASSISTANTS

T-I

Shri M.E. Durghakar
Shri N.G. Vaidya
Shri M.P. Harikantra - Serang

ADMINISTRATION

Assistant

Shri G.K. Kudalkar

Senior Clerks

Shri Y.H. Gamanagaty
Shri Gangadhar B. Naik

Junior Clerk

Shri Ganesh R. Nadig

SUPPORTING STAFF

SSG-IV

Shri G.M. Korar - Fieldman

SSG-II

Shri M.R. Kotharkar - Watchman
Shri L.K. Suvarna "
Shri M.B. Kotharkar "
Shri Subhash K. Naik - Messenger

SSG-I

Shri Rajendra D. Hulsar - Watchman
Shri Harish Chandra Naik "
Shri Somayya S. Gonda "
Miss Premila Shiva Palekar - Messenger
Shri Chandrakant G. Ulvakar - Fieldman
Mrs. Somi M. Harijan - Safaiwala
Shri R.S. Harikantra - Oilman

GOA FIELD CENTRE

JUNIOR TECHNICAL ASSISTANT

T-2

Shri P.C. Shetty

MANGALORE RESEARCH CENTRE AND ITS FIELD CENTRE

SCIENTISTS

S(SG)

Shri C. Muthiah
Shri K.K. Sukumamran

S(SS)

Dr. K. Sunilkumar Mohamed
Dr. P.K. Krishnakumar

S

Shri P.U. Zachariah
Mrs. Prathibha Rohit

TECHNICAL ASSISTANTS

T-II-3

Shri B. Sridhara
Shri D. Nagaraja
Mrs. Uma S. Bhat
Mrs. Alli C. Gupta
Shri G. Subramanya Bhat
Shri S. Kemparaju

T-I-3

Shri Y. Muniyappa
Shri H. Vasu - Serang
Shri C. Purandhara
Shri H.S. Mahadevaswamy

FIELD ASSISTANTS

T-I

Shri Lingappa
Shri M. Chaniappa
Shri G. Sampath Kumar

ADMINISTRATION

Assistant

Shri Balakrishna Naik

Senior Clerks

Shri K.M. Abdulla
Shri K. Rama Naik

Junior Clerk

Mrs. Martha R. Mascarenhas

AUXILIARY STAFF

Shri P. Narayana Naik - Motor Driver

SUPPORTING STAFF

SSG-II

Shri A. Keshava - Watchman
Shri D. Gangadhara Gowda - Watchman
Shri U.B. Sadasiva - Lascar
Shri Mohan S. Puthran - Oilman
Shri Ramana Sapaliya - Watchman

SSG-I

Mrs. Savithri - Fieldman
Shri S. Mahalinga Naik - Watchman
Mrs. V. Padmavathi - Safaiwala

BHATKAL FIELD CENTRE

JUNIOR TECHNICAL ASSISTANT

T-2

Shri Ganesh Bhatkal
Shri R. Appayya Naik

FIELD ASSISTANT

T-I

Shri C.G. Ulvekar

CALICUT RESEARCH CENTRE AND ITS FIELD CENTRE

SCIENTISTS

PS

Dr. P.S. Kuriakose

Sr. S

Dr. E.V. Radhakrishnan

S(SG)

Shri T.M. Yohannan

S

Shri C.V. Mathew
Shri M. Feroz Khan
Shri P.K. Asokan
Shri K.P. Said Koya

TECHNICAL OFFICERS

T-5

Shri C.K. Krishnan
Shri T. Girijavallabhan
Shri K. Soman
Mrs. K. Koumudi Menon
Mrs. S. Lakshmi
Shri K.K. Balasubramanian
Shri K. Nandakumaran
Shri N.P. Kunhikrishnan

TECHNICAL ASSISTANTS

T-II-3

Mrs. V.K. Janaki
Shri K.P. Viswanathan

T-I-3

Shri V.G. Surendranathan
Mrs. P. Swarnalatha
Shri M.P. Sivadasan
Shri T.P. Haridasan - Carpenter

FIELD ASSISTANTS

T-2

Shri M.M. Bhaskaran

T-I

Shri C. Chandran

ADMINISTRATION

Senior Clerks

Mrs. C. Kamalakshi
Mrs. P. Subhadra

Junior Clerks

Shri R. Sreenivasan
Mrs. K.P. Shylaja
Shri M. Balaraman

AUXILIARY STAFF

Shri P. Harshakumar - Motor Driver

SUPPORTING STAFF

SSG-IV

Sshri M. Ramadasan - Lab Attendant
Shri K. Janardhanan - Fieldman

SSG-II

Shri K.E. Joseph Victor - Watchman
Shri K. Chekkutty "
Shri A. Sivadasan "

SSG-I

Shri T. Haridasan - Fieldman
Shri T.P. Renil Kumar "
Shri P. Dassan "
Shri T. Koman "
Shri M.K. Chandran - Safaiwala
Miss P. Renuka "
Shri K.T. Mohanan - Messenger
Shri Palaniappan - Safaiwala
Shri V. Rajendran - Messenger

CANNANORE FIELD CENTRE

TECHNICAL ASSISTANT

T-I-3

Shri K. Chandran

JUNIOR TECHNICAL ASSISTANT

T-2

Shri K.C. Purushothaman

VIZHINJAM RESEARCH CENTRE

SCIENTISTS

Sr. S

Dr. P.A. Thomas

S(SG)

Mrs. Rani Mary George
Shri K. Prabhakaran Nair
Shri G. Gopakumar
Shri S. Krishna Pillai
Shri G.P. Kumaraswamy Achary

S(SS)

Dr. N. Ramachandran

S

Shri K.K. Philipose
Mrs. S. Jasmine

TECHNICAL OFFICERS

T-5

Shri P.S. Sadasivasarma
Shri T.G. Vijaya Warrier
Shri Jacob Jerold Joel
Shri S.G. Vincent
Shri R. Bhaskaran Achari
Shri Ramakrishnan Nair
Shri Thomas Teles - Bosun
Mrs. P. Sreelatha

T-4

Shri Joseph Andrews

TECHNICAL ASSISTANTS

T-II-3

Shri P. Bhaskaran - Deckhand
Shri T.R. Sreekumaran - Oilman
Shri P. Hillary - Sr. Deckhand
Shri S. Ramachandran Nair - Motor Driver

T-I-3

Shri A.K. Velayudhan
Miss. T.A. Omana
Shri K.T. Thomas
Shri K.C. Gopalan - Cook (Boat)
Shri V.P. Benziger - Sr. Deckhand
Shri P.A. Reghu - Oilman-cum-Deckhand

JUNIOR TECHNICAL ASSISTANT

T-2

Shri C. Unnikrishnan

FIELD ASSISTANTS

T-I

Shri R. Anilkumar
Shri B. Raju

ADMINISTRATION

Assistant

Shri M. Regunathan

Senior Clerk

Shri S. Erishikesan

Junior Clerks

Shri C. Johnson
Shri S. Radhakrishnan

SUPPORTING STAFF

SSG-IV

Shri K. Kunjukunju
Shri V. Sasidharan Pillai
Shri J. Ansalem

SSG-III

Shri A. Ayyappadas - Peon
Shri V. Viswanathan - Watchman

SSG-II

Shri B. Prabhakaran - Messenger
Shri S. Antony - Messenger
Shri V. Kochunarayanan Nair - Watchman
Shri R. Madhusudanan Nair - Fieldman
Shri K. Chandran - Safaiwala
Shri B.K. Velukutty - Messenger

SSG-I

Shri A. Yesudas - Lab. Attendant
Shri B. Babu - Safaiwala

TUTICORIN RESEARCH CENTRE AND ITS FIELD CENTRE

SCIENTISTS

PS

Shri R. Marichamy

Sr. S

Dr. D.B. James
Dr. M. Rajamani
Dr. M. Mohamed Kasim
Dr. A.C.C. Victor

S(SG)

Shri D.C.V. Easterson
Shri A. Chellam
Shri P. Muthiah
Shri K. Ramadoss
Shri S. Dharmaraj
Shri D. Sivalingam
Shri V.S. Rengasamy
Shri P, Livingston
Shri Pon Siraimeetan
Shri M.E. Rajapandian

S

Mrs. Rani Palanisamy

TECHNICAL OFFICERS

T-8

Shri S. Natarajan

T-7

Shri A. Bastian Fernando

T-5

Shri T.S. Balasubramanian
Shri C.T. Rajan
Shri Agastheesa Pillai Mudaliar
Shri R. Gurusamy
Shri N. Ratnasami
Shri P. Ferozkhan - Bosun

T-4

Shri Joseph Xavier Rodrigo

TECHNICAL ASSISTANTS

T-II-3

Shri D. Sundararajan
Shri D. Anandan - Deckhand

Shri R. Arockiaswamy "
Shri S. Enasteen
Shri Xavier Mohandan - Motor Driver
Shri O.M.M.J. Habeeb Mohamed
Shri M. Selvaraj
Shri M. Manickaraja

T-I-3

Shri N. Jesuraj - Skin diver
Shri F. Soosai V. Rayan - Skin diver
Shri A. Dasman Fernando - Skin diver
Shri E. Sivanandan - Cook (Boat)
Shri K. Srinivasagam
Shri M. Chellappa
Shri G. Arumughan
Shri S. Rajapackiam
Shri P. Muthukrishnan - Skin Diver

T-2

Shri S. Mohammed Sathakkathullah
Shri K. Shanmughasundaram
Shri R. Athipandian
Shri S. Sekar V. Rayer - Skin Diver
Shri R. Ponniah - Electrician

FIELD ASSISTANTS

T-I

Shri U. Jayaram
Shri J. Padmanathan

ADMINISTRATION

Assistant

Shri B. Bavanandam

Junior Stenographer

Smt. S. Leelavathi

Junior Clerks

Miss S. Sarada
Smt. C. Rajeswari
Shri M. Samuthiram
Shri C. Jayakanthan
Smt. T. Mahalalshmi

AUXILIARY STAFF

Shri S.K. Gurusamy - Motor Driver
Shri K. Muthuvel - Motor Driver

SUPPORTING STAFF

SSG-IV

Shri A. Francis - Laboratory attendant

SSG-III

Shri M. Alfred - Watchman
Shri D. Motcham - Daftry

SSG-II

Shri V. Samayamuthu - Watchman
Shri R. Uchimahali - Fieldman
Shri K. Thangaraja - Watchman
Shri P. Muthumalai - Watchman
Shri P. Kandan - Fieldman
Shri W. Sathyawan Neelraj - Fieldman
Shri G.S. Rajappan- Fieldman
Shri M. Sankaran- Fieldman

SSG-I

Shri K. Subramanian - Safaiwala
Shri G. Kosalram - Watchman
Shri K. Murugan - Watchman
Shri M. Kalimuthu - Watchman
Shri M. Soundarapandian - Safaiwala
Shri M. Mariappapn
Shri S. Alagesan
Shri I. Ravindran
Shri K. John James - Gardner
Mrs. B. Koncies Mary - Messenger
Shri S. Mariappan - Watchman

CAPECOMARIN FIELD CENTRE

T-5

Shri I.P. Ebenezer

T-I-3

Shri A. Prosper

T-2

Shri P. Paul Sigamony

MADRAS RESEARCH CENTRE AND ITS FIELD CENTRES

SCIENTISTS

PS

Dr. K. Satyanarayana Rao

Sr. S

Dr. R. Paul Raj
Dr. P. Devadoss
Dr. P. Nammalwar
Dr. E. Vivekanandan
Dr. M. Vijayakumaran
Dr. P.V. Sreenivasan
Dr. M. Rajagopalan

S(SG)

Shri M.M. Meiyappan
Dr. V. Thangaraj Subramanian
Shri P. Natarajan
Shri R. Sarvesan

TECHNICAL OFFICERS

T-8

Shri G. Balakrishnan

T-5

Shri K.S. Krishnan
Shri P. Ramadoss
Shri S.K. Balakumar
Shri M. Mohamed Sultan

SENIOR TECHNICAL ASSISTANTS

T-4

Shri U. Alagumalai - Bosun
Dr. R. Thangavelu
Shri A. Deivendra Gandi

TECHNICAL ASSISTANTS

T-II-3

Shri P. Thirumilu
Shri S. Chandrasekhar
Shri S. Seetharaman
Shri S. Subramani
Shri H. Kather Batcha
Shri L. Jayasankaran
Shri D. Padmanathan - Driver (Boat)
Shri K. Pandi - Motor Driver
Shri K. Ratnakumar - Motor Driver
Shri S. Sankaralingam
Shri A. Ahamed Kamal Basha

T-I-3

Shri V.S. Gopal
Shri K. Shahul Hameed
Shri C. Manimaran
Shri G. Srinivasan
Shri P. Poovannan
Shri Vali Mohammed - Cook (Boat)
Shri C. Manibal - Deckhand

T-2

Shri S. Ganesan - Deckhand

ADMINISTRATION

Superintendent

Shri K.M. Karuppiah

Assistants

Shri S. Mangalam
Shri S.K. Murali

Senior Clerks

Mrs. M. Parvathy
Mrs. G. Abitha
Shri S. Balasubramanian

Stenographer

Mrs. Rosy Jochim

Junior Clerks

Mrs. A.B. Lalitha
Mrs. P. Thankaleelal

AUXILIARY STAFF

Shri S. Selvanidhi - Deckhand
Shri V. Joseph Xavier - Deckhand

SUPPORTING STAFF

SSG-III

Shri R. Ananda Jyothi -	Watchman
Shri M. Vellayan -	Lab attendant

SSG-II

Shri T. Mahalingam -	Watchman
Shri G. Chakrapani	"
Shri A. Janakiraman	"
Shri D. Pakkiri	"
Shri M. Ravindran -	Messenger
Shri G. Vijayarangam -	Safaiwala

SSG-I

Shri M. Chandrasekhar -	Watchman
Shri Imbamani -	Watchman
Shri R. Vasu -	Fieldman
Shri R. Sunder	"
Shri V. Sitaramacharyalu -	Helper
Shri S. Yuvarajan -	Lab Attendant
Mrs. Anjali Devi -	Peon
Shri M. Anbu -	Messenger
Shri P. Selvaraj -	Safaiwala

CUDDALORE FIELD CENTRE

T-II-3

Shri A. Srinivasan

T-I-3

Shri T. Dandapani
Shri M. Radhakrishnan
Shri M. Manivasagam

PONDICHERRY FIELD CENTRE

TECHNICAL ASSISTANT

T-II-3

Shri L. Chidambaram

MAHABALIPURAM FIELD CENTRE

T-5

Shri S. Manivasagam

ONGOLE FIELD CENTRE

TECHNICAL OFFICER

T-5

Shri K.V.S. Seshagiri Rao

FIELD ASSISTANT

T-1

Shri G. Sudhakar

SENIOR TECHNICAL ASSISTANT

T-4

Shri A. Hanumantha Rao

NELLORE FIELD CENTRE

TECHNICAL OFFICER

T-5

Shri G.C. Lakshmiah

T-I

Shri N. Boominathan

KOVALAM FIELD CENTRE

FIELD ASSISTANT

T-I

Shri S. Rajan

KAKINADA RESEARCH CENTRE AND ITS FIELD CENTRES

SCIENTISTS

PS

Shri G. Subbaraju

Sr.S

Dr. (Mrs) S. Lalitha Devi

S(SG)

Shri A. Raju

S

Miss. K.N. Saleela
Shri E.M. Abdusamad

TECHNICAL OFFICERS

T-8

Shri B.S. Ramachandrudu

T-5

Shri P. Ramalingam

TECHNICAL ASSISTANTS

T-4

Shri K. Dhanaraju
Shri K. Ramasomayajulu

T-II-3

Shri K. Dharma Rao - Motor Driver

T-I-3

Shri C.H. Ellithathayya

FIELD ASSISTANTS

T-2

Shri P. Venkataramana
Shri N. Burayya
Shri P. Achayya

T-I

Shri Vasamsetty Abbulu
Shri Y.V.S. Suryanarayana

ADMINISTRATION

Senior Clerk

Shri S. Suryanarayana Murty

Junior Clerk

Shri S. Appa Rao

SUPPORTING STAFF

SSG-IV

Shri K. Narasimhamurty - Lab attendant

SSG-II

Shri S. Tatabbai - Messenger

SSG-I

Shri D. Bhaskara Rao - Safaiwala
Shri G. Sainyadhipathi - Watchman
Shri K. Satyanarayana - Watchman
Shri C.H. Moshe - Watchman
Shri P. Satyanarayana - Watchman

NARASAPUR FIELD CENTRE

TECHNICAL OFFICER

T-5

Shri P. Ananda Rao

MACHILIPATNAM FIELD CENTRE

TECHNICAL ASSISTANT

T-I-3

Shri T. Chandrasekhara Rao

VISAKHAPATNAM RESEARCH CENTRE AND ITS FIELD CENTRES

SCIENTISTS

PS

Dr. V.S.K. Chennubhotla

Sr. S

Dr. G. Sudhakara Rao
Dr. G. Syda Rao

S(SG)

Shri G. Mohanraj
Shri K.M.S. Ameer Hamsa

S

Shri K. Vijayakumaran

TECHNICAL OFFICERS

T-5

Shri C.V. Seshagiri Rao
Shri M.V. Somaraju

TECHNICAL ASSISTANTS

T-4

Shri K. Chittibabu

T-II-3

Shri K. Diwakar
Shri T.N. Sukumaran - Bosun

T-I-3

Shri M. Samuel Sumithrudu
Shri J. Bhuvaneswara Varma
Shri M. Chandrasekhar
Shri Sailada Satya Rao
Shri K. Narayana Rao
Shri M. Prasada Rao

T-2

Shri S. Chandrasekhar
Shri P. Pasupati Rao - Motor Driver
Shri T. Nageswara Rao

FIELD ASSISTANT

T-I

Shri R.V.D. Prabhakar
Shri V. Mohana Rao

AUXILIARY STAFF

Shri S. Durai Pandian - Motor Driver
Shri R. Balakrishnan - Deckhand

ADMINISTRATION

Superintendent

Shri D. Gnanajabamani

Assistant

Shri R. Appa Rao

Senior Clerks

Shri K. Shanti Prasad
Mrs. B. Gauri

Junior Clerk

Miss. B. Madhavi Latha

SUPPORTING STAFF

SSG-IV

Shri V. Mohana Rao - Lab attendant

SSG-II

Shri Prasanta Kumar Das - Messenger (Contai)

Shri L. Appa Rao - Messenger
Shri V. Demudu - Watchman
Shri R. Kankaraju "
Shri R. Dalayya - Safaiwala
Shri R.V.S. Subramaniyan - Messenger
Shri P. Krishna Rao - Watchman

SRIKAKULAM FIELD CENTRE

JUNIOR TECHNICAL ASSISTANT

T-2

Shri N.P. Chandrakumar

PALASA FIELD CENTRE

TECHNICAL ASSISTANT

T-I-3

Shri V. Achutha Rao

GOPALPUR FIELD CENTRE

FIELD ASSISTANT

T-I

Shri Satchidananda Nayak

CONTAI FIELD CENTRE

TECHNICAL ASSISTANTS

T-I-3

Shri Sapan Kumar Ghosh
Shri Pulin Behari Day

T-2

Shri Bijay Krishna Burman

FIELD ASSISTANT

T-I

Shri Swapan Kumar Kar

PURI FIELD CENTRE

TECHNICAL ASSISTANTS

T-I-3

Shri P. Venkatakrishna Rao
Shri Sukdev Bar

FIELD ASSISTANT

T-2

Shri S. Hema Sundara Rao

MINICOY RESEARCH CENTRE

SCIENTISTS

S(SS)
Shri M. Sivadas

S

Mrs. P.T. Sarada
Shri A.K.V. Nassar

TECHNICAL ASSISTANT

T-II-3

Shri V.A. Kunhikoya

T-I

Shri A. Anasukoya

ADMINISTRATION

Junior Clerk

Mrs. M. Safiyabi

SUPPORTING STAFF

SSG-IV

Shri C.M. Rajappan - Lab attendant
Shri P.I. Koya "

SSG-III

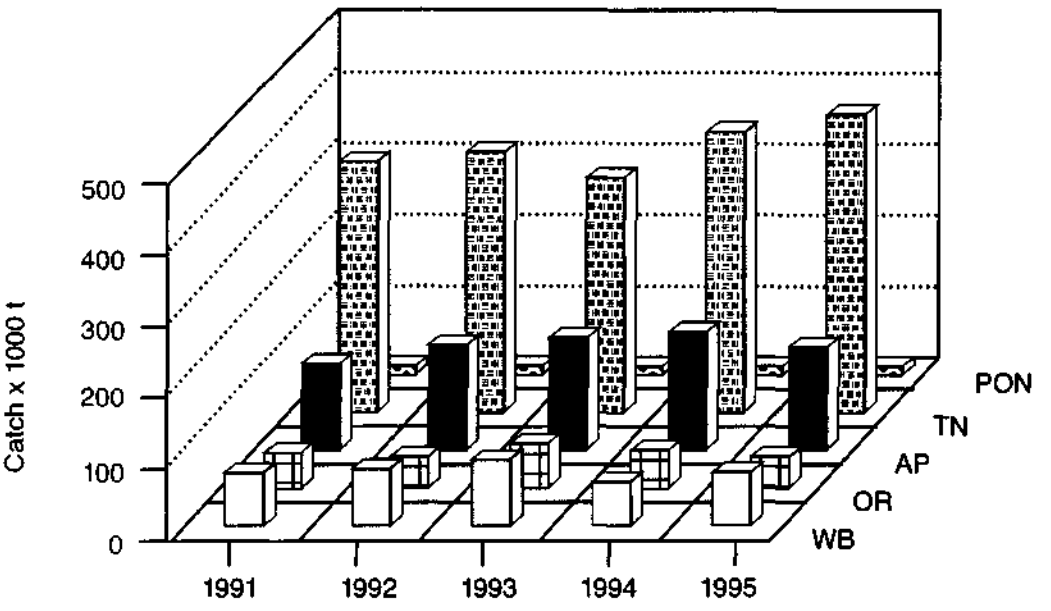
Shri O.M. Ismail

SSG-II

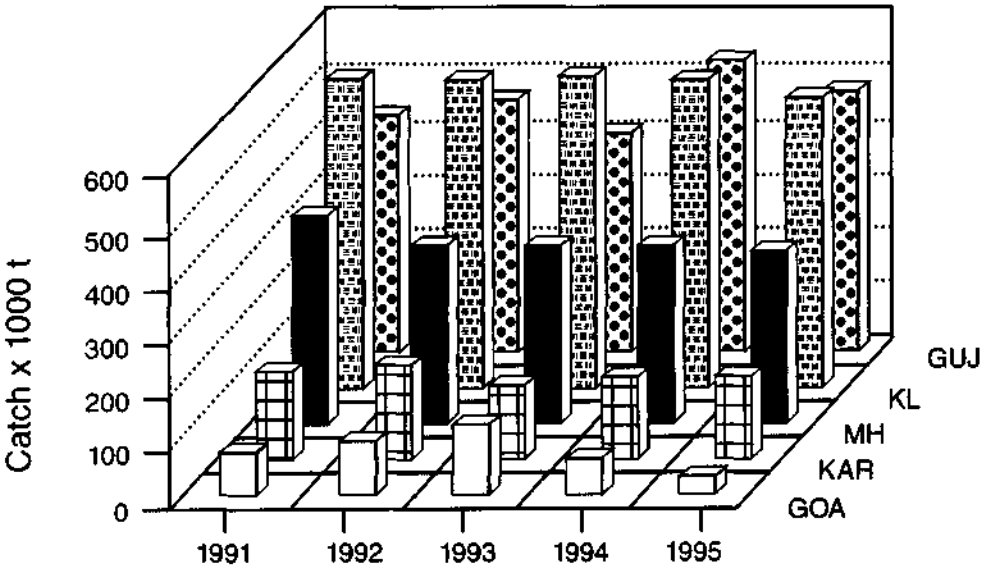
Shri N. Pookoya - Watchman

SSG-I

Shri M.P. Mohamed Khaleel - Fieldman
Shri P.K. Suresh Babu - Watchman



Marine fish landing in different states along the east coast of India during 1991-95 (WB: West Bengal, OR: Orissa, AP : Andhra Pradesh, TN : Tamil Nadu, PON : Pondicherry)



Marine fish landings in different states along the west coast of India during 1991-95 (KAR: Karnataka, MH: Maharashtra, KL: Kerala, GUJ: Gujarat)

Printed at : Amarakerala Industries, Kochi - 18