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FOREWORD

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

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

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

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

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

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

Cochin
August, 1997

M. DEVARAJ
Director
ABOUT THE INSTITUTE

Established in 1947 under the Government of India and transferred 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

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

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

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

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

The organisational set up

To be able to effectively carry out these tasks, the Institute has set up a Regional Centre at Mandapam Camp and Research Centres at Minicoy, Veraval, Bombay, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Madras, Kakinada and Visakhapatnam and 28 Field Centres. The entire activity is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory and field facilities in-
cluding computers and research vessels for carrying out research programmes and has been upgrading the same to meet the changing and additional requirements. The sanctioned staff strength of the Institute is: Scientists 189, Technical 445, Ministerial 172, Supporting 296 and Auxiliary 39.

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

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

The Library and Documentation section provides reference facilities to research staff and students of the Institute as well as to visiting Scientists both within and outside the country. The results of researches carried out in the Institute are published in various scientific journals, bulletins and special publications and Marine Fisheries Information Service.
# BUDGET 1996-97

(Rs in lakhs)

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* Due to short fall of Revenue Receipts
CMFRI COMMITTEES

I. MANAGEMENT COMMITTEE

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

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

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

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

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

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

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

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

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

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

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

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

13. Shri P.S. Sudersanan
    Member
    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
   Goa-403 004

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

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

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

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

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

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

1. Director  
   CMFRI, Cochin-14

2. Joint Director/Incharge  
   Research Coordination & Management Unit  
   CMFRI, Cochin-14

3. Heads of the Divisions/Sections  
   CMFRI, Cochin-14

4. Principal Investigators of ongoing projects  
   CMFRI, Cochin-14

5. Asst. Director General (M.Fy)  
   ICAR, Krishi Bhavan  
   New Delhi

6. Dr. N.R. Menon  
   Director  
   School of Marine Sciences  
   Cochin University of Science & Technology  
   Foreshore Road, Cochin-16

7. Dr. K. Nagappan Nayar  
   Retd. Principal Scientist  
   No.5, Second Street  
   Seetha Nagar  
   Madras-34

8. Dr. S.L. Shanbhogue  
   Prof. & Head  
   Dept. of Fishery Biology  
   College of Fisheries  
   P.B. No. 527  
   Mangalore-575002

9. Dr. V.N. Pillai  
   Principal Scientist  
   CMFRI  
   Cochin-14

IV. RESEARCH CO-ORDINATION AND MANAGEMENT UNIT

1. Dr. V.N. Pillai  
   Chairman  
   Head of Division  
   CMFRI, Cochin-14

2. Dr. V. Sriramachandra Murty  
   Member  
   Head of Division  
   CMFRI, Cochin-14

3. Dr. N.G.K. Pillai  
   Member  
   Head of Division  
   CMFRI, Cochin-14

V. DEPARTMENTAL RESEARCH COMMITTEE

1. Dr. M. Devaraj  
   Chairman  
   Director  
   CMFRI, Cochin-14

2. Dr. N.R. Menon  
   Member  
   Director, School of Marine Sciences, CUSAT, Cochin-16

3. Dr. M. Shahul Hameed  
   Member  
   Director, School of Industrial Fisheries  
   CUSAT, Cochin-16

4. Dr. P. Biensam  
   Member  
   Principal Scientist  
   CMFRI, Cochin-14

5. Dr. K.J. Mathew  
   Member  
   Sr. Scientist  
   CMFRI, Cochin-14

6. Dr. C. Suseelan  
   Member  
   Sr. Scientist  
   CMFRI, Cochin-14

7. Dr. (Mrs.) S. Sivakami  
   Member  
   Sr. Scientist  
   CMFRI, Cochin-14

8. Dr. M.K. George  
   Member  
   Sr. Scientist  
   CMFRI, Cochin-14

9. Dr. (Mrs.) V. Chandrika  
   Member  
   Sr. Scientist  
   CMFRI, Cochin-14
10. Dr. N. Gopinatha Menon  
   Sr. Scientist  
   CMFRI, Cochin-14  
   Member

11. Dr. N. Gopalakrishna Pillai  
   Head, PFD  
   CMFRI, Cochin-14  
   -do-

12. Dr. V. Kunjukrishna Pillai  
   Sr. Scientist  
   CMFRI, Cochin-14  
   -do-

13. Dr. C.P. Gopinathan  
   Sr. Scientist  
   CMFRI, Cochin-14  
   -do-

14. Dr. N. Sridhar  
   Scientist (SS)  
   CMFRI, Cochin-14  
   -do-

15. Dr. K. Rengarajan  
   Sr. Scientist  
   CMFRI, Cochin-14  
   Convener

VI. JOINT COUNCIL

   Office side

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

   Staff side

1. Dr. R. Thangavelu  
   Sr. Technical Assistant (T-4)  
   Member
2. Shri D. Soundararajan  
   Technical Assistant (T-II-3)  
   -do-
3. Shri M.P. Sivadasan  
   Technical Assistant (T-I-3)  
   -do-

VI. JOINT COUNCIL

VII. GRIEVANCE COMMITTEE

1. Dr. M. Devaraj  
   Chairman  
   Director
2. Dr. M. Peer Mohamed,  
   Principal Scientist  
   Member
3. Shri P. Bapaiah  
   Sr. Adm. Officer  
   Member
4. Shri A.V. Joseph  
   Sr. Finance & Accounts Officer  
   Member
5. Dr. A. Regunathan,  
   Sr. Scientist  
   Member
6. Dr. K. Muniyandi  
   Sr. Technical Assistant  
   Member
7. Shri Haji K.M. Abdulla  
   Sr. Clerk  
   Member
8. Shri U. Rajendran  
   SS Gr. I  
   Member
9. Shri P.A. Naik  
   Asstt. Adm. Officer  
   Secretary
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<td>Shri K. Balan</td>
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<tr>
<td>2. Pelagic Fisheries Division</td>
<td>Dr. P.P. Pillai</td>
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<tr>
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<td>3. Demersal Fisheries Division</td>
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<td>Dr. V. Sriramachandra Murty</td>
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<td>4. Crustacean Fisheries Division</td>
<td>Dr. N.N. Pillai</td>
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<td>5. Molluscan Fisheries Division</td>
<td>Dr. K.A. Narasimham</td>
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<td></td>
<td>Dr. K.K. Appukuttan</td>
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<td>6. Fishery Environment and Management Division</td>
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<tr>
<td>7. Physiology, Nutrition and Pathology Division</td>
<td>Dr. M. Peer Mohamed</td>
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<tr>
<td>8. Socio-Economic Evaluation &amp; Technology Transfer Division</td>
<td>Dr. R. Sathiadhas</td>
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# REGIONAL/RESEARCH CENTRES AND THEIR OFFICERS-IN-CHARGE

<table>
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<tr>
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<th>Position</th>
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<tbody>
<tr>
<td>Mandapam Regional Centre of CMFRI</td>
<td>Dr. A. Regunathan</td>
<td>Senior Scientist</td>
<td>5-3-97</td>
</tr>
<tr>
<td>Marine Fisheries P.O.</td>
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<tr>
<td>Mandapam Camp-623 520, Tamil Nadu</td>
<td>Dr. A.C.C. Victor</td>
<td>Senior Scientist</td>
<td>6-3-97</td>
</tr>
<tr>
<td>Phone: 41443 &amp; 41456</td>
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<tr>
<td>Veraval Research Centre of CMFRI</td>
<td>Dr. K.K. Joshi</td>
<td>Scientist</td>
<td>31-3-97</td>
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<td>Bhidiya Plot, Near B.M.G. Fisheries</td>
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<td>Veraval-362 267, Gujarat</td>
<td>Dr. B. Manoj Kumar</td>
<td>Scientist</td>
<td>1-5-97</td>
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<tr>
<td>Bombay Research Centre of CMFRI</td>
<td>Dr. Kuber Vidyasagar</td>
<td>Senior Scientist</td>
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<td>Calicut Research Centre of CMFRI</td>
<td>Dr. P.S. Kuriakose</td>
<td>Principal Scientist</td>
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<td>Vizhinjam Research Centre of CMFRI</td>
<td>Dr. P.A. Thomas</td>
<td>Senior Scientist</td>
<td></td>
</tr>
<tr>
<td>Vizhinjam P.O., Trivandrum-695 521, Kerala</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone: 481143, 480324</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuticorin Research Centre of CMFRI</td>
<td>Shri R. Marichamy</td>
<td>Principal Scientist</td>
<td></td>
</tr>
<tr>
<td>90, North Beach Road</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuticorin-628 001, Tamil Nadu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone: 322274, 320274</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Madras Research Centre of CMFRI
68/1, 4th Floor, Greams Road
Madras-600 006, Tamil Nadu
Phone : 8254252, 8253299

- Dr. R. Paul Raj
  Senior Scientist
  (upto 8-9-96)

- Shri K. Dorairaj
  Principal Scientist
  (w.e.f. 9-9-96)

Kakinada Research Centre of CMFRI
Door No. 8-14-18/2
Red Cross Street, Gandhi Nagar
Kakinada-533 004, Andhra Pradesh
Phone : 78039, 76231, 76082

- Shri G. Subbaraju
  Principal Scientist

Visakhapatnam Research Centre of CMFRI
Andhra University P.O.
Visakhapatnam-530 003
Andhra Pradesh
Phone : 543154, 543793, 63779

- Dr. V.S.K. Chennubhotla
  Principal Scientist

Minicoy Research Centre of CMFRI
Minicoy, U.T. of Lakshadweep
Phone : 22228, 22263

- Shri M. Sivadas
  Scientist (SS)

Field Lab of CMFRI
Cochin Fisheries Harbour
Thoppumpady
Cochin-682 005, Kerala
Phone : 230892

- Mrs. Grace Mathew
  Senior Scientist

TRAINERS' TRAINING CENTRE

Trainers' Training Centre
CMFRI
Cochin - 682 014

- Dr. V. Kunjukrishna Pillai
  Senior Scientist

KRISHI VIGYAN KENDRA

Krishi Vigyan Kendra of CMFRI
Narakkal-682 505
Ernakulam Dist., Kerala
Phone : 492482, 492450

- Dr. D. Noble
  Sr. Scientist
  (upto 19-11-96)

- Shri P. Said Koya
  (w.e.f. 20-11-96)
FIELD CENTRES

Alleppey Field Centre of CMFRI
Geetha Building, Kalarcode
Alleppey-688 006, 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
Edakkazhiyoor P.O.
Chavakkad P.O. 680 515
Trichur District, Kerala

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

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

Dahanu Field Centre of CMFRI
Kirtane Bungalow
Maangilwada
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

Jannagar Field Centre of CMFRI
Milan Chambers, Khodiyar Colony
Aerodrome Road
Jannagar-361 006
Gujarat

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

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

Kanyakumari Field Centre of CMFRI
Kanyakumari-629 702
Tamil Nadu

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

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

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

Malwan Field Centre of CMFRI
2799/2, Dawoolwads,
Pawar Chal
Malwan-416 606
Maharashtra
Narasapur Field Centre of CMFRI
C/o Ratnam Enterprises
Darga Street, Narasapur
Andhra Pradesh.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Summer Institute on Recent Advances in Mariculture of Molluscs

A Summer Institute on Recent Advances in Mariculture of Molluscs was held at Tuticorin Research Centre of the Institute from 20-5-96 to 8-6-96 by the Molluscan Fisheries Division. 24 participants representing various Fisheries Research Institutes and Universities attended the Summer Institute. They were appraised about the latest developments in the farming and breeding of the commercially important
molluscs like edible oysters, clams, mussels, scallops, abalones and about the pearl culture techniques developed in the Institute.

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

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

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

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

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

b. farmers in Chellanam village on group farming of prawns

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

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

Lab to Land Programme:

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

SC/ST Programme:

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

Programmes arranged/participated:

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

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

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

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

The library also stocks and distributes the Institute's publications. Sale of Indian Journal of Fisheries, CMFRI Bulletins and
Special Publications were also made during the period.
The following publications were issued:
1. Indian Journal of Fisheries Vol. 43 Nos. 1-3
2. CMFRI Special Publication No. 65
3. Marine Fisheries Information Service Nos. 140-145
4. CMFRI Newsletter Nos. 68-69, 70-71
5. CMFRI Annual Report 1995-96
6. Research Highlights 1995-96
7. Institute Brochure (Reprint)
8. Vision - 2020, CMFRI Perspective Plan
VESSLE MANAGEMENT CELL

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

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

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

MOUs SIGNED DURING 1996-97 / TO BE SIGNED

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Entrepreneur</th>
<th>Location &amp; activity</th>
<th>Amount (Rs)</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>M/s N.C.C. Bluewater Products Ltd.</td>
<td>Chandanada (A.P.)</td>
<td>84,000</td>
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<td>Pearl Culture</td>
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<td>2.</td>
<td>M/s Balaji Bio-Tech Ltd., Nellore</td>
<td>Thupilipalem</td>
<td>1,66,250</td>
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<td>Pearl Culture</td>
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<td>M/s Aqua Prime International (India) Ltd.</td>
<td>Nellore</td>
<td>2,01,350</td>
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<td>Location &amp; activity</td>
<td>Amount(Rs)</td>
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<td>4.</td>
<td>M/s Gem Holiday Resorts Ltd.</td>
<td>Madras Pearl Culture</td>
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<td>5.</td>
<td>M/s Sterling Shrimpex (P) Ltd.</td>
<td>Chirala (A.P.) Pearl Culture</td>
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<td>6.</td>
<td>M/s Kalinga Aquatics Ltd.</td>
<td>Bhubaneswar Crab Farming</td>
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<tr>
<td>7.</td>
<td>M/s Pink Gold British Exports Ltd.</td>
<td>Raigarh (Maharashtra) Crab Farming</td>
<td>1,94,000</td>
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<tr>
<td>8.</td>
<td>M/s Mangalore Refineries &amp; Petrochemicals</td>
<td>Mangalore Pollution Monitoring</td>
<td>3,60,000</td>
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<tr>
<td>9.</td>
<td>M/s Kudremukh Iron Ore Co. Ltd. (KIOCL)</td>
<td>Mangalore Pollution Monitoring</td>
<td>3,80,000</td>
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<tr>
<td>10.</td>
<td>M/s Master Pearls Ltd.</td>
<td>Hyderabad Pearl Culture</td>
<td>6,71,250</td>
</tr>
</tbody>
</table>
THE OFFICIAL LANGUAGE IMPLEMENTATION PROGRAMME

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

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

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

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

At the Veraval Research Centre of CMFRI, Functional Hindi course for one month has been organised.
Training: 3 staff of CMFRI passed the various courses under Hindi.

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

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

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

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

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

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

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

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

Meeting of the Parliamentary Committee on Official Language at Minicoy Research Centre
Shri T. K. Ramakrishnan, Hon’ble Minister for Fisheries, Kerala, inaugurating the Golden Jubilee Celebrations of CMFRI.

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

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

1. Fishery Resources Assessment Division

Assessment of Exploited Marine Fishery Resources (FSS/FRA/1.1)
K. Balan, K.N. Kurup, K.S. Scariah, M. Srinath and K. Vijayalekshmi

Marine Fish Production in India During 1996

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

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

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

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

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

* Provisional estimate
REGIONWISE LANDINGS

Northeast region

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

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

Southeast region

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

Southwest region

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

From an estimated production of 18,000 t in 1995 the oil sardine fishery rose to 39,000 t in 1996, with a substantial increase of 21,000 t. However, the landings of lesser sardines registered a decline of 41,000 t. The estimate of lesser sardines was only 14,000 t in 1996. Stolephorus fishery, another important fishery of the region, also declined by 14,000 t; the estimate in
PFZ VALIDATION
MINICOY ISLAND
First week of March '97

Pole and line fishing for skipjack tuna

PFZ
NON-PFZ

Catch/boat(kg)

33
6

PFZ
NON-PFZ

Catch/boat(kg)

83
28

Pole and line fishing for skipjack tuna

Third week of March '97
1996 was 34,000 t. Perch landing was 86,000 t during the year, which showed an increase of 28,000 t; the threadfin breams are mainly responsible for this spurt with an increase of 26,000 t in their landings. Croaker landing was 23,000 t and that of ribbonfishes 27,000 t, with increase of 8,000 t and 20,000 t respectively. However, carangid fishery declined by 41,000 t, the fall was due to decline in scad fishery. The estimate of carangids was 87,000 t in this region. A substantial increase of 99,000 t in the landings of mackerel was observed in the southwest coast with an estimate of 2,04,000 t. The other major fishery, penaeid prawns, also indicated an increase of 3,700 t in this region with an estimate of 5,65,000 t in 1996. However, the cephalopod landing was 41,000 t which showed a decline of about 12,000 t in 1996.

**Northwest region**

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

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

**Pelagic Finfishes**

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

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

<table>
<thead>
<tr>
<th>Name</th>
<th>1995</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLUPEOIDS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wolf herring</td>
<td>13874</td>
<td>14341</td>
</tr>
<tr>
<td>Oil sardine</td>
<td>56633</td>
<td>110346</td>
</tr>
<tr>
<td>Other sardines</td>
<td>127905</td>
<td>106924</td>
</tr>
<tr>
<td><em>Hilsa</em> shad</td>
<td>19518</td>
<td>25648</td>
</tr>
<tr>
<td>Other shads</td>
<td>13452</td>
<td>7981</td>
</tr>
<tr>
<td><em>Coilia</em></td>
<td>33545</td>
<td>30986</td>
</tr>
<tr>
<td><em>Setipinna</em></td>
<td>1771</td>
<td>2316</td>
</tr>
<tr>
<td><em>Stolephorus</em></td>
<td>69496</td>
<td>61392</td>
</tr>
<tr>
<td><em>Thrissina</em></td>
<td>0</td>
<td>146</td>
</tr>
<tr>
<td><em>Thryssa</em></td>
<td>36839</td>
<td>37944</td>
</tr>
<tr>
<td>Other clupeoids</td>
<td>45486</td>
<td>60126</td>
</tr>
<tr>
<td><strong>BOMBAYDUCK</strong></td>
<td>88106</td>
<td>91657</td>
</tr>
<tr>
<td><strong>HALF BEAKS &amp;</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FULL BEAKS</strong></td>
<td>5747</td>
<td>3783</td>
</tr>
<tr>
<td><strong>FLYING FISHES</strong></td>
<td>4090</td>
<td>997</td>
</tr>
<tr>
<td><strong>RIBBON FISHES</strong></td>
<td>74043</td>
<td>126905</td>
</tr>
<tr>
<td>Name</td>
<td>1995</td>
<td>1996</td>
</tr>
<tr>
<td>---------------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td><strong>CARANGIDS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horse Mackerel</td>
<td>21021</td>
<td>17652</td>
</tr>
<tr>
<td>Scads</td>
<td>103063</td>
<td>66790</td>
</tr>
<tr>
<td>Leather-jackets</td>
<td>5966</td>
<td>5176</td>
</tr>
<tr>
<td>Other carangids</td>
<td>66818</td>
<td>57760</td>
</tr>
<tr>
<td><strong>MACKERELS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indian mackerel</td>
<td>176749</td>
<td>275677</td>
</tr>
<tr>
<td>Other mackerels</td>
<td>81</td>
<td>17</td>
</tr>
<tr>
<td><strong>SEERFISHES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>S. commerson</em></td>
<td>28615</td>
<td>24613</td>
</tr>
<tr>
<td><em>S. guttatus</em></td>
<td>17205</td>
<td>12662</td>
</tr>
<tr>
<td><em>S. lineolatus</em></td>
<td>87</td>
<td>96</td>
</tr>
<tr>
<td>Acanthocybium spp.</td>
<td>5</td>
<td>23</td>
</tr>
<tr>
<td><strong>TUNNIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>E. affinis</em></td>
<td>15447</td>
<td>14778</td>
</tr>
<tr>
<td>Auxis spp.</td>
<td>4867</td>
<td>11119</td>
</tr>
<tr>
<td><em>K. pelamis</em></td>
<td>796</td>
<td>1225</td>
</tr>
<tr>
<td><em>T. tonggol</em></td>
<td>5787</td>
<td>4263</td>
</tr>
<tr>
<td>Other tunnies</td>
<td>10892</td>
<td>9535</td>
</tr>
<tr>
<td><strong>BILL FISHES</strong></td>
<td>1388</td>
<td>3889</td>
</tr>
<tr>
<td><strong>BARRACUDAS</strong></td>
<td>14679</td>
<td>14476</td>
</tr>
<tr>
<td><strong>MULLETS</strong></td>
<td>6475</td>
<td>6198</td>
</tr>
<tr>
<td><strong>UNICORN COD</strong></td>
<td>139</td>
<td>297</td>
</tr>
<tr>
<td><strong>MISCELLANEOUS</strong></td>
<td>42823</td>
<td>40104</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1113408</td>
<td>1247842</td>
</tr>
</tbody>
</table>

However, a reduction of 12,000 t of mackerel landing was observed in the southeast region resulting the overall increase of 99,000 t.

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

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

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

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

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

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

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

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

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

<table>
<thead>
<tr>
<th>Name</th>
<th>1995</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRUSTACEANS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penaeid prawns</td>
<td>179143</td>
<td>188060</td>
</tr>
<tr>
<td>Non-penaeid prawns</td>
<td>73999</td>
<td>104462</td>
</tr>
<tr>
<td>Lobsters</td>
<td>1923</td>
<td>2631</td>
</tr>
<tr>
<td>Crabs</td>
<td>30610</td>
<td>29049</td>
</tr>
<tr>
<td>Stomatopods</td>
<td>66330</td>
<td>72342</td>
</tr>
<tr>
<td>MOLLUSCS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cephalopods</td>
<td>116764</td>
<td>107071</td>
</tr>
<tr>
<td>Total</td>
<td>468769</td>
<td>503615</td>
</tr>
</tbody>
</table>

DEMERIAL FINFISHES

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

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

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

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

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

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

<table>
<thead>
<tr>
<th>Name</th>
<th>1995</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELASMOBRANCHS</td>
<td></td>
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</tr>
<tr>
<td>Sharks</td>
<td>45960</td>
<td>34750</td>
</tr>
<tr>
<td>Skates</td>
<td>2327</td>
<td>2132</td>
</tr>
<tr>
<td>Rays</td>
<td>20987</td>
<td>21752</td>
</tr>
<tr>
<td>EELS</td>
<td>5904</td>
<td>7030</td>
</tr>
<tr>
<td>CATFISHES</td>
<td>38493</td>
<td>36090</td>
</tr>
</tbody>
</table>
Percentage contribution of different regions to the landings by each category of units during 1995 and 1996

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>6.03</td>
<td>0.39</td>
<td>8.47</td>
<td>6.68</td>
<td>0.04</td>
<td>6.51</td>
</tr>
<tr>
<td>Southeast</td>
<td>24.90</td>
<td>8.33</td>
<td>72.79</td>
<td>20.85</td>
<td>23.39</td>
<td>74.21</td>
</tr>
<tr>
<td>Southwest</td>
<td>23.25</td>
<td>76.78</td>
<td>12.25</td>
<td>26.37</td>
<td>68.51</td>
<td>14.21</td>
</tr>
<tr>
<td>Northwest</td>
<td>45.82</td>
<td>14.50</td>
<td>6.49</td>
<td>46.10</td>
<td>8.06</td>
<td>5.07</td>
</tr>
</tbody>
</table>


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

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>83.87</td>
<td>1.35</td>
<td>14.78</td>
<td>89.37</td>
<td>0.15</td>
<td>10.48</td>
</tr>
<tr>
<td>Southeast</td>
<td>68.94</td>
<td>5.78</td>
<td>25.28</td>
<td>58.09</td>
<td>17.01</td>
<td>24.90</td>
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<tr>
<td>Southwest</td>
<td>52.80</td>
<td>43.71</td>
<td>3.49</td>
<td>57.37</td>
<td>38.91</td>
<td>3.72</td>
</tr>
<tr>
<td>Northwest</td>
<td>91.15</td>
<td>7.23</td>
<td>1.62</td>
<td>94.44</td>
<td>4.31</td>
<td>1.25</td>
</tr>
</tbody>
</table>

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

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

The mechanized units accounted for maximum (94%) landing in the northwest coast; the yield from artisanal units was only marginal. In the southeast region, the operation of motorized craft has been slowly increasing over the years; 17% of the total catch in this region was from these units. In the southwest region the higher contribu-
tion was by mechanized units followed by motorized units and the share of artisanal units in landings from this region was negligible because most of the artisanal units were fitted with outboard engines. In the northeast region, mechanized units contributed about 89% of the total catch.

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

<table>
<thead>
<tr>
<th>Region</th>
<th>Effort</th>
<th>Catch</th>
<th>CPUE</th>
<th>Effort</th>
<th>Catch</th>
<th>CPUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>I 369</td>
<td>97513</td>
<td>264</td>
<td>455</td>
<td>115197</td>
<td>253</td>
</tr>
<tr>
<td></td>
<td>II 51</td>
<td>1577</td>
<td>31</td>
<td>4</td>
<td>187</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>III 291</td>
<td>17179</td>
<td>59</td>
<td>320</td>
<td>13517</td>
<td>42</td>
</tr>
<tr>
<td>Southeast</td>
<td>I 2036</td>
<td>402570</td>
<td>198</td>
<td>1239</td>
<td>350331</td>
<td>290</td>
</tr>
<tr>
<td></td>
<td>II 481</td>
<td>32743</td>
<td>70</td>
<td>1639</td>
<td>105190</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>III 3832</td>
<td>147640</td>
<td>39</td>
<td>3289</td>
<td>154018</td>
<td>47</td>
</tr>
<tr>
<td>Southwest</td>
<td>I 816</td>
<td>375871</td>
<td>461</td>
<td>766</td>
<td>454406</td>
<td>593</td>
</tr>
<tr>
<td></td>
<td>II 1474</td>
<td>311186</td>
<td>211</td>
<td>1682</td>
<td>306189</td>
<td>183</td>
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<tr>
<td></td>
<td>III 1089</td>
<td>24851</td>
<td>23</td>
<td>985</td>
<td>29500</td>
<td>30</td>
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<tr>
<td>Northwest</td>
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<td>740980</td>
<td>718</td>
<td>1066</td>
<td>794560</td>
<td>745</td>
</tr>
<tr>
<td></td>
<td>II 498</td>
<td>58749</td>
<td>118</td>
<td>381</td>
<td>36250</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>III 197</td>
<td>13169</td>
<td>67</td>
<td>99</td>
<td>10499</td>
<td>106</td>
</tr>
</tbody>
</table>

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

**EVALUATION OF CHANGE IN THE PATTERN OF CATCH AND COMPOSITION OF MARINE FISHERY RESOURCES IN INDIA (FSS/FRA/1.19)**

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

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

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

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

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

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

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

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

A training programme on Computer-based Statistical Application in Aquaculture was arranged for three weeks for the personnel engaged in research/teaching.
STOCK ASSESSMENT TECHNIQUES IN MARINE FISHERIES RESEARCH AND MANAGEMENT (FSS/FRA/1.3)

M. Srinath and K.N. Kurup

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

Forecasts for 1996

<table>
<thead>
<tr>
<th>State</th>
<th>Qr-I</th>
<th>Qr-II</th>
<th>Qr-III</th>
<th>Qr-IV</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Gujarat</td>
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<td>99.000</td>
<td>30.785</td>
<td>209.830</td>
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<tr>
<td>Total</td>
<td>593.414</td>
<td>431.566</td>
<td>510.159</td>
<td>790.965</td>
<td>2326.104</td>
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</table>

(Note: The figures are in thousand tonnes)

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

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

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

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

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

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

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

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

The oil sardine production during the last 12 years varied from 0.47 lakh t in 1994 to 2.79 lakh t in 1989 with the present production at 1.1 lakh t. The catch, after the peak in 1989, showed a gradual reduction till 1994 and increased slowly subsequently. Kerala, which was the major contributor till 1993, was slowly relegated and in 1996 Tamil Nadu became the major contributor (40%) followed by Kerala (27.7%). Contrary to oil sardine, lesser sardine production showed a steadily progressing trend and the catch ranged from 0.6 lakh t in 1985 to 1.3 lakh t in 1995 with the present catch at 1.1 lakh t. The major contributor in 1996 was Tamil Nadu (56.6%) followed by Andhra Pradesh (14.7%).
The fishery and resource characteristics of *Sardinella* spp. exploited by different gears were monitored at Karwar, Mangalore, Calicut and Cochin along the west coast and Tuticorin, Mandapam, Madras and Visakhapatnam along the east coast. During 1996, there was a significant increase in the sardine production compared to the previous year; an estimated 2.17 lakh t were landed against 1.85 lakh t in 1995 which constituted 7.6% of the total marine fish production. There was a remarkable increase of about 96% in the catch of oil sardine compared to 1995. The improvement in the fishery was noticed along the southwest region, particularly along the Kerala coast. Contrary to this, the lesser sardine catch recorded a decline of 16.4% compared to that of 1996.

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

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

The length range of *S. longiceps* in purseseine at Karwar, Mangalore and Cochin was 80-205 mm with fishes of 125 to 175 mm length dominating the fishery. The recruitment size at the latter two centres was 50-100 mm. In ring seine at Calicut and Cochin the size range was 50-225 mm; 90-120 mm size groups dominated. In gillnet, the size range of *S. longiceps* was 110 to 205 mm with 135 to 150 mm and 180 to 190 mm.
size groups supporting the fishery at Visakhapatnam. The size of *S. gibbosa* in purseseine at Mangalore ranged from 135 to 180 mm whereas in gillnet at Tuticorin it was 105 to 165 mm with 135 to 145 mm groups supporting the fishery. *S. fimбриata* had a size range of 40 to 175 mm in gill net at Visakhapatnam with 60 to 90 mm group dominating.

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

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

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

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

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

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

At Cochin, *Stolephorus bataviensis* dominated forming 44.3% followed
by *S. devisi* (40.2%), *S. indicus* (15.3%) and *S. commersoni* (0.2%) in trawl net whereas in ringseine, *S. devisi* formed the dominant one (55.6%) followed by *S. macrops* (22.2%), *S. bataviensis* (21.6%) and *S. indicus* (0.6%). At Mangalore-Malpe, *S. devisi* dominated in both purseseine and trawl net followed by *S. bataviensis* and *S. macrops*.

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

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

At Vizhinjam, the anchovy fishery was better (304.5 t) this year than in the previous year (176.5 t). Boat seine and the Netholi valai contributed 57% and 42% respectively and the rest was by shoreseine. *S. devisi* dominated forming 39.8% followed by *S. bataviensis* (27.1%), *E. punctifer* (25.7%) and the rest by *S. andhraensis* and *S. indicus*. The length of *S. devisi* ranged from 35 to 95 mm in boat seine with modal size at 40 mm and 70-90 mm and 85 mm respectively in Netholi valai.

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

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

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

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

In the seerfish landings, during 1985-96, the maximum catch was 0.46 lakh t in 1995 and the minimum was 0.28 lakh t in 1990. The annual average catch was around
0.4 lakh t. Statewise, Gujarat recorded the maximum share (22%) in 1996 followed by Maharashtra (17.8%), Andhra Pradesh (15.7%) and Kerala (12.9%).

![Catch Graph](image)

All India landings (t) of seerfishes

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

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

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

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

The king seer fishery was supported mainly by a wider size range in drift gillnet (16-132 cm) and hook and line (40-140 cm); and by smaller size groups in bottom trawl (16-86 cm). The spotted seer fishery was sustained by 14-68 cm size fish in both gillnet and bottom trawl. Young king seer below 34 cm in size was caught in appreciable quantity in the small meshed gillnet, *podivalai* (52.7%) at Tuticorin and in trawl net (58.6%) at Mangalore-Malpe. Almost all king seer caught by trawl at Mangalore-Malpe, Cochin
and Tuticorin and in podivalai at Tuticorin were below the minimum size at first maturity (67 cm).

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

**FISHERY AND RESOURCE CHARACTERISTICS OF TUNAS, TUNA LIVE-BAITS AND BILLFISHES (PF/RE/2.2)**

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

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

Studies on the fishery and resource characteristics of tunas, tuna live-baits and billfishes were continued at Veraval, Bombay, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Madras and Minicoy. During the year 1996-97 tuna catch declined at major centres such as Mangalore, Calicut, Cochin, Vizhinjam and Minicoy at the rate of 23% to 154% when compared to the previous year. Although the effort increased at most of the centres (12% to 56%), the C/E declined at the rate of 8% to 21%. At Tuticorin also, the catch and C/E declined by 26% and 14% respectively but the effort increased by 12%.

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

Among tunas, *E. affinis* constituted the major species (46.7%) at all the centres along
the mainland of India. *T. tonggol* contributed 16.3%, *A. thazard* 14.4%, *T. albacares* 10.7%, *A. rochei* 10.4% and *S. orientalis* 2.0% of the overall tuna catch.

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

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

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

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

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

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

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

The stock assessment studies on *E. affinis* at Bombay gave the following values: $L_\alpha = 83.0$ cm, $K = 0.72$, $Z = 3.84$ and $F/Z = 0.79$ which indicate that the present level of fishing is very close to the optimum level.
FISHERY AND RESOURCE CHARACTERISTICS OF MACKEREL (PF/RE/2.3)


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

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

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

The M:F ratio in ring seine at Calicut was 1:1, but the males were dominant in
trawl catch at Cochin. Maturation commenced by October/November and by February/March all were in fully matured condition. Oozing gonads were common in March-June period.

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

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

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

Alexander Kurian and B. Manoj Kumar

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

Investigations on the fishery and resource characteristics of Bombay duck were conducted out at Sasoon dock, Bombay and Jaffrabad, Rajpara and Nawabunder along the Sourashtra coast. The estimated landing in 1996 was 85,766 t against 92,687 t in 1995. Northwest region contributed 72,610 t (84.9%) to the total Bombay duck landings. Gujarat alone contributed 62,446 t forming 72.8% of the total production. Along the Sourashtra coast, Rajpara contributed to
38.1% followed by Jaffrabad (36.7%) and Nawabunder (25.2%). The average catch per
dolnet haul in the above three centres to-
gether was 55.57 kg against 63.69 kg ob-
served in the previous year. The catch per
haul decreased at all the centres except at
Nawabunder.

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

The length range in the catch was 30 to
314 mm along Gujarat and Maharashtra.
Recruitment (at 30 mm) occurred during
February to June. The Bombay duck fishery
at Nawabunder was supported by wider size
groups (30-209 mm) with 195-204 mm size
dominating the fishery, whereas 210-224 size
groups supported the fishery at Rajpara.
About 28.3% of the fishes at Nawabunder
and 31.7% at Rajpara were with empty stom-
achs in the observed samples. The gut of
the sampled fish mainly contained non-
penaeid prawns, fishes and juveniles of
Bombay duck. The sex ratio showed female
domination at Nawabunder and Rajpara.
Two spawning periods, one during pre-monsoon and another during winter were no-
ticed along the Gujarat coast.

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

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

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

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

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

The landings by trawl increased in all
the centres except at Kakinada and
Visakhapatnam where the trawl fishery had
the impact of cyclone. The annual catch and
its percentage increase at different centres
were as follows: Veraval 14131 t (124%),
Bombay 7956 t (381.4%), Karwar 191.2 t
(141%), Mangalore 2788 t (141%), Cochin 1795.3 t (2393.5%) and Madras 1382 t (52.5%). The catch and its percentage decrease at Kakinada and Visakhapatnam were 1956 t (60%) and 76 t (62.5%) respectively. At Vizhinjam, a total of 5663.2 t of ribbonfish was landed by all the gears together, which is the highest since 1993.

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

The size of *T. lepturus* varied from 12 to 118 cm with the mode at 66 cm in trawl and 32 to 118 cm with the mode at 36 and 112 cm in gillnet at Veraval; 30 to 120 cm with the mode at 65 cm at Bombay; 32-106 cm at Mangalore-Malpe with the modes at 38 and 100 cm; 34 to 122 cm with multimodes at Cochin; 22 to 74 cm with multimodes at Kakinada and 19-99 cm at Visakhapatnam. The recruitment size in trawl was the smallest (8 cm) at Kakinada. It was 16, 20, 30, 32 and 40 cm at Visakhapatnam, Veraval, Mangalore, Cochin and Bombay respectively. The food and feeding studies showed the dominance of crustaceans and cephalopods at Kakinada and crustaceans (*Acetes sp.*) and fishes at Visakhapatnam. Females were dominant at Veraval (55%), Bombay (57%), Mangalore (59%) and Kakinada (53%). At Visakhapatnam, the males dominated in trawl net (59%) and females in boat seine. At Cochin, males were more (58%). Spawning season was generally from November to May or June.

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

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

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

The objective of the project was to develop a multispecies yield prediction model for commercially important fisheries. Historical data on the monthly landings of major pelagic finfish resources was the prerequisite for the development of pre-
diction models. To begin with, the data on mackerel and sardines since 1978 were gathered, compiled and passed on to the statisticians for computer processing and developing yield prediction models. The data on oil sardine landings along the Kerala coast, since 1961, was processed and correlated statistically with the effect of sunspot activity, total rainfall and mean sea level pressure.

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

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

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

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

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

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

— A decadal periodic trend in the oil sardine and that of the mean sea level pressure could be observed.
The Oil Sardine — a fishery that started improving again along the southwest coast

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

Little tunny — The most abundant coastal tuna
A part of a day's catch of threadfin breams (Nemipteridae) at Neendakara during southwest monsoon period

Catfish (Tachysuridae) at Cochin Fisheries Harbour

Croakers (Sciaenidae) at Fisheries Harbour, Cochin
III. Demersal Fisheries Division

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

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

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

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

Work in the project was continued at Bombay, Madras, Mandapam and Tuticorin. Data were collected from Trawlers, drift gill net, bottom set gillnet and deepsea trawl. Trawlers landed this resource from all the centres, drift gill net from Madras and Tuticorin, bottom set net and deepsea trawls only at Tuticorin. The estimated catch from all these four centres was 6,163 t, of which trawlers contributed 5910 t (96%). Rays contributed to 63% of the elasmobranchs, followed by sharks (32%) and guitar fishes (5%).
The catch at Tuticorin (2190 t) and Bombay (2084 t) accounted for 69% of the total of the four centres. October to March is the period of maximum catch at Bombay, July to September at Tuticorin (both trawl and drift gill net), October to June at Mandapam and January to March and July to September at Madras.

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

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

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

Elasmobranchs were landed only by trawlers at Bombay. The catch (2084 t) showed a decline of 36% over previous year. This group formed around 3% in the total landings. Sharks were dominant forming 71% of elasmobranchs followed by rays with 20% and the rest guitar fishes. *Scoliodon laticaudus*, *Dasyatis zugei* and *Rhynchopterus djeddensis* were the dominant species among sharks, rays and guitar fishes respectively. The size range of *S. laticaudus* males was 180-560 mm with the mean at 393 mm and that of females 160-640 mm with the mean at 396 mm. The male:female ratio was 1:1.5 and pregnant female were recorded during April and December to March.
MONITORING THE RESOURCE CHARACTERISTICS OF GROUPERS, SNAPPERS AND PIGFACE BREAMS (DF/RE/2)

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

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

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

![Perch landing in India](image)

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

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

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

At Tuticorin, the estimated total landing during April-December was 3579 t. Trawl was the principal gear for the resource followed by gillnets and hooks and lines. The average CPUE was 85 kg. The average annual CPUE from trawlers, drift nets and hooks and lines were 102 kg, 15 kg and 75 kg respectively. *Lethrinus nebulosus, Epinephelus undulosus, L. miniato, E. tawina, Lutjanus rivulatus, E. malabaricus, L. waigaiensis* were the most dominant species in the order of their abundance. In *L. nebulosus* the length range was 100-660 mm with modes at 170 mm and 350 mm.
Epinephelus undulosus was in the length range of 330 - 580 mm with mode at 435 mm.

At Madras only 85 t were landed. Groupers constituted 55%, snappers 9% and Pigface breams 36%. Hooks and lines by mechanised craft were used principally.

Epinephelus tauvina and E. diacanthus were the dominant species of groupers. E. tauvina ranged from 250 to 949 mm in length with major mode at 530 mm. Fishes in advanced stages of maturation occurred during July-September. The dominant food items were fish, small prawns and crabs.

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

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

A total of 1382 t of marine catfish were landed at New Ferry Wharf (Mumbai) by trawlers; compared to previous year there was a decline of 21%. The maximum catch of 205 t was obtained in November with a CPUE of 50.7 kg. The average CPUE during the year was 47 kg. Tachysurus dussumieri was dominant forming 40.3% of catfish catch followed by O. militaris (25.7 %), T. sona (9.9 %), T. caelatus (9.8 %) and others. The size range of O. militaris in trawlers was 120-450 mm with mean at 267 mm. T. caelatus ranged from 170 to 460 mm in length with the mean at 313 mm. The male : female ratio of T. caelatus was 1:1.4. The rates of mortality and exploitation of two species are estimated as:

<table>
<thead>
<tr>
<th>Species</th>
<th>Z</th>
<th>M</th>
<th>F</th>
<th>F/Z</th>
<th>F/Z(1-e^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O. militaris</td>
<td>4.3239</td>
<td>1.10</td>
<td>3.2239</td>
<td>0.7456</td>
<td>0.7357</td>
</tr>
<tr>
<td>T. caelatus</td>
<td>1.5160</td>
<td>1.10</td>
<td>0.4160</td>
<td>0.2744</td>
<td>0.2141</td>
</tr>
</tbody>
</table>

The estimated catfish catch was 19 t at Cochin, with drift gill netters contributing 76.5% and purse seiners 23.5%. Maximum catch was obtained during July-November. The drift net catch consisted chiefly of Tachysurus thalassinus (14-54 cm) and a few mature females of T. serratus (85-110 cm)
cm) in the month of June. The entire catfish landing by purseseine was in October, consisting of *T. serratus* only; the catch was taken from two shoals on two consecutive days. Ripe females and egg carrying male brooders were caught. An estimated 280 kg of eggs/embryos of *T. serratus* was also landed on these 2 days.

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

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

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

K.V.S. Nair, V.S. Rengaswamy, A.Raju and K.M.S.A. Hamsa

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

**Threadfin Breams**

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

At Bombay (New Ferry Wharf) the estimated landing was 1389 t (CPUE: 47.3 kg/boat) which formed 2.2 % of the total trawl landings. The catch decreased by 42% over that of previous year. The length range of *N. japonicus* was 80-309 mm and the annual mean length was 128 mm. In *N. mesoprion* the length range in the catch was 60-277 mm with the mean at 152 mm. In this species most of the fish were in maturing stage with a few mature adults occurring in September, November, December and March. The mortality rates and MSY were estimated as:
Species | Z | M | F | MSY
---|---|---|---|---
*N. japonicus* | 2.88 | 1.5 | 1.33 | 315 t
*N. mesopron* | 3.44 | 1.57 | 1.87 | 1551 t

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

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

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

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

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

<table>
<thead>
<tr>
<th>Species</th>
<th>Z</th>
<th>F</th>
<th>M</th>
<th>Current Yield</th>
<th>MSY</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>N. japonicus</em></td>
<td>5.085</td>
<td>3.610</td>
<td>1.475</td>
<td>851 t</td>
<td>1075 t</td>
</tr>
<tr>
<td><em>N. mesopron</em></td>
<td>5.796</td>
<td>3.721</td>
<td>2.075</td>
<td>908 t</td>
<td>1410 t</td>
</tr>
</tbody>
</table>

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

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

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

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

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

At Visakhapatnam, an estimated 176 t (CPH:1.4 kg) were landed forming 8.3% of the total trawl landings. *L. bindus* (41.7%) and *Gazza minuta* (14.1%) dominated the fishery. The length range of *L. bindus* was 35-119 mm and *S. insidiator* 60-114 mm.
Development of Management Strategies for Judicious Exploitation of Sciaenids (DF/RE/5)


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

The number of species of sciaenids landed and dominant species at each centre are shown below which clearly show the differences at different centres.
<table>
<thead>
<tr>
<th>Centre</th>
<th>Gear</th>
<th>Total number of species</th>
<th>Dominant species with their % in parentheses in Sciaenids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veraval</td>
<td>Trawl</td>
<td>16</td>
<td><em>Otolithus cuvieri</em> (55.7), <em>Johnieops glaucus</em> (14.3), <em>Otolithus bioarius</em> (6.4)</td>
</tr>
<tr>
<td></td>
<td>Gillnet</td>
<td>15</td>
<td><em>P. diacanthus</em> (43.1), <em>Otolithus</em> spp. (30.5)</td>
</tr>
<tr>
<td>Mumbai</td>
<td>Trawl</td>
<td>12</td>
<td><em>Otolithus cuvieri</em> (23.5), <em>J.macrorhynus</em> (21.2), <em>J. vogleri</em> (19.6)</td>
</tr>
<tr>
<td>Karwar</td>
<td>Trawl</td>
<td>3</td>
<td><em>O. cuvieri</em> (45), <em>J.coitor</em> (43), <em>O. ruber</em> (12)</td>
</tr>
<tr>
<td></td>
<td>Gillnet</td>
<td>3</td>
<td><em>O. cuvieri</em> (52), <em>J.coitor</em> (40), <em>O. ruber</em> (8)</td>
</tr>
<tr>
<td>Tadri</td>
<td>Trawl</td>
<td>3</td>
<td><em>O. cuvieri</em> (51), <em>J.coitor</em> (40), <em>O. ruber</em> (9)</td>
</tr>
<tr>
<td>Majli</td>
<td>Gill net</td>
<td>3</td>
<td><em>J.coitor</em> (53), <em>O. cuvieri</em> (45), <em>O. ruber</em> (2)</td>
</tr>
<tr>
<td>Calicut</td>
<td>Trawl</td>
<td>7</td>
<td><em>J. sina</em> (52), <em>J. belengeri</em> (23), <em>O. ruber</em> (17)</td>
</tr>
<tr>
<td>Cochin</td>
<td>Trawl</td>
<td>2</td>
<td><em>J sina</em> (64), <em>O. ruber</em> (36)</td>
</tr>
<tr>
<td>Tuticorin</td>
<td>Trawl</td>
<td>4</td>
<td><em>J. maculatus</em> (63), <em>O. ruber</em> (35)</td>
</tr>
<tr>
<td></td>
<td>Drift gill</td>
<td>4</td>
<td><em>O. ruber</em> (69), <em>J. maculatus</em> (29) net</td>
</tr>
<tr>
<td>Kakinada</td>
<td>Trawl</td>
<td>18</td>
<td><em>J. macrorhynus</em> (16), <em>O. ruber</em> (10), <em>J. dussumieri</em> (11), <em>J. vogleri</em> (9), <em>P.macrophthalmus</em> (9)</td>
</tr>
<tr>
<td>Visakhapatnam</td>
<td>Trawl</td>
<td>10</td>
<td><em>P.macrophthalmus</em> (18), <em>J. amblycephalus</em> (18), <em>O. ruber</em> (14), <em>N. maculata</em> (12), <em>J. dussumieri</em> (10), <em>J. carutta</em> (10)</td>
</tr>
</tbody>
</table>
The details of the length range and dominant lengths of different species in the fishery at different centres are furnished below:

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

In *J. sina* at New Ferry Wharf, mature fish were recorded in October and February - March. At Visakhapatnam, mature and ripe females of *J. carutta* in the length range of 175-220 mm occurred in trawl catch.
**Resources Characteristics and Biology of Lizard Fishes, Polynemids, Pomfrets, and Bulls Eye (DF/RE/6)**

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

**Lizard Fish**

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

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

<table>
<thead>
<tr>
<th>Centres</th>
<th>Dominant species</th>
<th>Length range (mm)</th>
<th>Dominant maturity stages</th>
<th>Sex ratio M : F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mangrol</td>
<td><em>S. tumbil</em></td>
<td>180-450</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bombay</td>
<td><em>S. tumbil</em></td>
<td>100-440</td>
<td>V, VI, VII Oct-Nov</td>
<td>1 : 1.7</td>
</tr>
<tr>
<td>Calicut</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Puthiappa</td>
<td><em>S. undosquamis</em></td>
<td>70-400</td>
<td>V-VI Jan</td>
<td>1: 0.7</td>
</tr>
<tr>
<td>Beypore</td>
<td><em>S. tumbil</em></td>
<td>100-329</td>
<td>I-V, II dominant</td>
<td></td>
</tr>
<tr>
<td>Cochin</td>
<td><em>S. undosquamis</em></td>
<td>100-300</td>
<td>V-VI Oct-Jan</td>
<td>1 : 1</td>
</tr>
<tr>
<td></td>
<td><em>S. tumbil</em></td>
<td>240-450</td>
<td>-</td>
<td>1: 1.13</td>
</tr>
<tr>
<td>Madras</td>
<td><em>S. undosquamis</em></td>
<td>80-269</td>
<td>V-VI Oct-Nov</td>
<td>1: 0.9</td>
</tr>
<tr>
<td>Visakhapatnam</td>
<td><em>S. undosquamis</em></td>
<td>115-305</td>
<td>I-II (65%) III-IV (35%)</td>
<td></td>
</tr>
</tbody>
</table>
In the Veraval region, the length range of *P. indicus* was 300-640 mm with modes at 385, 525, 625 mm in the trawlers; at 330, 450, 490, 550 and 590 mm in gill nets.

**Pomfrets**

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

**Bulls Eye**

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

**Polynemids**

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

At New Ferry Wharf the estimated catch was 310 t (C/E: 10.6 kg) and at Sassoon Dock 42 t (C/E: 2.8 kg).
BIOLoGY AND FISHERY OF FLATFISHES, GOATFISHES AND WHITE FISH (DF/RE/7)

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

FLATFISHES

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

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

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

WHITEFISH

At Mangalore the production declined by 190% over the previous year and there was a marginal increase at Malpe. At Cochin, the total annual production was only 8 t, with the peak of 5 t in April; at Vizhinjam
and Mandapam the estimated catches were to 6 t and 19 t respectively. At Mangalore the length range was 8 - 20 cm, with the mode at 15 cm. Immature fishes formed about 35% and the major spawning season was November to March, as judged from the occurrence of partly spent specimens.

**Goat Fishes**

There was no landing of this resource at Mangalore and 19 t were landed at Malpe.

![Goatfish landing in India](image)

**Aquaculture of Marine Ornamental Fish (DF/RE/8)**


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

**Vizhinjam:** Collections were made using a cage of 5' x 2' x 2' size with live mussel as bait in the Vizhinjam Harbour. The cages were operated round the year except during the monsoon months of June-September. A total of 11,859 specimens comprising 10,215 specimens of 68 species belonging to 17 families of ornamental fishes and 1,644 specimens of 25 species belong to 9 families of other fishes. The details of important ornamental fishes collected are given below:
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Family</th>
<th>Number of species</th>
<th>Number of specimens</th>
<th>% in total</th>
<th>Dominant species and their % in the collection of the family</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Chaetodontidae</td>
<td>7</td>
<td>2,531</td>
<td>24.7</td>
<td><em>Chaetodon collaris</em> (85%)</td>
</tr>
<tr>
<td>2.</td>
<td>Pomacanthidae</td>
<td>2</td>
<td>34</td>
<td>0.3</td>
<td><em>Centropyge bispinosus</em> (74%)</td>
</tr>
<tr>
<td>3.</td>
<td>Pomacentridae</td>
<td>13</td>
<td>3,509</td>
<td>34.3</td>
<td><em>Abudefduf spp</em>, (80%)</td>
</tr>
<tr>
<td>4.</td>
<td>Acanthuridae</td>
<td>8</td>
<td>799</td>
<td>7.8</td>
<td><em>Acanthurus nigricauda</em> (18.4%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A.<em>philippinu</em>s (16.3%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>Ctenochaetus striatus</em> (43.6%)</td>
</tr>
<tr>
<td>5.</td>
<td>Zanclidae</td>
<td>1</td>
<td>17</td>
<td>0.2</td>
<td><em>Zanclus canescens</em></td>
</tr>
<tr>
<td>6.</td>
<td>Platacidae</td>
<td>2</td>
<td>123</td>
<td>1.2</td>
<td><em>Platax orbicularis</em> (79%)</td>
</tr>
<tr>
<td>7.</td>
<td>Scorpaenidae</td>
<td>2</td>
<td>7</td>
<td>0.1</td>
<td><em>Pterois. volitans</em></td>
</tr>
<tr>
<td>8.</td>
<td>Scaridae</td>
<td>1</td>
<td>126</td>
<td>1.2</td>
<td><em>Scarus ghobban</em></td>
</tr>
<tr>
<td>9.</td>
<td>Labridae</td>
<td>10</td>
<td>355</td>
<td>3.5</td>
<td><em>Thassoma lunare</em> (54.6%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>Bodianus pulchellus</em> (16.3%)</td>
</tr>
<tr>
<td>10.</td>
<td>Monacanthidae</td>
<td>1</td>
<td>196</td>
<td>1.9</td>
<td><em>Pervagor melanocephalus</em></td>
</tr>
<tr>
<td>11.</td>
<td>Ostraciidae</td>
<td>2</td>
<td>49</td>
<td>0.5</td>
<td><em>Ostracion tuberculatus</em> (87.8%)</td>
</tr>
<tr>
<td>12.</td>
<td>Diodontidae</td>
<td>1</td>
<td>4</td>
<td>–</td>
<td><em>Diodon hystrix</em></td>
</tr>
<tr>
<td>13.</td>
<td>Balistidae</td>
<td>3</td>
<td>45</td>
<td>0.4</td>
<td><em>Balistapus undulatus</em> (44.4%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>Odonus niger</em> (42.2%)</td>
</tr>
<tr>
<td>14.</td>
<td>Siganidae</td>
<td>2</td>
<td>825</td>
<td>8.1</td>
<td><em>Siganus javus</em> (62.4%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>S. canaliculatus</em> (37.6%)</td>
</tr>
<tr>
<td>15.</td>
<td>Apogonidae</td>
<td>6</td>
<td>1159</td>
<td>11.3</td>
<td><em>Apogon taeniatus</em> (56.3%)</td>
</tr>
<tr>
<td>16.</td>
<td>Mullidae</td>
<td>3</td>
<td>197</td>
<td>1.9</td>
<td><em>Parupeneus indicus</em> (53.8%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>P. macronema</em> (45.7%)</td>
</tr>
<tr>
<td>17.</td>
<td>Holocentridae</td>
<td>4</td>
<td>239</td>
<td>2.3</td>
<td><em>Sargocentron rubrum</em> (72.8%)</td>
</tr>
</tbody>
</table>

**All 17 families**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Family</th>
<th>Number of species</th>
<th>Number of specimens</th>
<th>% in total</th>
<th>Dominant species and their % in the collection of the family</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

12 glass aquaria of the size 8'x2'x2' were installed at the regional centre. Ornamental fishes were collected from the Gulf of Mannar and Palk Bay from the fishermen as well as by using the traps fabricated at
Vizhinjam. The fishes were transported in plastic bins and released in aquaria. Water was changed every day and fishes were given chopped sardines. Periodically, the fishes were treated with malachitegreen, acriflavine and methylene blue. The important species in the collections are: Chaetodon collaris, C. octofasciatus, Heniochus acuminatus, Abudelfuf septemfasciatus, Siganus oramin, S. javus, Sargocentron rubrum, Diodon hystrix, Tetrodon hispidus, Syngnathus biauculeatus and Hippocampus kuda.

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

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

INVESTIGATIONS ON THE IMPACT OF COASTAL BOTTOM TRAWLING ON DEMERSAL FISHES AND MACRO-BENTHOS (DF/TR/1)

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

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

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

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

At Kollam, the total trawl catch was 97,463 t. Finfishes formed 64.5 %, Prawns and other crustaceans 13.4 %, cephalopods 12.7 % and macrobenthos 9.4 % of the total catch. The benthic biota consisted of gastropods & bivalves (22.9 % of non-edible component), Squilla (0.2 %), nonedible crabs (13.1 %), echinoderms and non edible ground fishes (63.8 %). Sea pens, sponges, seanemons, seaweeds and egg mass of cephalopods also occurred occasionally. Juveniles and subadults of finfishes occurred throughout the period consisting of threadfin breams, lizard fishes, carangids, silverbellies, flatfishes, Thryssa and sciaenids (50-120 mm).
In the trawl landing from Gulf of Mannar (Pamban), the finfishes formed 94.5%, the target groups 2.1% and the nonedible catch 4.0% whereas the finfish catch was 73.8% the target group 13.8% and the nonedible bycatch 12.4% from Palk Bay (Rameswaram).

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

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

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

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

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

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

**A. TUTICORIN**

_Culture_

- Seed of _Epinephelus tauvina_ were collected from mini shoreseine and drag-net operating at Vellapatti near Tharuvaikulam.

- Seed were transported to Karapad field laboratory and maintained in 1000 L, FRP tanks.

- Trash fish was provided as food from the second day of stocking in FRP tanks

- During June-July, 450 grouper seed were stocked in 0.3 ha pond in the fish farm at Karapad

- The stocking size range was 110-205 mm (13-120 g) with the average of 130 mm/28 g.

- Juveniles of _Tilapia_ were also released into the pond in the ratio of 1 grouper: 10 _Tilapia_ to serve as forage.

- During November 96, another 360 groupers were released into the same pond thus making the total of 810 at the rate of 2700/ha.

- By the end of March '97 the fish were in an average length of 281 mm/372 g.
Live fish transport

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

B. MANDAPAM

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

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

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

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

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

C. COCHIN

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

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

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

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

This project was initiated during the year under report. The Scientists and technical personnel involved in this project had discussions on the modalities of the various aspects of the work and formulated procedures for classification of various developmental stages and descriptions of salient features. Compilations of the various publications were under progress during the above period as per the agreed norms and guidelines. Over 250 reference pertaining to eggs and larvae of marine
fishes were collected. Data and information on developmental stages of different fish species were compiled from published work of the period 1951-65. Writeups were prepared for some species belonging to the genera *Pseudosciaena*, *Mugil*, *Sphyraena*, *Acanthocybium*, *Anodontostoma*, *Albula* and *Nematomela*.

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

M. Devaraj and V. Sriramachandra Murty

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

The data collected over a period of three years from 9 islands show that the above mentioned forty species along with a few others are consistently abundant throughout and suggest scope for exploitation for aquarium purpose. A rough estimate (on the basis of area of operation and the number of fish caught) of potential yield of 10 groups was made; this consists of 38% of wrasses, 32.7% of damselfish, 8.4% of goatfish, 7.4% of parrotfish, 4.8% of surgeonfish, 4.9% of squirrelfish, 2.1% of butterflyfish, 0.8% of triggerfish, 0.5% of pufferfish and 0.4% of moorish idol. The data are being analysed further, taking into account the biological characteristics, to enable arriving at refined and reliable estimates. It is however observed that the most sought after fish, such as moorish idol and butterfly fish, are less abundant. Hence it is essential to formulate exploitation strategy incorporating quotas for each species or species group. Further,
since the lagoons are shallow and are abundant in corals, exploitation of ornamental fish would lead to overexploitation and environmental degradation if proper care is not taken in the very beginning. It is therefore necessary that exploitation is carried out by nondestructive methods such as that using traps and through diving using hand nets, besides formulating effective mechanisms of monitoring exploitation specieswise and fixing quotas specieswise taking into account the relative abundance of each species in the area.

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

STUDIES ON MANGROVE ECOSYSTEM OF GULF OF MANNAR ISLANDS AND THEIR IMPACT ON LARVAL RECRUITMENT OF ECONOMICALLY USEFUL FISHES AND PRAWNS (CMFRI/SPO/10)

P. Nammalwar, R. Thiagarajan and A. Raju

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

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

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

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

COMPARISON BETWEEN MARINE AND MANGROVE HABITATS

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

Convict surgeon
*(Acanthurus triostegus)*

Patchy trigger fish
*(Rhineacanthurus rectangulus)*

Butterfly fish
*(Chaetodon collaris)*
Orangestriped trigger fish
(*Balistapus undulatus*)

Domino (*Dascyllus trimaculatus*)

Orange-spine unicorn
(*Naso litturatus*)

Yellow goatfish
(*Parupeneus luteus*)
extremes in *Rhizophora* zone of Chinnapalam) to 8.80 whereas in marine habitat it ranged from 8.01 to 8.38 (both the extremes in Chinnapalam). Net primary productivity ranged from 24.01 mg C/m³/h in *Avicennia* zone of Chinnapalam to 97.64 mg C/m³/h mangrove habitat of Hare island; in marine habitat it ranged from 11.57 mg C/m³/h to 56.50 mg C/m³/h.

**SEED ABUNDANCE**

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

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

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

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

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


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

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

Trawl fishery

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

The estimated penaeid prawn catch and catch rate during 1996-97 was 5,497t (6.0 kg/hr) at Veraval, 15,994t (10.5 kg/hr) at New Ferry Wharf, 586t (32.5 kg/boat trip) at Karwar, 683t (46.2 kg/boat trip) at Tadri, 558t (1.1 kg/hr) at Malpe, 1,683t (1.6 kg/hr) at Mangalore, 1,515t (42.5 kg/boat trip) at Kozhikode, 6,426t (9.7 kg/hr) at Kochi and 13,228t (11.8 kg/hr) at Sakthikulangara. The
landings increased by 46% at Veraval, 37% at New Ferry Wharf, 2% at Karwar, 27% at Tadri, 44% at Kozhikode and 26% at Kochi over those of previous year and declined by 23% at Mangalore, 42% at Malpe and 16% at Sakthikulangara.

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

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

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

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

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

Artisanal fishery

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

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

'Konchuvala' (bottom set gill net) at Vizhinjam and Manakudy landed 52t at a catch rate of 2.8 kg/unit; the catch registered a decline of 55.6% over the previous
year. The entire fishery was composed of P. indicus with the 141-175 mm size range being dominant.

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

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

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

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

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

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

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

The estimated catch and catch rate (in parantheses) during 1996-97 at important trawl landing centres along the east coast
were: 792t (7.4 kg/hr) at Paradeep, 269t (2.2 kg/hr) at Visakhapatnam, 6,360t (8.3 kg/hr) at Kakinada, 2,650t (3.8 kg/hr) at Madras, 839t (1.6 kg/hr) at Mandapam, 228t (2.1 kg/hr) at Pamban and 128t (1.9 kg/hr) at Tuticorin. Over the previous year, landings declined at all the centres: 22.8% at Paradeep, 50% at Visakhapatnam, 8.7% at Kakinada, 39% at Madras, 16% at Mandapam, 25.4% at Pamban and 22.3% at Tuticorin.

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

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

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

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

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

Artisanal fishery

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

Fishery in Nursery grounds

Stake nets at B.V. Palem (Kakinada) fished 269t (24 kg/unit) of juvenile prawns dominated by M. monoceros (64%), M. dobsoni (12%) and P. indicus (6%). Over the previous year, the fishery suffered a decline of 22%.
INVESTIGATIONS IN THE NONPENAEID SHRIMP FISHERY OF NORTHWEST COAST OF INDIA (CF/RE/1.13)

V.D. Deshmukh and A.P. Dineshbabu

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

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

Trawl fishery

At Veraval, nonpenaeids formed 67% of the crustacean catch landed by trawlers. With a total catch of 21,166t (23 kg/hr) landed by trawlers, the nonpenaeid fishery improved by 46% over the previous year. 98% of the nonpenaeid catch composed of Acetes spp, the rest being shared by Nematopaemon tenuipes and Eupanoplosmata ensisrostris.

Nonpenaeid landings by trawlers at New Ferry Wharf and Versova amounted to 1,661t (1.1 kg/hr) and 597t (2 kg/hr) respectively. While the fishery declined by 16% at New Ferry Wharf the catch improved by 63% at Versova. N. tenuipes formed 97-100% of the fishery at these centres.

‘Dol’ net fishery

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

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

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

At Mumbai, the ‘dol’ nets landed 142t (40 kg/haul) at New Ferry Wharf and 2,037t (31 kg/haul) at Versova. The catch showed no variations from the previous year. At both the centres Acetes spp. supported nearly 75% of the fishery. N. tenuipes formed the rest of the fishery. In N. tenuipes 39-57 mm sizes dominated the fishery. Peak spawning was recorded in April and May.
INVESTIGATIONS ON LOBSTER AND CRAB RESOURCES OF INDIAN COAST (CF/RE/1.14)


LOBSTER

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

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

Trawl Fishery

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

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

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

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

Artisanal fishery

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

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

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

Trawl Fishery

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

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

Artisanal fishery

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

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

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

The project initiated in 1996 aims at establishment of artificial reefs and study the habitat generation in such reefs. After initial surveys between Tuticorin and Vaipar, 3 centres namely Vaipar, Vellappatti and Hare Islands were identified for construc-
tion of artificial reefs. Vaipur and Vellappatti were selected for construction of fish reefs and Hare island for lobster reefs. 11 modules were released at Hare island at a depth of 5 meters in September 1996. Modules were constructed with hollow concrete blocks of 3 dimensions viz. 38 x 20 x 20 cm, 38 x 20 x 15 cm and 38 x 20 x 10 cm and condemned sewage pipes. Hollow blocks formed the base on which pipes numbering 3, 5 and 6 were tied. Fishing carried out in the vicinity of the reefs showed the availability of lobsters in these areas.

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

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

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

**SEED PRODUCTION, EXPERIMENTAL FARMING AND TAGGING OF MARINE PRAWNS (CF/CUL/1.9)**


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

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

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

Farming experiments have been carried out in 3 ponds, each of 0.25 ha. Pond bottom was properly prepared and lime was applied @ 400 kg/ha. Ten days before stocking, pond water was fertilized with urea and super phosphate @ 135 kg/ha and 67 kg/ha respectively. Each pond was stocked with seed @ 60,000/ha. They were fed with prepared shrimp feed @ 20% of biomass during first 15 days and gradually reduced to 4% of bio-
mass during the last 2 months. Feeding rate was adjusted by close monitoring. Within 4 months shrimps have reached 14-17 g weight from 0.02 g and ovary of one female specimen of 132 mm TL was found to be in third stage of maturity. Regular monitoring of the environmental parameters has been carried out. Salinity varied from 30 ppt to 38 ppt, dissolved oxygen from 5.5 ml/l to 9.2 ml/l and pH from 8.0 to 9.0. The initial experiments have revealed the possibility of introducing *P. semisulcatus* as a candidate species along the coastal Tamilnadu. Further, the experiments have also revealed the possibility of broodstock maintenance of this species in grow out systems.

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

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

**BROODSTOCK DEVELOPMENT, SEED PRODUCTION AND FARMING OF COMMERCIALLY IMPORTANT SPINY AND SAND LOBSTERS (CF/CUL/1.10)**

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

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

Experiments on the breeding and larval rearing of spiny lobster *Panulirus homarus* has been initiated at Calicut and Tuticorin. The phyllosoma larvae of *P. homarus* have reached stage II during March 1977 and experiments are being continued. Sterilized sea water is used for rearing and larvae were fed with freshly hatched *Artemia* nauplii.
MARICULTURE OF CRABS (CF/CUL/1.11)

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

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

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

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

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

Experiments were carried out on the brood stock maintenance and induced matu-
ration of Scylla oceanica. 4 males and 12 females of this species have been individu-
ally marked and introduced in a pool, fitted with recirculation facility. Nine females ma-
tured and got ‘berry’ in captivity. Repeated spawnings were also observed. The inter-
val between the successive spawnings was 30-35 days and incubation period 10-11 days.

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

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

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

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

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

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

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

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


Green Mussel: The total production from Challiyam near Calicut to Koduvally near Kannur was estimated at 5393 t. The total effort was 80,437 mandays and the average
catch per manday was 64 kg. The price per 100 kg shell-on mussels at the landing centre varied from Rs 550 to 1000 and Rs 650-1100 in the market. About 50% of the mussel was sold as shucked meat and rest shellen to restaurants and distant places.

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

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

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

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

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

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

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

![Image of clams](image-url)

**Estimated Biomass of Clams in Ashtamudi Lake**

<table>
<thead>
<tr>
<th>Clam Type</th>
<th>Biomass (t)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>V. cyprinoides</em></td>
<td>369451</td>
<td>60%</td>
</tr>
<tr>
<td><em>M. casta</em></td>
<td>16381</td>
<td>3%</td>
</tr>
<tr>
<td><em>P. malabarica</em></td>
<td>226721</td>
<td>37%</td>
</tr>
</tbody>
</table>

The clam fishery in Mulki estuary (Mangalore) started only in December. The estimated catch in December was 6,465 t with a catch rate of 13.4 kg/man day.
<table>
<thead>
<tr>
<th>Place</th>
<th>Resource</th>
<th>Production t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malabar coast</td>
<td>MUSSEL Perna viridis</td>
<td>5393.27</td>
</tr>
<tr>
<td>Karwar</td>
<td>&quot;</td>
<td>3.19</td>
</tr>
<tr>
<td>Southwest coast</td>
<td>P. indica EDIBLE OYSTER Crassostrea madrasensis</td>
<td>2040.00</td>
</tr>
<tr>
<td>Ashtamudi</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>Chettuva</td>
<td>CLAMS</td>
<td></td>
</tr>
<tr>
<td>Ashtamudi Lake</td>
<td>Paphia malabarica</td>
<td>9360.9</td>
</tr>
<tr>
<td>Vembanad Lake</td>
<td>Villorita cyprinoides</td>
<td>37173.2</td>
</tr>
<tr>
<td>Karwar</td>
<td>P. malabarica Meretrix meretrix M. casta</td>
<td>4.73</td>
</tr>
<tr>
<td>Kakinada</td>
<td>Anadara granosa M. meretrix Mercia opima M. casta</td>
<td>421.4</td>
</tr>
<tr>
<td>Mangalore</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total bivalve production</td>
<td></td>
<td>54783.75</td>
</tr>
</tbody>
</table>

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

**SEED PRODUCTION OF BIVALVE MOLLUSCS AND RANCHING OF CLAM SEED IN COASTAL WATERS (MF/CUL/4)**


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

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

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

**Pearl oyster:** A total of 7.72 lakh spat were produced in the hatchery and distributed to various research centres of CMFRI and entrepreneurs. Delay in gonadal maturity re-
sulted in spawning postponement from June to September. The effect of water exchange was studied. The larvae with no water change up to settlement yielded higher rate of settlement. Another batch of larvae are being reared.

**SELECTION OF SUITABLE SITES FOR BIVALVE CULTURE (MF/CUL/8)**


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

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

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

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

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

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

The hydrological parameters of the oyster farm site were monitored regularly. The fouling rate in the farm area was observed to be 470 g/string during July-August-September.
Participants of the Summer Institute on ‘Recent advances in Mariculture of Molluscs’ were acquainted with oyster hatchery and farming activities. Eleven participants of UGC training programme on ‘Industrial Fish and Fisheries’ and personnel from Gujarat Fisheries Department were trained on edible oyster culture and seed production through hatchery system.

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

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

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

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

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

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

<table>
<thead>
<tr>
<th>Name of entrepreneurs/ Research Centre</th>
<th>Veliger larvae</th>
<th>Spat</th>
<th>Adult</th>
<th>Nucleated</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/s.Balaji Biotech</td>
<td>69 lakhs</td>
<td>52,000</td>
<td>1100</td>
<td>200</td>
</tr>
<tr>
<td>M/s.NCC Bluewater</td>
<td>-</td>
<td>31,000</td>
<td>800</td>
<td>200</td>
</tr>
<tr>
<td>Visakhapatnam</td>
<td>-</td>
<td>30,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Madras</td>
<td>-</td>
<td>10,000</td>
<td>110</td>
<td>-</td>
</tr>
<tr>
<td>Mandapam Camp</td>
<td>50 lakhs</td>
<td>2,000,000</td>
<td>550</td>
<td>-</td>
</tr>
<tr>
<td>Kochi</td>
<td>11.4 *</td>
<td>1,500</td>
<td>62</td>
<td>-</td>
</tr>
<tr>
<td>Minicoy</td>
<td>-</td>
<td>500</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>130.4</strong></td>
<td><strong>3,250,000</strong></td>
<td><strong>2622</strong></td>
<td><strong>400</strong></td>
</tr>
</tbody>
</table>
**Popularisation and Transfer of Bivalve Culture Technology at Selected Centres Along Kerala Coast (MF/CUL/11)**

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

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

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

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

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

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

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Meat sold (kg)</th>
<th>Revenue earned Rs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mukkanadan</td>
<td>438.2</td>
<td>19717</td>
</tr>
<tr>
<td>2. Bruno</td>
<td>88.75</td>
<td>3994</td>
</tr>
<tr>
<td>3. Mohan Das/Asokan</td>
<td>78.5</td>
<td>3532</td>
</tr>
<tr>
<td>4. Devadas</td>
<td>62.0</td>
<td>2790</td>
</tr>
</tbody>
</table>

| Total               | 667.45         | 30033              |

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

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

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

Trainings:

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

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

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

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

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

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

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

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

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

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

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

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

More demonstration programme will be taken up. Mixed farming will be done in all estuaries. Training and consultancy for more farmers and entrepreneurs will be taken up.
SELECTIVE BREEDING OF BIVALVES AND EVALUATION OF PERFORMANCE BY FARM TRIALS (MF/CUL/12)

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

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

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

CULTURE OF CEPHALOPODS (MF/CUL/13)

D. Sivalingam

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

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

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

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

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

Spawning experiments were attempted in abalones. Freshly collected specimens were treated for spawning. Prior to spawning they were kept in a glass beaker 5 l covered with a black cloth. The abalones were observed for three days. The larvae were observed for three days. The larvae showed settlement from the 4th day onwards. The stones with algal growth were collected from the harbour and provided as spat collectors. In view of the small size of spat, they could not be observed on the stones. Isochrysis was given as food during the larval phase. Further work is in progress.
Onshore Pearl Culture (MF/CUL/15)
G. Syda Rao, E.M. Abdusam, P.V. Sreenivasan, M.M. Meiyappan

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

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

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

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

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

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

Development of Low Cost Technology System for SeaFarming of Pearls and Mussels (MF/CUL/16)


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

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

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

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

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

Heavy infestation by *Modiolus* was observed on the spat collectors during November and were cleared from the raft.
Mussel ready for harvest at CMFRI demonstration farm at Chettuva (Kerala)

Harvested mussel at Karwar (North Kanara)
Tissue Culture laboratory (Pearl Culture) at Tuticorin Research Centre

Explant culture in Pearl oyster at the Tissue Culture Laboratory at Tuticorin Research Centre
The spat collectors also proved to be sanctuaries for cephalopods (*Sepia pharaonis*) for depositing their eggs/egg capsules.

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

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

P. Natarajan, R. Sarvesan, E. Vivekanandan

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

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

P.V. Sreenivasan, D. Sivalingam

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

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

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

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

P.S. Kuriakose

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

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

During December, 1 lakh juveniles of 10-15 mm size were transferred to the mussel culture farm and the remaining 2000 were retained in the hatchery for further studies.
STUDIES ON THE BIOLOGY AND SEARCHING OF THE SACRED CHANK
*ANCUS PYRUM* WITH SPECIAL REFERENCE TO THE PROTECTION OF
SPECIES IN THE MARINE NATIONAL PARK OF GULF OF MANNAR (CMFRI/SPO/5)

A.P. Lipton

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

187 babies were hatched out from one egg capsule which had 35 chambers and the remaining egg capsules were oozed. The babies in the new batch grew to 3.81 mm length per month (1.60 mm MSD/month).

They registered a weight increase of 1.48 g/month.

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

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

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

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

S. Dharmaraj

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

Live pearl oysters *P. fucata*, pre-conditioned in filtered seawater for 48 hours, were soaked in 70% alcohol for 15 seconds. The mantle tissue was removed and washed in 35% alcohol and treated with a drop of penicillin and streptomycin in sterile seawater, the tissue was cut into small fragments. The fragments were used for *Explant* culture.

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

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

Further work on standardisation of culture media is progressing.
COMMERCIAL PROPAGATION OF MARINE PEARL CULTURE TECHNOLOGY  
(CMFRI/SPO/7)

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

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

1) NCC Blue water, Chandanada, Andhra Pradesh

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

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

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

5) Mr. Jagadeshwar Rao, Visakhapatnam, Andhra Pradesh

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

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

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

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

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

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

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

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

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

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

Cochin

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

The potential primary production in terms of chlorophyll a in the inshore waters of Cochin during the premonsoon period indicated moderate to high values observed at 10-20 m depth stations (1-9 mg/m³) while during the monsoon months, low values were noted (1-2 mg/m³). Again, during the postmonsoon period, moderate to high values of chlorophyll a was observed in the inshore waters (1-8 mg/m³) revealing that the pre and post monsoon periods were slightly more productive compared to the monsoon period.

Highest zooplankton volume (65.11 ml/100 m³) was observed during August at 30 m depth and lowest (1.3 ml/100 m³) at 10 m depth in May.

Calicut

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

Mangalore

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

SST varied between 25.85°C in January and 30.5°C in April. The lowest surface salinity of 7.01 ppt was recorded in July and highest (29.69 ppt) in April. Dissolved oxygen content at surface level varied between 3.09 ml/l in November to 4.64 ml/l in February. Primary productivity varied at surface levels 61.75 mgC/m³/day to 627.76 mgC/m³/day in July.

Bombay

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

Minicoy

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

Vizhinjam

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

Tuticorin

SST varied from 25.8°C in February to 31.4°C in May. Salinity from 25.44 ppt in September to 35.4 ppt in July. Diss. oxygen content at surface levels varied between 4.15 ml/l in April and 4.96 ml/l in July. Primary production recorded a maximum of 737 mg C/m³/day during May and a minimum of 93.8 mgC/m³/day in February. The volume of zooplankton varied between 1.36 ml in March to 6.0 ml in August.

Madras

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

Kakinada

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

Mandapam

SST varied between 26.3°C in August to 30.8°C in June, salinity varied between 29.27 ppt in May to 35.5 ppt in July. Low values of dissolved oxygen at surface level (3.71 ml/l) were observed in April. Gross primary production varied between 220 mgC/m³/day to 1427 mgC/m³/day in May and August respectively. Zooplankton volume ranged from 2.6 ml (September) and 6.8 ml (May).

Visakhapatnam

Upwelling indices such as seawater temperature, salinity and dissolved oxygen content at surface level indicated upwelling in the inner shelf during end of May and also during July. SST varied between 22.75°C in January to 29.87°C in September. Salinity varied between 23.58 during October to 34.8 ppt in May. Dissolved oxygen concentration varied between (1.9 ml/l) in Feb. to 5.85 ml/l in June.
**BIOLOGICAL PRODUCTIVITY OF THE INDIAN EEZ IN RELATION TO OCEANOGRAPHIC PARAMETERS (FEM/SS/1)**

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

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

**INVESTIGATIONS ON ZOOPLANKTON COMPONENTS OF THE EEZ OF INDIA (FEM/SS/3)**

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

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

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

2. Average zooplankton biomass in the EEZ has been estimated to be 88.33 cc per 1000 m³ of water.

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

4. The values of secondary production ranged between 0.5 and 20.92 gC/m²/year.

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

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

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

8. The cladoceran population was found to be more during July to October, with greater abundance in the Arabian sea. The highest density 245899/1000 m³ of water was recorded off Cochin.

9. 93 species of pelagic copepods were identified; high density was recorded in the slope of the central west coast during premonsoon season (368/m³) and from the inshore area of the southeast coast (4.2/m³). A latitudinal shift in seasonal abundance was observed.
10. The average number of mysidacea was estimated as 364 per 1000 m³ of water. The shelf had two times more mysids than the oceanic areas. While southwest monsoon was favourable in the west coast, the premonsoon was favourable for mysids along the east coast.

11. Amphipods occurred at a density of 2274/1000 m³ of water along the west coast whereas along the east coast, the density was 1501; in the oceanic area the density was 1014 and 925 respectively. The average density in the EEZ was 1291/1000 m³. The premonsoon accounted for the maximum quantity of amphipods.

12. The average density of Euphausiacea in the EEZ was 3214/1000 m³ of water. More euphausiids were present in the eastern Arabian sea (3680/1000 m³) than in the Bay of Bengal (2517/1000 m³). The shelf area contained double the number of euphausiids. The southwest monsoon accounted for more euphausiids along the west coast whereas premonsoon was more favourable along the east coast.

13. *Lucifer* was present in the EEZ at an average rate of 2499 per 1000 m³. No significant variations were found in the distribution between Arabian sea and the Bay of Bengal. A four times increase was noticed in the shelf area than in the oceanic area.

14. Stomatopod larvae were widely distributed in the EEZ and their number varied between 3 and 3347/1000 m³. More number of larvae were encountered in the shelf waters. A striking regional difference was noticed in the two sea areas.

15. The average density of pteropods and heteropods in the EEZ was 734 and 335 respectively per 1000 m³. Both were more abundant in the eastern Arabian sea. A kind of population explosion was observed among pteropods in the shelf area. A trimonthly abundance was noticed with this group.

16. The planktonic gastropods had an average density of 877/1000 m³. The population density was more than double in the Arabian sea while in the Bay of Bengal, February to March was more favourable.

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

18. A study of the vertical distribution and abundance of zooplankton and the component groups over a diurnal period indicated that an average at the rate of 6.24, 6.70 and 6.07 ml/1000 m³ was present in the 0-30 m, 30-60 m and 60-90 m depth zones respectively and the average counts of the various groups together were 14490, 13355 and 11290 per each depth zone respectively. The night samples collected more zooplankton. Amphipods and ostracods indicated vertical migration.

19. 13 species of Chaetognaths belonging to 3 genera: *Krohnitta, Pterosagitta* and *Sagitta* were recorded from the eastern Arabian Sea. The distribution pattern of *Sagitta dicipiens* indicated upwelling in the study area.
20. Study of the cladocera in the eastern Arabian Sea showed that 86% of the specimens belonged to *Penilia avirostris* and the rest to *Eudanone tergestina*. Both the species were abundant in the shelf waters particularly during night.

21. The average density of ostracods was 17395/1000 m³. They were more abundant in the shelf waters. Out of the total ostracods taken from the EEZ, 95%, was from the Arabian Sea.

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

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

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

25. Distribution of 12 species of Ostracods was studied from the Andaman waters.

It was found that *Euconchaceia aculeata* was the commonest, which occurred at a rate of 9732/1000 m³.

26. A study of the quantitative distribution of the amphipods of the Andaman-Nicobar waters showed that their maximum abundance (1763/1000 m³) was in January and minimum (315) in July.

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

28. Forty four species of hydromedusae belonging to 20 families were identified from the zooplankton samples from the Lakshadweep. The dominant species were *Solumndella bitentaculata*, *Liriope tetrakhylla*, *Aglaora hemistoma*, *Rhopalonema velatum* and *Cyctis tetrastyia*.

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

**ECOLOGICAL INVESTIGATIONS ON THE INTERTIDAL AND SURF ZONES OF THE KERALA AND KANYAKUMARI COASTS IN RELATION TO FIN AND SHELL FISH SEED RESOURCES (FEM/ES/6)**

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

Investigations were carried out at Calicut, Cochin and Vizhinjam in the surf regions and adjoining inter-tidal estuarine systems. The SST in the surf zone varied between 24.2 and 30.7 C at Calicut, 25.8 and 30.1 C at Cochin and 26.5 and 30.0 C at Vizhinjam and 26.1 and 30.1 at Kanyakumari, with the minimum in August and Maximum during March-April. Salinity variations were between 30.45 ppt and
36.1 ppt at Calicut, 9.0 and 34.9 ppt at Cochin, 30.4 and 35.9 ppt at Vizhinjam and 31.0 and 34.9 ppt at kanyakumari. Lowest values were observed during June-July due to effect of rainfall and river run off. In general, Korapuzha estuary recorded relatively low oxygen levels. Both nutrient levels and primary production values observed in the surf zone and estuarine region showed wide seasonal fluctuations. Fish eggs and larvae and juvenile fishes in the surf zone and estuaries showed large scale fluctuations both qualitatively and quantitatively.

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

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

The work was carried out at Visakhapatnam, Mandapam and Tuticorin. Cultivation of agar yielding seaweed, *Gracilaria edulis* by vegetative propagation method was carried out during May-August on long-line coir rope in the Gulf of Mannar. Growth of seedlings on horizontal coir ropes was good and they attained harvestable size with mean length of 19 cm and maximum length of 28 cm after 45 days.

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

<table>
<thead>
<tr>
<th>Seaweed</th>
<th>Quantity (Tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Sargassum</em> ssp.</td>
<td>3161</td>
</tr>
<tr>
<td><em>Turbinaria</em> spp.</td>
<td>234</td>
</tr>
<tr>
<td><em>Cystocera</em> ssp.</td>
<td>35</td>
</tr>
<tr>
<td><em>Gelidiella</em> ssp.</td>
<td>307</td>
</tr>
<tr>
<td><em>Gracilaria edulis</em></td>
<td>161</td>
</tr>
<tr>
<td><em>Gracilaria folifera</em></td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3905 Tonnes</strong></td>
</tr>
</tbody>
</table>

(Dry wt.)

MARINE POLLUTION (FEM/MP/1)

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

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

Cochin

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

Mangalore

Generally, concentration of nutrients like phosphate, nitrate and silicate in seawater collected from Thanneer Bavi near the effluent discharge point of the fertilizer factory were higher compared to those collected from cleaner areas at Chitrapur near Petroleum Refinery, Oil and grease content at surface levels varied from 2.33 - 3.67 mg/l,
phenol from 0 - 0.9 mg/l and BOD from 1.06-2.62 mg/l. Chlorophyll-a showed a steady increasing trend while zooplankton biomass showed a gradual decrease.

**Tuticorin**

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

**Madras**

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

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

**P.A. Thomas, Rani Mary George**

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

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

**V. Chandrika**

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

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

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

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**Development of Artificial Seawater (IDP/AS/1)**

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

Two more culture media were developed for the culture of *Chlorella* sp. It was found that the declining phase of the cells in these media occurred only after 35 days when compared to 25 days period in the conventional culture solutions.
Sponge *Callyspongia diffusa* (Ridley) with wonderdurg potential, from S.W. coast of India.

Gorgonid *Echinomuricea indica* Verrill — rich in prostaglandins
Bacterial flora screened from pokkali field useful in probiotics

Seaweed biotechnology laboratory at Headquarters
Breeding, Seed Production and Searching of the Sea Cucumber, *Holothuria scabra* (FEM/CUL/2)

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

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

Conservation of Marine Turtles (FEM/MT/1)

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

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

Designing, Developing and Fabrication of Automatic Electrical Blinker for Marker Buoy (FEM/INST/1)

S. Natarajan

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

Culture of Live Feed Organisms (FEM/LF/1)


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

At Cochin, a comparative analysis on the biochemical constituents such as proteins, total amino acids, soluble sugars and total lipid content of six spp of micro algae were estimated. It was found that the diatom, *Chaetoceros calcitrans* and the flagellate, *Isochrysis galbana* are having the maximum biochemical constituents, required for the growth of larvae in a hatchery system.
ULTRASTRUCTURAL STUDIES OF MARINE ORGANISMS (IDP/EM/1)

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

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

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

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

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

CULTIVATION OF AGAR YIELDING SEAWEEDS IN GREEN HOUSE CONDITIONS (CMFRI/SPO/9)

N. Kaliaperumal

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

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

APPLICATION OF REMOTE SENSING TECHNOLOGY IN MARINE FISHERIES (CMFRI/SPO/11)


SST data for satellite Infra-red imagery validation was collected at 6-hourly interval onboard FORV Sagar Sampada in 5 cruises in the southeast and north east Arabian Sea,
covering premonsoon, southwest monsoon and post monsoon seasons.

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

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

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

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

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

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

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

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

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

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

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

Feeds for *P. indicus* compounded using the seaweed *G.edulis*
Studies on non-specific immunity in fish

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

Presence of carbon inside spleenic macrophage

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

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

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

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

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

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

**TOLERANCE LIMITS OF CERTAIN ENVIRONMENTAL FACTORS AFFECTING PHYSIOLOGICAL BEHAVIOUR OF SOME CULTIVABLE ORGANISMS (PNP/44)**

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

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

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

The clam *Meretrix casta* exposed to 10 to 45 ppt salinities at 29 - 30 °C for 45 days showed maximum survival of 75% at 20 ppt. While at 10, 15 and 25 ppt salinities the mean survival was 70%. 65 and 40% survival was observed for salinities 30 - 35 ppt. The clams exposed to 45 ppt salinity survived only for 30 days with 10% survival rate. The percentage weight gain of 7.18 was observed for clams exposed to 20 ppt salinity. The percentage weight gain of 6.43, 5.33, 4.87, 4.51 and 2.34 were observed for those exposed to 25, 30, 15, 10 and 35 ppt salinities. The clams exposed to 45 and 40 ppt salinities survived for 30 and 35 days with 5 and 10% survival.
DISEASE INVESTIGATIONS IN MARINE SHELLFISHES (PNP/46)

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

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

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

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

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

DEVELOPMENT OF DNA FINGERPRINTS AND PROBES FOR DIAGNOSIS OF PATHOGENS OF FINFISH AND SHELLFISH (PNP/48)

P.C. Thomas and M.K. George

Two of the major fish pathogens Viz. *Vibrio parahaemolyticus* and *V harveyi* were cultured in laboratory and protocols for the isolation of both nuclear DNA and plasmid DNA from them were standardized, using the alkaline lysis method appropriately modified for the purpose. These were checked spectrophotometrically for purity, integrity and yield. Qualitative integrity was checked using submarine gel electrophoresis and found to be intact. The molecular weight of the nuclear and plasmid DNA from *V. parahaemolyticus* was observed to be about 23 kilobase and 19 kilobase respectively.
Nuclear DNA was subjected to restriction digestion using two of the type II endonucleases namely Hind III and Pst.I, to generate restriction fragments and for the preparation of restriction maps. As there were numerous restriction sites it was impossible to resolve these innumerable fragments in the submarine agarose gel electrophorosis. Hence, experiments with enzymes having rare cutting sites are underway to generate less numerous fragments.

Trials are underway to standardise the parameters for the restriction of plasmid DNA also using various endonucleases. Plasmid vectors like pBR322 and V517 have been procured and successfully cultured. These vectors are being maintained in the laboratory to be used for cloning in the future.

**Population Genetic Studies in Rastrelliger Kanagurta, Sardinella Longiceps and Penaeus Indicus (PNP/49)**

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

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

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

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

**Induced Maturation in Groupers (PNP/50)**

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

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

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

When Feed I (moist pellets) was fed to twelve groupers (*E. malabaricus*) a very favourable response was not obtained, rather
showing a favourable sign by accepting few of the pellets. Two animals of total length 31 and 32 cm and weight 540 and 620 g respectively were being maintained on fresh fish supplemented with cod liver oil (twice a week) in order to prepare them for maturation studies. However, heavy mortality of animals occurred due to power failure and infestation by vibrio and bacteria and the results of all experiments could not be obtained as only three animals survived. Fresh efforts are on to stock juveniles and restart the feeding experiments. The proximate composition analysis of carcasses of the dead animals is being carried out.

**IN VITRO EFFECTS OF NEUROHORMONES ON OVARY DEVELOPMENT IN CRUSTACEANS (PNP/51)**

N. Sridhar and M. Peer Mohamed

A layout plan was drawn for setting up a invertebrate tissue culture laboratory; equipments (CO₂ incubator, Laminar flowhood and inverted microscopes ) were requisitioned. Since 5-hydroxy tryptamine induces the synthesis of moulting inhibiting hormone in crustaceans, it was decided to identify the precursor amino acid tryosine and its tissue of predominance. To identify the amino acid and other catecholamines namely Dopa, Dopamine and Epinephrine, thin layer chromatography was carried out using tyrosine, phenyl alanine and tryptophan as standards. The run was carried out using Butanol acetic acid and water solvent mixture (12:3:5) and the plates were heated in an oven and then sprayed with Ninhydrin (0.2%) dissolved in ethanol. The spots developed were measured for their relative mobility values.

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

The extracts, in buffer of hepatopancreas and ovary, of 12 mature females of *Pindicus* were applied on to silica gel chromatographic plates using butanol-acetic acid-water (BAW) (4:1:1). After developing the spots the area and their RF values were measured and compared with the standard RF values obtained with tyrosine, phenylalanine and tryptophan. The experiment is being repeated after injecting the animals with 5-hydroxytryptamine.
STUDIES ON THE EFFECT OF TOXINS, POLLUTANTS AND PROBIOTICS ON FISH HEALTH WITH SPECIAL REFERENCE TO IMMUNE SYSTEM (PNP/52)

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

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

Separation of leucocyte and demonstration of in vitro phagocytosis:

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

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

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

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

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

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

SCREENING AND ISOLATION OF BIOACTIVE SUBSTANCES FROM MARINE ORGANISMS (PNP/53)

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

Seven species of ascidians and two species of sponges were collected from Rameswaram and Vizhinjam. For standardisation of the extraction procedure, two species of sponges collected from Rameswaram were selected and the methanol fraction was filtered and concentrated in a rotary evaporator at an atmosphere of Nitrogen. The sponges were treated with chloroform methanol (1:1) for further extraction. The extract was concentrated further and stored for IR and NMR spectral analysis. The concentrated methanolic fraction was treated with Hexane. The supernatant obtained was treated with ethylacetate. The ethylacetate and methanolic fraction were separated and concentrated as before and stored for analysis. Further fractionation through chromatographic procedure, is being carried out. By the standardised proce-
Amylolytic enzymes responsible for degradation of cell walls of seaweed from Abalones (for somatic hybridization of seaweed) and GABA a morphogenetic hormone for bivalves from red seaweeds were also included in the study and the methodology for their extraction is being standardised.

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

**GENETIC STUDIES IN MARINE PENAEID PRAWNS (SPO/12)**

M.K. George and N.N. Pillai

The electrophoretic screening of six enzymes extracted from the population samples of *Penaeus indicus* collected from Mandapam, Madras and Calicut and that of *P. monodon* collected from Calicut and Madras was carried out to study the population genetics of the two species. Morphometric data were also collected from the samples. The analysis of the polymorphic loci in the two species indicated regional allelic frequency differences at certain loci.
VIII. Socio-Economic Evaluation and Technology Transfer Division

There are five ongoing projects in the Division, three in Extension and two in Economics. Besides, the division is engaged in the programme of collection of fish price data from all important landing centres, wholesale and retail markets. The division was involved in organising exhibitions at U.C. College, Alwaye, Mar Augustins College, Ramapuram, St. Albert's school ground in Ernakulam and Trissur Pooram festival. Several visiting teams from various colleges/schools to the Institute were taken round and the activities of the Institute were explained. Further, the scientists in the Division, actively participated in the state level planning process on the request of State Planning Board, Kerala and Tamil Nadu.

Modelling and Evaluation of Extension Methods for Fisheries Development (FE & E/31)

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

Besides Chellanam, the activities were undertaken at Kandakadavu, Valappau and Nayarambalam. The group farming programme was extended to north Chellanam Padasekharam also bringing a total of 90 farmers operating in an area of 150 acres. The new farmers were imparted training in the technology with the help of KVK. An inter-divisional team from the Institute made visits to the farm and rendered technical advice to the new farmers. Shrimp feed production continued at Chellanam, Palluruthi and Nayarambalam and a new unit was initiated at Valappu. Training in Mahima Feed production was given to three women groups from Trivandrum, Quilon and Valappu.

Under the special component plan for SC, a financial assistance of Rupees 6 lakh was made available by the District Administration to Matsya Mahilavedi at Chellanam, SC/ST Society at Kandakadavu and AMSF Society at Valappu for promoting net making, ornamental fish culture, fish processing, prawn farming and feed production.

At Matsyamahilavedi 50 women were trained in net making and an amount of Rs 1000/- each was provided as capital input to start production activities. Five units of ornamental fish culture were also set up and the first harvest was done in November 1996 which demonstrated the feasibility of producing angel fish in the brackishwater during June to November.

At AMSF prawn harvest was done in September 1996 and the building construction for Mahima unit is in progress. A group of 5 women were trained in Mahima shrimp feed production. At Kandakadavu the fish processing training was imparted to 15 women with the help of CIFT in December 1996. The District Administration has sanctioned Rs. 2,64,450/- to the Matsyamahilavedi for implementation of integrated fish and poultry farming, crab farming and ornamental fish culture. Other activities organised at Chellanam included:

1. Organisation of DWCRA group for ornamental fish culture
2. Celebration of 'women in Agriculture Day' jointly with CIFT, on 4 December 1996
3. Visits of IMG trainees consisting of presidents of 25 Panchayats from dif-
different parts of Kerala, 12 December, 1996.

4. Visits of AIR/Trissur Team to cover the group farming project in the Vayyalum Veendum programme, 9 February, 1997

5. Visits of All India Radio Advisory Committee, Trissur consisting of heads of Government departments, educational institutions and NGOs.

6. All India Radio Trissur broadcast features on Matsuymahilavedi and Mahima shrimp feed production and ornamental fish culture at Chelleanam in Vayyalum Veendum programme on 12 March, 23 March and 27 March respectively.

7. All India Radio Trissur, has also approved the broadcast of a series of lessons in the Krishi Padam programme to be coordinated by the institute with the participation of other R&D agencies in fisheries.

The group farming model was found to be very effective due to the social and economic gains it demonstrated for the first time. The interagency linkages developed under the project could lead to the integration of technologies developed by the Institute into poverty alleviation programme.

The Chellanam model received wide coverage in the media. It is cited and described as a suitable model for women and development in the hand book released by the state planning board in connection with participatory planning. With the video facility available in the division a film on innovations developed at the Institute entitled 'Sankethika Vidyakal Samoohika Namakkuk' was produced and screened to the user groups. A cassette on mariculture technologies was produced in connection with the Director's visit to Egypt. Video coverage of TOT activities were also made using institute facility and outside agencies. Coordinated Mussel farming and harvest at Andhakaranazhi and it was telecast in the Vipani programme of Doordarshan, Trivandrum. The project is continuing with the modified title of 'empowerment of coastal communities through fisheries extension'.

INTEGRATION OF SMALL SCALE MARICULTURE WITH SMALL SCALE FISHERIES ALONG THE PENINSULAR INDIA (FE & E/32)


A number of demonstrations and extension activities were undertaken under this project during the period under report. At Headquarters 11 fishermen-industry-institution meets were organised. The response for these meets was very good due to excellent participation of the end users and good coverage in the media. These meets were conducted by all Research Centres. In Mangalore, mudcrab culture was demonstrated successfully. A harvest of 349.3 kg of S. tranquebarica was achieved out of 500.5 kg of soft crabs stocked in an area of 800 m sq. and a net profit of Rs 36,000.00. In Vizhinjam, good response from the farmers for propagating artificial reef to enhance the
production in the inshore belt have been received. Potentiality of open sea mussel culture was demonstrated successfully at Mandapam camp. 187 ropes of brown mussels with a total seeds input of 467.5 kg @ 2.5 kg/m of rope were cultured on an off-shore rack and the production was estimated to be in the order of 3.372 tonnes in a unit area of approximately 150 m² indicating a total production potential of nearly 22 tonnes/ha (21.812 t).

Similarly 241 ropes of green mussels with a total seed weight of 602.5 kg @ 2.5 kg/m of rope were cultured and the production was estimated to be 4.0 tonnes @ 16.6 kg/m indicating a potential yield of 20 tonnes/hact.

However a part of the yield was lost in the inclement weather and 2.0 tonnes of brown and 1.45 tonnes of green mussels were harvested. Of this 1.4 tonnes of brown mussels were sold to IFP, Cochin @ Rs.14/ Kg and 1.0 tonne of green mussels was sold to Amalgam Fisheries Company, Mandapam @ Rs.15/Kg and a sum of Rs.13,500 was realised for green mussels.

Culture of mussels in Mandapam waters and the harvest mela organised during the year under report gave wide publicity and various interest groups from Rameswaram, Pamban, Meemisal, Thiruchendur, Thangachadam etc. approached the associate project leader for off shore culture of mussels. Site inspections were made at Olakuda, Thangachadam, Pamban, Manapad, and Thiruchendur. A private entrepreneur (M/s. Femina prawn culture Pvt. Ltd) has sent proposal to the Institute for signing MOU to propagate the commercialisation of off shore culture of mussels in Mandapam area involving Institute-fishermen-industry. The same entrepreneur has proposed to enter into an MOU with the Institute for onshore pearl culture also. The prospects of Seaweed culture is also evoking good response from the fishermen. The Madras Research Centre, besides giving technical guidance on onshore culture of pearls and organisation of monthly meets involving the Institute fishermen Industry has organised training programmes on pearl oyster surgery for developing local talents with the help of Tuticorin Research Centre of CMFRI. M/s Master Aquaproducts, Chirala, M/s Maheswari and Co, Madras and M/s Rank Marine hatchery, Pondichery were given technical guidance on onshore culture of pearls. Technical guidance on fattening of lobster and crabs were also extended. At Visakhapatnam good response was obtained at meets on prawn and clam culture. An entrepreneur from Orissa seeking for prawn feed technology was given information about Mahima Feed. The demand of Mahima shrimp feed among the prawn farmers is continuously increasing and several commercial units have been established in and around Cochin with the technical advice of CMFRI. The project is progressing well in accordance with the Technical Programmes.

RESOURCE MANAGEMENT AND SOCIO-ECONOMIC SURVEY OF SMALLSCALE FISHERIES IN LAKSHADWEEP ISLAND (FE &E/33)

R. Sathiadhas, Krishna Srinath and R. Narayana Kumar

Collection of data from secondary source has been completed. Three types of schedules were prepared to collect data on the cost and earnings of different craft-gear at selected landing centres and socio-economic parameters through household survey. The preliminary analysis of data indicated that there are 11 landing centres, 10 fishing villages and about 5600 active fishermen in Lakshadweep Islands. There are about 550
traditional boats, 300 motorised boats and 415 mechanised boats in the island. The per capita production per active fishermen works out to 1750 kg. Steps are being initiated to collect data from households at Lakshadweep from May 1997 onwards.

A STUDY ON DIFFUSION AND ADOPTION OF SELECTED MARICULTURE PRACTICES (FE & E/34)

Sheela Immanuel

Mariculture technologies developed by the Institute have been identified to study the diffusion and adoption pattern. Narakkal, Chellananam and Kumbalangi in the Ernakulam District, Dalavapuram in Kollam District and a few areas in Kozhikode and Kasargod Districts which are dominated by fishermen involved in the selected technologies have been identified for detailed study.

Using simple random sampling technique, a total of about 500 respondents in the case of prawn, crab and mahima feed, and all the farmers who have taken up mussel and oyster culture in Kerala were selected for observation. Interview schedule/questionnaire on diffusion pattern of the technology, extent of adoption and problems in taking up the culture were prepared to collect data. Data collection work has been initiated and is in progress.

ECONOMIC EVALUATION OF MECHANISED FISHING UNITS IN COCHIN FISHERIES HARBOUR (FE & E /35)

R. Narayana Kumar and R. Sathiadhas

Cost and earnings data from sample units of gillnetters and trawlers were collected weekly from Cochin Fisheries Harbour. The operational cost and earnings of a single-day and multiday fishing units of trawlers were tabulated. The initial investment of the trawler ranges from Rs 7-10 lakhs. The fishing trip of multiday unit consist of two to three days. The average operational cost of a single day unit comes out to Rs 3500/- per trip and a multiday fishing unit comes out to Rs 7700/-. Fuel and wages to labourers are the major operating expenses constituting 40% and 35% respectively for both type of fishing units. The average gross earnings works to Rs 6000/- per trip for single day units as against Rs 13200/- per trip for multiday fishing unit. The net operating income of a single day fishing unit works out to Rs 2500/- and the same for multiday fishing units comes out to Rs 5500/-. The detailed analysis like net profit, rate of return, pay back period and other economic parameters in progress.
Dr. Meryll Williams, Director General, ICLARM
Philippines with Dr. M. Devaraj, at CMFRI Cochin

Delegation of Chinese fisheries Scientists at the Institute

Dr. Meryll Williams D.G., ICLARM and Dr. M.V. Gupta,
Director, International Relations, ICLARM, Philippines at the
Mudbank fishery — Landing centre at Chavakkadu in Trichur district, Kerala

Trawl landing centre at Sakthikulangara, near Quilon
संपन्न कार्यों का मुख्य अंश

मछली उत्पादन का आकलन

समृद्ध मान्यता मान्यताकी का मुख्य अंश करता ओर मिश्रवार व जिवनवार उत्पादन का आकलन करता स्वयं एक और आज के प्रमुख वातावरण में एक है। विभिन्न विकासाध्य और बालकपाल उद्योगों के अंतर्गत वह गुंजाई समृद्ध प्रशासन मान्यता का प्रमुख बायंकरण बनना है और वह महत्वपूर्ण उद्योग के अन्तर्गत उपयोग व्यवस्थापन करने लगेंगी भी सिद्ध हो जाएंगी। भारत में यूनिक्युल 1996 के मछली उत्पादन में पिछले वर्ष की अपेक्षा 6.9% की वृद्धि हुई है और आकलन उत्पादन 2.41 मिलियन टन था।

कुल उत्पादन का 87.1% बंदीकूट और मोटोरूड एको का व्यापार था। कुल समृद्ध मछली उत्पादन का 52% वेलापारी फिन फिश का वृद्धि और दूसरी मिल मान्यता और दूसरों का प्रशासन का उत्पादन था। इस कारण के दौरान तारंगियों की मान्यता में पुनर्गठन की प्रगति दिखाई पड़ी। नॉर्ड के अंतर्गत भी पिछले वर्ष की अपेक्षा एक नाबाद टन की वृद्धि हुई गई, पेनिनस्लाइड, नाला पेनिनस्लाइड और फिनियनों के अंतर्गत भी उन्नति बदल की वृद्धि हुई। लेकिन उपायशिमीयों, नॉर्द सार्वजनिक, खक्क केंद्रों, कार्जिक्स और गोल्फ्स के अंतर्गत में घटना दिखाई पड़ी। विशेष वर्ष का उत्पादन इस वर्ष 1.07 लाख टन था जो पिछले वर्ष की तुलना में 10,000 टन कम था।

मध्यमांड्रौं और तूफान के उल्लर-पश्चिम तट से नारी अवकलन (इंड. के कुल अवकलन का 34.9%) हुआ जिसके वजह दक्षिण - पश्चिम तट (क्रांत, कारपेल और गोमाता) (32.8%), दक्षिण-पूर्व तट (आंध्र प्रदेश, तमिलनाडु और पोंडिचेरी) (25.6%), उत्तर-पूर्व तट (पश्चिम बंगाल और उड़ीसा) (5.3%) और उत्तराखंड और आंध्राप्रदेश (1.4%) आते हैं।

उत्तर-पश्चिम तट में बंदीकूट एको (उदाहरण, कोष संपादन और मिलंजाल) द्वारा कुल उत्पादन का 40% और दक्षिण-पश्चिम तट में मोटोरूड एको द्वारा 49% उत्पादन हुआ।

उन्होंने आज एम एकमात्र के उत्पादों में समृद्ध मछली उत्पादन के पुर्वांतरण में अनुमानित उत्पादन पिछले वर्ष 23.7 लाख टन था जो 24.1 लाख टन आकलन मूल्य में विद्वंद्वितार भी हो गए।

मान्यताओं और मंडल विशेषज्ञों का अध्ययन

पिछले कुछ वर्षों में लेकर समृद्ध मछली उत्पादन नम्बर 2.3 मिलियन टन में छिपा रहा था ओर इन के विकास का ध्यान में रखता था। वह स्थिति विशेष विदेशों पर आवश्यक मालिकाना और आधुनिक अनुसंधान परिषदों के परामर्श व्यक्त करते हुए अनुसंधान विभाग के लिए अनुयोग्य उत्पादन रीतियों प्रदान की और इशारा करता है। इस अवकलन का पूर्व के अंतर्गत प्रशासन क्षेत्र में कई अनुसंधान प्रारम्भों का कार्यान्वयन किया जाता है।

वेलापारी फिनिक्स: दोनों तरह में तारंगियों की मंडल विशेषज्ञों के अंकड़े मिलाकर लाई गए। मांगोलू संपादन के अंकड़े मिलाकर लाई गए। मांगोलू संपादन के लिए रेंच 0-100 मी था। अनुसंधान द्वारा कार्कित के दौरान फकरों में मिला जाता अवकलन में प्राप्त तारंगियों के तीन फकरों के लिए रेंच बने, जो हैं। 110-205 मी मी, 130-150 मी मी और 180-190 मी मी। मांगोलू में अनुसंधान-नवाचत मंडलों के,
दोरान अंदाज़ पर भाविक रूप से अंदरित अस्वय की तार्किकों अधिक थीं और तवहर-राम के दोरान छोटी तार्किकों भी. कालिकेत में अपने-कुंल के दोरान किसान तार्किकों अधिक थीं और विविधात्मकताम में जमाने-मारे के दोरान अंदरित और पुनरुत्थान अंदे के दौरे मध्य में अधिक थे।

कालिकेत में ट्रांज जाला द्वारा तात्विक समय में स्थूलविश्वास विद्वान मिश्रण तथा जर्जर मानसून के आधार में नक्सल द्वारा एम. इंजीनियर की अधिक पकड़ हुई। एम. इंजीनियर का लंबाई रेत ट्रांज जाला में 60-100 मि और कोंग संपता में 65-95 मि था। ट्रांज जाला में एम. विद्वान मिश्रण अचार रेत 60-105 मि और कोंग संपता में 80-105 मि था।

वो कंट्रोल में गैरसिक्क के निदेशन पर अधिक संप्रभुत किया गया। पूरी तरह में कोंग डॉर के अनुसार डिम्फ गिल नान और बोम्बे ट्रांज द्वारा माध्यमिक निर्माण हो गया। इन कंट्रोल में डिम्फ गिल जान का योगदान कुल उन्नयन का 60.4% और ट्रांज रेत 20%। कोंग डॉर का 7.7%। वार्गिक विश्वास का 1.1% और कोंग संपता का 0.3% था। आकर्षण राममंत्री कर दिया जा रहा था।

वह समानांतर अध्ययन यह मुद्दा देखा है कि गैरसिक्क संपता का विदेश उद्घाटन अनाथक में अन्तरित बढ़ती प्राप्ति के गर्भ में निम्न होता है। परिवहन नीति और कंट्रोल में इस नारे पर अधिक और अन्य श्रेणियों में इस नारे में कम निर्माण होता है।

देश के आठ श्रेणी कंट्रोल के गमुदारी नारा और मिश्रित में टूटनायों की संपता किया रखता है और निर्माण श्रेणी में मुख्यत एष्टोनिया और मिश्रित में विभिन्न एक्स-मिश्रित नुक्सल इन्तकालों की प्रमुख जानियों थी। स्थूल अध्ययन अध्ययन यह मुद्दा देखा है कि गैरसिक्क संपता का विदेश उद्घाटन अनाथक में अन्तरित बढ़ती प्राप्ति के गर्भ में निम्न होता है। परिवहन नीति और कंट्रोल में इस नारे पर अधिक और अन्य श्रेणियों में इस नारे में कम निर्माण होता है।

फी आठ श्रेणी कंट्रोल के गमुदारी नारा और मिश्रित में टूटनायों की संपता किया रखता है और निर्माण श्रेणी में मुख्यत एष्टोनिया और मिश्रित में विभिन्न एक्स-मिश्रित नुक्सल इन्तकालों की प्रमुख जानियों थी। स्थूल अध्ययन अध्ययन यह मुद्दा देखा है कि गैरसिक्क संपता का विदेश उद्घाटन अनाथक में अन्तरित बढ़ती प्राप्ति के गर्भ में निम्न होता है। परिवहन नीति और कंट्रोल में इस नारे पर अधिक और अन्य श्रेणियों में इस नारे में कम निर्माण होता है।
और मांगलूर में 0.32 आकलित किया गया।

मनवार उत्पादन क्षेत्र में किए गए मान्यताकी पूर्वस्थान कार्यक्रम में तार्किताओं के अतिरिक्त और बाकी दोनों के वैषय में आपसी संबंध देखा गया।

तलमजी फिनिकिया: नवर केंद्रों में उपस्थितियाँ के विदीर्ण का मौनीयन किया गया और घर केंद्रों में तूफानों द्वारा अधिकांक पकड़ प्राप्त हुई। बंदर में धोंतियों का डैक कोर्ट रेंग 160-640 मि में देखा गया और अंत और विमान-मार्च के दोरान गर्भावस्था सुरूआत को अधिक रूप से देखा गया।

पांच केंद्रों में पच्ची की संपदा वित्तपत्रों का अधिवेशन किया गया। बंदर में 10-52 मि के आकार रेंग के और कोटाई में टूफानों द्वारा 10-37 मि के आकार रेंग के एफ्युडिंकस ड्यानाडम प्रमुख रूप से प्राप्त हुए। कोर्ट में कंट्रोल डॉर डरा प्राप्त इस जाति का लंबाई रेंग 23-50 मि था। वित्तवृत्त में बर्बर-गुजारी के दोरान प्राप्त पकड़ में मेन्टिस लेंडिंग का लंबाई रेंग 180-730 मि के और एल. नेबुलोग मला 140-440 मि में था। तूफान की में एल. नेबुलोग का लंबाई रेंग 100-660 मि और ई. नाइडुलोग का 330-580 मि में था।

तीन केंद्रों में जिंगिटों की संपदाओं का अधिष्ठान कला गया और टैक्सिस्ट का ड्राफ्टर और और मिलिटारिया प्रमुख जातियों की लागू कृषि का विदीर्ण अनुपात 0.74 आकलित किया गया। कोटीर में जुलाई-फरवरी के दौरान बंग के लंबाई रेंग का अक्षर विभाग में मेरा संपाद लिखने से ठीक से फरवरी के 280 कि ग्राम शिक्षा और अभ्यास का अवधारण किया गया। विश्वसनीयताओं में पकड़ का 50% ठीक हुआ था।

यूथपाश श्रीमान के संपदाओं का मौनीयन नी केंद्रों में किया गया और सभी केंद्रों के बंपर पकड़ में एन. जाधवलक्ष्य को एन. मीमोनियान प्रमुख जातियों की अधिकतम वहनीय प्राप्ति 315 टन और 3551 टन आकलित किया गया। क्षेत्र एन. जाधवलक्ष्य की अधिकतम वहनीय प्राप्ति 3410 टन आकलित किया गया जो कर्मचार वार्षिक एकांक के करीब आता है। टूफान की में पकड़ की प्रमुख जाति एल. डिजा थी। मद्रास में एल. जाधवलक्ष्य और एन. मीमोनियान की अधिकतम वहनीय प्राप्ति क्रमशः 1075-1410 टन आकलित किया गया जो बढ़ते हुए उत्पादन की ओर इशारा करते हैं।

नी केंद्रों में मुलानों के अवधारण का मौनीयन किया गया। भारत में विभिन्न पदोन्नतियों 20 जातियों में मांगलूर, मद्रास, कालिकटा और विश्वसनीयता से प्राप्त विश्वसनीयता विन्यास में एकल टूफानिया द्वारा एकल लेगेंडेफार प्रमुख जातियों की प्राप्ति। फिर भी भारत के दक्षिण-पूर्व तट विश्वास: पाक उपमार को एल. ब्रूनिस्टोरिया, एल. जाधवलक्ष्य और एल. ड्राफ्टर जातियों देखी गई। मद्रास में एल. विन्यास के अधिकतम वहनीय प्राप्ति 1285 टन आकलित कर गई जो 1045 टन के वार्षिक औसत प्राप्ति के अधिक थी।

समयंद संपदाओं का भी नी केंद्रों में मौनीयन किया गया। इस मान्यताकी में कालिकट में 18, वेरानाद में 16, मद्रास में 15, विश्वसनीयता में 10, कालिकट में 7 और कार्यालय, कोटाई और जिंगिटों के 1 से 4 जातियों का उपयोग किया गया। वेरानाद, बंदर और कार्यालय में ड्राफ्ट रेंग में अटलांकस क्षुद्री प्रमुख जाति थी। वेरानाद में ड्राफ्ट परिचालन द्वारा सबसे बड़ी समयंद जाति थी। विश्वासरथों और अंत द्वारा फ्रायरिस डॉनोजन का विदीर्ण किया गया। बंदर में अक्षर और फ्रायरिस के दौरान जी. तीने के परिचालन प्रदेश को प्राप्त हुआ।

विभिन्न केंद्रों में तुम्हारों की दो जातियों प्रमुख थी और बंदर में ड्राफ्ट परिचालन द्वारा 100-440 मि में, मांगलूर में 180-450 मि में, कालिकट में 100-
329 मि मी और कोचीन में 240-440 मि मी आकार
रेंच के सॉरिडा दुंगिल को पकड़ा गया। बंबई में अक्तूबर-
नवंबर के दौरान और कालिकट में जनवरी के दौरान
परिस्थित प्रौढ़ों को प्राप्त हुआ। मद्रास में अक्तूबर-
नवंबर के दौरान एम. अन्ड्रोस्फारम्स के अंद्रेरुट वयस्क
प्राप्त हुए थे।

द्रायरो द्वारा पकड़ी जाने वाली चप्टी मछलियों
में 5-17 से मी आकार रेंच की साइनोस्फोंस माक्रोस्फों
प्रमुख जाति थी। मांगलूर में नवंबर-जनवरी इस जाति
के अंडनजन का रंगटगंगल था।

पकड़ी गई जंतुमछली का लंबाई रेंच 8-20 से
मी था और मांगलूर में नवंबर-मार्च के दौरान मुख्यतः
इस जाति का अंडनजन संपूर्ण हो जाता है।

क्रेस्टिकियन कवच प्राप्ती: देवें दे कुल 1.88 लाख टन
वापसी समुद्री मछली अवतरण का 7.8% पेनियाइड
श्रृंगों का योगदान था। पक्षिय तट में द्रायरों द्वारा
77% पेनियाइड श्रृंगों का अवतरण हुआ। कोचीन और
शक्तिकुलगंगा में मानगुन अवधि के दौरान पेयरामीकोटियों
क्रेस्टिकियन का क्रमांक 1210 और 5602 टन अवतरण
हुआ जिससे वर्ष 1995 की अपेक्षा कोचीन में 28% की
वृद्धि और शक्तिकुलगंगा में 51% की घटती न्रजर आती
है। पक्षिय तट के विभिन्न केंद्रों में फी. स्ट्राइजिफारा का
लंबाई रेंच 60-125 मि मी, मेंटोपैक्सिअस ड्रायरो की
56-120 मि मी और एम. मानोसिस का 96-150 मि
मी आकार किया गया। कर्नाटक के केरल में मानपुनी
की अवधि कार्यकारी मिश्रणों द्वारा पेनियाइड श्रृंगों के
अवतरण का रंगटगंगल था। इस क्षेत्र के कार्यकारी सेंटर
में हुए 87% श्रृंगों अवतरण में प्रमुख जाति एम. ड्रायरो
थी केरल में छोटे-छोटे द्रायरों द्वारा 27.2% का ग्राम प्रती एक
की पकड़ दर में फी. स्ट्राइजिफारा और एम. ड्रायरो का
अवतरण हुआ। 10-12 मि मी जलाशय आकार
वले इस गियर के परिवार द्वारा तटीय समुद्र से कम
आकार वाले श्रृंगों (इस गियर की पकड़ का 60%)
का
शोपन हुआ है।

भारत के पूर्व तट में पेनियाइड श्रृंगों का अवतरण
50,383 टन आकलन किया गया जो पिछले गाल की
अपेक्षा 1.3% घटती दिखाता है। तमिलनाडू में अवतरण
का अधिक योगदान हुआ, पूर्व तट की डट्र वस्त्रिकी में
पारावी में पेनियाइड श्रृंगों का 42% पेयरामीकोटियों
जातियों थीं, विशेषतः रवी स्रोत में 37% कार्नाकाड में
40% और मादगार में 21% एम. ड्रायरो म्यान हुए
और मस्तन में 44% पाया गया 36% और ट्रीटिकोरिन में
67% पी. तेंदुरुस्ट्रोस्ट्रो प्राप्त हुए। इस क्षेत्र के पेनियाइड
श्रृंगों की पकड़ यह युगल हो देती है कि उत्तर-पूर्व तट के
पेयरामीकोटियों और एम. मानोसिस के बड़ी जातियों की
अपेक्षा कुछ गालों में पेयरामी-कोटियों जैसे छोटी जातियों
की अधिकता हुई है और एम. ड्रायरो म्यान जाति
थी। पाक उपमागर व मादगार बाइडी ट्रोल्स में जमान: एम.
स्ट्राइजिफारा और पी. मेंटोपैक्सिअस अवतरण की प्रमुख
जातियों की। इसी प्रकार चौधी तट में बड़े पत्ते द्वारा
गब्बर सागर में मन्नन किए जाने पर साधारणतः
मिलते-बाली जातियों जैसे मेंटोपैक्सिअस और
ट्रीटिकोरिन जातियों को पकड़ा सकता। कार्नाकाड में
द्रायरों द्वारा एम. मानोसिस के बिजोरों का बड़ी मात्रा
में विद्यमान किया गया और इस पकड़ के 70% नमूनों
का आकार 100 मि मी से कम था।

ट्रीटिकोरिन में वर्ष 1995 की अपेक्षा महीना सागर
श्रृंगों के अवतरण में 71% घटती देखी गई और
हेट्रोकार्पस और मेंटोपैक्सिअस जातियों प्रमुख थी।
कार्नाकाड के निकट स्ट्रेट जाल द्वारा पालन क्षेत्रों में कुल
269 टन किया गया श्रृंगों का अवतरण हुआ और अवतरण
का 80% एम. मानोसिस, एम. ड्रायरो और पी.
इंडिका था।

भारत में नौन पेयरामीकोटियों का अवतरण लगभग
1.04 लाख टन था जिसका 64.4% मुगल और और
27.1% महाराष्ट्र में पिछले
वर्ष की आपेक्षिकता उत्पन्न व बढ़ गया. गुजरात में कुल अवरोध का 77% ट्रेलर का और महाराष्ट्र में 89% ट्रेलर जातियों का योगदान था, वेंकाल में तों पेनिस्लाइड जीवित पकड का 98% अपेक्षिका जातियाँ और मुंबई में पकड का 10% नोएडापोलिंग टेस्टिंग थी.

चिंता के अवरोध में पिछले साल की आपेक्षिक 36.7% वृद्धि हुई है. भारत की कुल चिंगाट पकड का 86% गुजरात और महाराष्ट्र में वृद्धि हुआ जिसके बाद तमिलनाडु (9.5%) और केरल (4.2) आए हैं. पिछले साल के अवरोध की तुलना करने पर महाराष्ट्र में पकड में वृद्धि दी और गुजरात में 7% की घटती दिशाई पड़ी. उन्नत-पक्षिक नित और कुल चिंगाट उत्पादन का 80% और केरल में 60% ट्रेलर का योगदान था. लेकिन तमिलनाडु में चिंगाट पकड का 67% वृद्धि पकड का योगदान था. मुंबई में नीचे मायों के बाद पकड में अनेक प्रयास फ़क्‍क के दृष्टि 100 कि व थी. प्रमुख जातियाँ बोलियों हुआ हो और चीफों अक्सकला थी. पक्षिक निवेश में अंदाज मानसून मानसून लोकप्रिय अवधि में और पूर्व तट में अक्तुन्द्र-दिवंगत अवधि में देखा गया. एल. हुसैनी का रोक निरोजन अध्ययन अवधि के वहाँ वहाँ पकड प्राप्त था एक निरंतर कोर्ट के आदेश के कारण करने की आवश्यकता पर इशारा करती है. केरल में चालू मायों और कोडुनाली में नामभ 5390 टन हुए शुरुआत का और दक्षिण-पश्चिम तट में 2040 टन हुए सुब्बूर अवरोध हुआ. वेंकाल में पकड में काली चीफ क्लरिफिका साइकोलाइक्स का कुल अवरोध नया 37,000 टन था. अपठुमुडी में रोकियों का कुल वर्ड रोक 61,000 टन आकलित किया था. जिसमें 12,000 टन प्रतिया मानवाधिकारिक था. कारवार वाड़ी में हिंसा की कुल अवरोध का दृष्टि 28 टन आकलित किया था. नामनाला वाड़ी के 3467 टन का मोक्षकर पकड में 46% भिङघड़ी और 54% भार था. मुंबई में नया तट में दिसंबर 1996 में नया 6465 टन रोकियों का अवरोध हुआ था.

मान्यताक्रम परिचिति मॉनिटरिंग

पूर्व मानसून, दक्षिण-पश्चिम मानसून और मानसून लोकप्रिय मोर्सलों के दौरान संग्रहित यी 320 टूट डाटा के मानसून और कालरागु के बीच के श्रेणियों में दक्षिण-पश्चिम मानसून के दौरान उत्पाद की उपस्थिति देखी गई.

भारत की अन्य आर्थिक में मक्कल के प्राप्तिकारों पर विशेष ग्रंथ अवधि अन्य आर्थिक में मक्कल के प्राप्तिकार उत्पादन प्राप्त 100 मी. है 88.3 मिलियन पर आकलित करने के लिए महाराष्ट्र में और यूरोप की खेड़ी की तुलना में अर्थ समुद्र का उत्पादन दुगुना था. रात में धूसरकी शीर्ष प्रति वह. आल्मान-निकोलाई गुप्ता में इंतियोलिक्स की आकलित देखी गई. यह उपयोग नया अधिकार समस्त हुआ गया.
उत्तर पूर्व तट पर प्राणित्वकों की मोमबित अनुभूता चिन्ह-पार्श्वीक श्रेणियों में जनवरी के दौरान देखी गयी और नवंबर और अप्रैल में विशारद प्रतिक्रिया में. फरवरी-मई के दौरान मछली के अंद और जनवरी-फरवरी में प्रशंसित धीर थे.

कोविन द अमानिया का उच्च स्तर (79.31) ज्वारनदमुख में रिकाउ दिया था. उपत्यका जल में अमानिया का स्तर कम था. मछली, शीघ्र और धिनांपिया में मारी धातु का स्तर दसवीं धारा के लिए निर्धारित रेखा के अंदर ही था. एनोर में (जेब्स) फॉर्मेट के दौरान जनवरी-मार्च के दौरान उच्च थी (0.5 पी.पी. एम). अगस्त-अगस्त में अधिक में लगे के स्तर भी उच्च थे (0.1 पी.पी. एम).

दूर-संबंधन और शक्ति मत्त्य क्षेत्र

पकड़ पर मिश्रित धारा के शक्ति मत्त्य क्षेत्रों पर किया गया था. पूर्वार्द्ध में से स्कॉने ट्यूब का इस पकड़ की अनुप्रस्तुता व्यक्त की. इस प्रकार कोविन द आप को भी कोण संपादित और मिलजोन के जरिए प्राप्त उच्च पकड़ इस तनाव की विश्वासी कारण करती है.

समुद्री संवर्धन प्रोटोटिपियाँ

प्रोटोटिपियाँ पंजाबियन के वीजोड़ देश में 14 प्रजन्तुओं

ने 87 लाख जोड़े का उत्पादन किया जिसमें 14.8 लाख रूपरेखा के 5 जोड़ा अस्या, भूलोपोत, और प्रमुख इंसानों अस्याओं के जरिए पालता दिया था. इसमें अतिरिक्त में 16% के बीच देखी गयी और कुल 13,277 में 1148 को पालन करने लिए तत्काल दिया था. इसलिए आयुक्तिक के चूना ट्यूब के अनुसूचार प्रेरित परिक्षण पर भी प्रीव्यू करते थे. इस प्रकार एक ताल में अनुसूचित 12 माहों में 9 परिक्षण हुए थे. 10-15 दिनों के उपाय-अवधि में 30-35 दिनों के अंतराल में सफल आवार्त अंडले देख गये थे.

एस. ट्रांक्युवार्क को शुल्क बनाने के स्तर के परिक्षण में नारकवाल के 0.1 हेक्टेयर में 292 तरंग कच्चे का पालन किया था. इसका परिणाम प्रोटोटिपियाँ के अंदर ही में 600 ग्राम भार में प्राप्त रहे थे.

विस्तार विस्तार में 1.2 हेक्टेयर एक भी चाँदी के पारिवारिक होमियज़ का शुल्क बनाने के स्तर के परिवारिक दो अंतराल में 25 ग्राम एक चाँदी के अंतराल में 1.5 ग्राम में 600 ग्राम भार में प्राप्त किया था.

शाखा मुक्ति स्तर पर कुल 21 अंडन दो चाहे गये थे और उपाय में घटना को पालन के लिए उपयोग किया था. फ्रान्डन में उत्पादित अवधि में 640 रजूसों को नसरी में स्वायत्त व्यापार किया था. नसरी में 25 ग्राम भार में मुक्ति अवधि सहित 800 रजूसौं को फार्म में स्वायत्त किया था.

उत्तराखंड मुक्ति स्तर की मुक्ति अवधि में 7,72 लाख घटना का उत्पादन हुआ था और उनको 25 हेक्टेयर एक भी विभिन्न अनुमोदन करना और उद्योगकर्ताओं को वितरण किया था.

बिल्लोट्सटाइटस साइबियोध्रिया का बुड्स्टाइट अनुसूचार अंतराल में 10 से 34 पी.पी. चांदी तक की लक्ष्य के आ स्तर में देखा गया.

अप्रैल में 30% सीमित अवधि के अंतराल में 10% प्रोटेक्शन में और बाकी अंडरिक अवधि में थी.

सीमित अवधि के अंदार उनको एक भी चांदी के पारिवारिक अवधि के 0.1 हेक्टेयर में 600 ग्राम भार में प्राप्त किया था और जिसके परिमाण स्तर में 458 हेक्टेयर भार हुए थे.

मद्रास में उपाय नदिया संवर्धन कार्यक्रम में 3 मी. मी. और 4 मी. मी. केंद्रों का उत्पादन 1700 अवधि में 272 मोटी पालन हुए थे और निको नी केंद्रों में उत्पादन हुआ था और जिसके परिमाण स्तर में 50,000 और 13,000 ग्राम में उत्पादन हुआ था और केंद्रों में उत्पादन हो गया था.
कार्यक्त्रित में हाल ही में निमित ग्रुपोंवाणियों में तापाई उद्योग के जश्ने हस्तियों के प्रशिक्षण प्रणाली में लगभग 5-6 लाख ग्रुपों का उपयोग हुआ था जिनमें 1.28 लाख ग्रुप का स्थापना उद्योग ने जोड़े जिन्होंने आगे 45 दिनों के लिए 10-15 दिनों मे भी आयाम प्रणाली करते तक पालन किया जा सकता।

समूहों को फिरेसंघर्ष राष्ट्र-मंडल में, वल्लुके (एक में अन्य जानकारी) वीडियो को संगठन दृष्टिकोण में दूर स्थित तलाव से दिखाया था। इस प्रकार संगठन वीडियो को नर्मी में पालन करने वाली का निरीक्षण किया था, जिसके अतिरिक्त दृष्टिकोण में मिटर्स में निमित तलाव में बुड़ बूथक दिखाये पर परीक्षण में भी चलाया जाता है।

दृष्टिकोण में जैसे 1996 के दौरान संगठन 530-850 मि भी आयाम के नमूनों को जीतने में 100% अन्तिक्रिया के नाम संदर्भ को परिवर्तित किया था। कोशिका में भी बुड़ बूथक दिखाये पर परीक्षण चलाया और 120-242 मि भी आयाम के इंस्टाट्रीक निर्देशों को देखी जिन्हें वहाँ एक आर पी ट्रैक्टरों में स्टॉक किया था, उनकी औसत अधिकतम वहाँ 130-160 ग्रा थी।

शिक्षकीय संस्करण श्रीमानों के उपयोग, व्यक्ति निरीक्षण और स्थानांतरण

गुणतात्त्व माता पाने के उद्देश्य से मुख्य ग्रुपों से प्राप्त सुरक्षित बाल और नर्मी में प्राप्तिगत परीक्षण से गुणतात्त्व माता पाने का उपयोग हुआ।

उद्योगों को मुख्य ग्रुपों में सुरक्षित बालों को स्थापित वीडियो की तापाई और संगठन अनुपात का निरीक्षण करने वाले के लिए मलाइ सड़क दिखाए थे।

केंद्र में कई कृषि क्षेत्र ने नाव में शुरु होने संवर्धन स्तर में अन्धकारक 62 में 438 कि ग्रा तक ग्रुप का उपयोग हुआ और 3,000 से 19,700 से ऊपर कमाया, थर्मडेम ज्वारनामुख में शब्द संवर्धन निर्देशन के ग्रुप में निमित मिलने में एक रैंक के निरीक्षण परीक्षण करने में की थी। पाँच महीने की अवधि में लगभग 1300 कि. जा शंबर पाए हुआ जिसका निरीक्षण उद्योग प्रतिष्ठा के लिए 12 कि. दिन था।

केंद्र सरकार ने 4 जिलाओं में वायू क्षेत्र कृप्तियों के कार्यान्वयन का अनुमोदन किया। 125 विश्वास और 30 प्रशिक्षण के 15 दल की एक एकड़ की आर्थिक सहायता से इस प्रोग्राम को कार्यान्वयन करने वाले। इस प्रकार 67 जिलों में पाथ बनाए 2.5 टन शंबर के उद्योग के अन्सर 800 वर्ष में नृत्य क्षेत्र में शंबर संवर्धन प्रारंभ किया है।

संस्थान की प्रशिक्षण और सहायता में पाथ के एक दिन के 2.5 टन शंबर के 2.5 टन शंबर का उपयोग किया।

समूह के संवर्धन प्रोग्रामों का संयोग

प्रणव: लागू का मुख्यालय नेबद तापाई का उद्योग प्रशिक्षण में 9.2% बढ़ती दिन गई, इसी प्रकार नेबद तापाई का उद्योग में 8.6% बढ़ती दिन गई। इस संगठन में नेबद तापाई का शरीयर इंडिक्स परिवर्तन के साथ, जो बढ़ते हुए नाव दिखाये। नेब लागू के नेबद किया, जो बढ़ते हुए नाव दिखाये। पी. डी. लागू लागू लागू का आयाम में 35% प्रोग्राम की आवश्यकता दिखाये। विभिन्न तापाई के बाद नेबद ताप जोड़ने पर उच्च परीक्षण और 30% बढ़ती दिखाये जबकि मोटर चिपेट जोड़ने पर बढ़ती 20% थी।

शरीरीक निरीक्षण: 45 दिनों के लिए विविध नवणांत में रखे गये बाल और सीमित ने उच्च किया कि राजस्थान का माध्यम प्रतिसंभालन 85% की उच्च
अतिनिविता दर 20 और 25 पी दी में प्राप्त किया जा सकता है। रोगिक्रिया कार्या में 75% की ऊँचा अतिनिविता और 7.18% की ऊँचा भार प्राप्त 20 पी दी पर थी।

रोग विज्ञान: पी. मोरोडोनेन में वाइट स्पोट सिन्द्रोम रोग पर किने हिन्दोप्राकृतिक अध्ययन ने मीनोर्मालन और एडिगार्मेंट कोशियों में इन्डूक्सिलार इनक्लूसन बोडीस दिखाया। पहली वार पी. मोरोडोनेन के हेपारोपोनिकॉस के इंटर और एद्रा ट्यूकूलर स्थान में एक प्रोटोकोल दिखाया गया है।

दो महीने रोगजनक विषयों पर अनुसंधान के दौरान किया और इनमें से केंद्रक दी एन.ए. और लेसिमिय दी एन.ए के पृथक्करण के लिए प्रोटोकोल का मानकीकरण किया।

अनुभवों: रास्ट्रीय अनुसंधान और सार्वजनिक लोकसंस्कार पर किये गये अध्ययन पहली जाति के मस्तर प्रोटोवर्ग और दोषों के एम. दी. दी. एन.ए. अनुस्वरूप अनुसंधान संलग्नियता के मुख्यांकन के लिए शक्ति अनुसंधानीय मूल्य है।

मात्रिकी आधिक अध्ययन

कॉचीन में रोग प्रचालन में लगे हुए अनाय का आंकन प्रचालन नामक प्रति रुपया 3500/- और कई दिनों में प्रचालित अनाय के लिए 7700/- और आकलित किया था। इंडिया और मजूर मुख्य प्रचालन खर्च थे। एक दिन में प्रचालन में प्रति रुपये आकलित सकल आय 6000/- और वहुदिवसीय प्रचालन में एका का आकलित सकल आय प्रति रुपये 13,200/- और आकलित किया गया।

प्रोतोगिनियों का स्थानांतरण

विस्तार कार्यकलाप कण्डकड़, कल्यु, और नायरमान तक बिस्तर किये थे। 150 एकड़ के क्षेत्र में 90 कृषकों की कार्यक्रम भी बिस्तर किया था। महिला वास्तव उत्साह की तैयारी में करने के तीन महिला समूहों को प्रशिक्षण दिया था। कई मुल्ले-उद्योग- संस्था सम्मेलनों का प्रमाणित किया थे और समुदाय के लिए यूपूर्ण कई चरणों चलाए और अंतर्क्षेत्र सहायता भी प्रदान की गयी थी।

माँगनुर में रोग कर्मकांड संचालन का निर्देशन किया गया और 80(1) कान्य क्षेत्र में 50(1) क्र. ग्राम के जन कर्मकांड से 349 क्र. ग्राम का कार्यक्रम प्राप्त हुआ था। निर्देश 36.000/- रू. था, बिने जमा के कृषक उत्साह विभाग के निर्देश के लिए कृषिम रीतों के उद्योग में कहने उन्नत थे। महाराज में नये समूह गठन संचालन कार्यक्रम का सफल निर्देशन हुआ था।

प्रशिक्षण और शेषेश्चित्र कार्य

सम्मान में एम.एक. एम. और एम. भारी कार्यक्रमों का आयोजन जारी रहा। 9 छात्रों ने एम.एक. एम. और एम. भारी प्राप्त की और तीन छात्रों को एक भारी, छात्र देने दी गई। इसके अतिरिक्त तीन छात्रों ने अपने वीसिस पेंशन किये गये हैं।

प्रशिक्षण प्रशिक्षण केंद्र के समस्त संचालन के बिमारी के विभिन्न क्षेत्रों और मात्रिकी के संग्रहणलार प्रायोगिकी पर 9 प्रशिक्षण कार्यकर्ता चलाये। विभिन्न समुदाय के जातीय राज्यों द्वारा प्रायोजित 66 उम्मीदवारों को इनमें प्रशिक्षित किया गया।

सम्मान के कृषि विज्ञान केंद्र (के वी के) के विभिन्न विषयों पर 32 कार्य प्रकाशित और 802 व्यक्तियों को इसमें प्रशिक्षित किया गया।
Dr. P.V. Dehadrai DDG (FY), ICAR speaking at the conference of Directors of Fisheries Research Institutes held at CMFRI

Directors of Fisheries Research Institutes of ICAR at the ICAR Fisheries Division Meeting at CMFRI Cochin
Inauguration of Golden Jubilee Celebrations of the Institute at Madras Research Centre

INAUGURATION OF
GOLDEN JUBILEE YEAR CELEBRATIONS
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
03-02-1997

Inauguration of Golden Jubilee Celebrations of the Institute at Visakhapatnam Research Centre by Shri Subbam Hari, Hon'ble Mayor, Visakhapatnam

CMFRI stall at the Karvali Festival at Karwar
<table>
<thead>
<tr>
<th>क्र.सं.</th>
<th>उद्योगकर्ता का नाम</th>
<th>स्थान/कार्यक्लाप</th>
<th>राशि</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>मेसर्स एन.सी.सी. चुंबाटर प्रोडक्ट्स लिमिटेड</td>
<td>चन्दननगर (आ.प्र)</td>
<td>84,000</td>
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<tr>
<td>2</td>
<td>मेसर्स वालानी बायो-टेक लिमिटेड, नेल्लूर</td>
<td>तुम्पिलिपालेम</td>
<td>1,66,250</td>
</tr>
<tr>
<td>3</td>
<td>मेसर्स अक्रा प्राइम इंटर वैशालिक (इंडिया) लिमिटेड</td>
<td>नेल्लूर</td>
<td>2,01,350</td>
</tr>
<tr>
<td>4</td>
<td>मेसर्स जेम होल्डिंग्स रिसर्चल्स लिमिटेड</td>
<td>मद्रास मुक्ता कृषि</td>
<td>4,30,750</td>
</tr>
<tr>
<td>5</td>
<td>मेसर्स स्टेंडिंग थ्राइंडेक्स (प्राइवेट) लिमिटेड</td>
<td>विवांता (आ.प्र)</td>
<td>मुक्ता कृषि</td>
</tr>
<tr>
<td>6</td>
<td>मोर्गेन करिंग अक्सेटिस्ट्री लिमिटेड</td>
<td>मुवाच्वार (उड़ीसा)</td>
<td>कर्नाट पालन</td>
</tr>
<tr>
<td>7</td>
<td>मेसर्स चिंक गोल्ड ब्रिटिश एक्सपोर्ट लिमिटेड</td>
<td>रायगढ़ (महाराष्ट्र)</td>
<td>1,94,000</td>
</tr>
<tr>
<td>8</td>
<td>मेसर्स माँगनूर रिफाइनरिज व पेट्रोकम्युनिकल्स</td>
<td>मांगलूर</td>
<td>3,60,000</td>
</tr>
<tr>
<td>9</td>
<td>मेसर्स कुडंबुख अर्न्य एंड कंपनी लिमिटेड (के आई ओ मी एल)</td>
<td>मांगलूर</td>
<td>3,80,000</td>
</tr>
<tr>
<td>10</td>
<td>मेसर्स माइटर फेल्स लिमिटेड</td>
<td>हंदीराबाद</td>
<td>6,71,250</td>
</tr>
</tbody>
</table>

अनुसंधान परिणामों का प्रकाशन

पिछले वर्षों की तरह संस्थान द्वारा वैज्ञानिक लेखों का प्रकाशन इस साल में भी जारी रखा और निम्नलिखित प्रकाशन निकाले गये।

1. इंडियन जर्नल ऑफ फिशरीज वर्ड 43 सं. 1-3
2. सी एम एफ आर आई शिशु रक्षा प्रकाशन सं. 65
3. समस्त मात्स्यकी मृगाचा सेवा सं. 140-145
4. सी एम एफ आर आई न्यूजलेटर सं. 68-69, 70-71
5. सी एम एफ आर आई वैज्ञानिक रिपोर्ट 1995-96
6. अनुसंधान मुख्य अंश 1995-96
7. सी एम एफ आर आई विवरणिका (पुनर्मुद्रण)
8. विज्ञान -2020, सी एम एफ आर आई पेशेवरीय पतान
RESEARCH PAPERS PUBLISHED


KALADHARAN, P. AND S. KANDAN 1996. Primary production of Seaweeds in the


RADHAKRISHNAN NAIR, P.N., ALEXANDER KURIAN, C. MUTHIAH, S. LAZARUS, R. THIAGARAJAN, M. ZAFFAR KHAN AND


<table>
<thead>
<tr>
<th>Name &amp; Designation</th>
<th>Meeting/Symposium/Workshop etc.</th>
<th>Date/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. M. Devaraj, Director</td>
<td>Discussion with Deputy Director General (F) for finalization of World Bank National Agricultural Technology Project (NATP) at ICAR Headquarters, New Delhi Second meeting of the Committee on Marine Living Resources, Drugs and Chemicals at Indian Institute of Chemical Technology, Hyderabad Finalisation of IX Plan programme document of DOD and to participate in the discussion as a member of the High level Committee for implementing the recommendation of the Johl’s Committee report at NAARM, Hyderabad Inauguration of Summer Institute on Recent developments in Mariculture of molluscs at Tuticorin Second meeting of Evaluation Committee for Fishery Survey of India at Mumbai Meeting of ICAR Project Screening Committee of the Scientific Panel for Fisheries at New Delhi Preliminary meeting on State Fisheries Research Council at Commissionerate of Fisheries, Madras 13th Task Force meeting on aquaculture and marine biotechnology of Department of Biotechnology at New Delhi Standing Committee on Parliament on Science &amp; Technology, meeting of the Department of Ocean Development at New Delhi Symposium on ‘Fish genetics and Biodiversity Conservation for sustainable Fisheries development’. National Bureau of Fish Genetic Resources at Lucknow Review meeting of the Perspective Plan of CMFRI at ICAR, New Delhi Scientific colloquium for identifying collaborative projects for the mutual benefit of India and Australia at New Delhi Attended the Fourth Asian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Cochin</td>
<td>22 April 1996</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13-14 May 1996</td>
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<td>7 June 1996</td>
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<td>2-3 July 1996</td>
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<td>24 July 1996</td>
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<td>6-7 August 1996</td>
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<td>8-9 August 1996</td>
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<td>27 September 1996</td>
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<td></td>
<td></td>
<td>11 October 1996</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 October 1996 to 2 November 1997</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24-28 November 1997</td>
</tr>
</tbody>
</table>
Trainees attending the computer training programme organised by the TTC of CMFRI, at Cochin

The CMFRI Stall at the Pooram Festival at Trichur
Shri K. Jayaprakash Hegde
Hon'ble Minister for
Fisheries and ports,
Govt of Karnataka
speaking on the occasion
of the opensea mussel
harvest of CMFRI at
Byndoor, Karnataka.

Dr. E. G. Silas former
V.C of KAU and former
Director CMFRI
speaking at the function
of mussel harvest at
Dharmadam

CMFRI stall at the
Food Security
Expo 1996
organised jointly
by Rotary Club
of Madras East
and
M.S. Swaminathan
Research
Foundation
at Madras
<table>
<thead>
<tr>
<th>Name &amp; Designation</th>
<th>Meeting/Symposium/Workshop etc.</th>
<th>Date/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. V.N. Pillai</td>
<td>National Committee meeting on the amendment of CRZ Notification at Thiruvananthapuram</td>
<td>20-21 January 1999</td>
</tr>
<tr>
<td>Head, FEMD</td>
<td>Meeting of task force on Aquaculture and Marine Biotechnology of the Department of Biotechnology at New Delhi</td>
<td>22 January 1997</td>
</tr>
<tr>
<td></td>
<td>Interdisciplinary workshop on Biostatistics to deliver inaugural address on the topic 'Fish stock Assessment' at Manonmanian Sundaranar University</td>
<td>26 March 1997</td>
</tr>
<tr>
<td></td>
<td>NATP meetings at ICAR, New Delhi</td>
<td>22-24 April 1996</td>
</tr>
<tr>
<td></td>
<td>Workshop on Remote Sensing and its applications at CWRDM, Calicut</td>
<td>23-26 May 1996</td>
</tr>
<tr>
<td></td>
<td>ISRO Working group meeting on OCEANSAT at ISRO HQ, Bangalore</td>
<td>28-30 May 1996</td>
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<tr>
<td></td>
<td>GOOS meeting at NIO, Goa</td>
<td>18-20 July 1996</td>
</tr>
<tr>
<td></td>
<td>IRS P3 meeting at SAC, Ahmedabad</td>
<td>29 July 1996 to 2 August 1996</td>
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<tr>
<td></td>
<td>MARSIS - Validation meetings at CMFRI, Calicut</td>
<td>21-23 August 1996</td>
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<tr>
<td></td>
<td>Indo-US International Symposium on Remote Sensing at IIT, Bombay</td>
<td>5-10 October 1996</td>
</tr>
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<td></td>
<td>GOOS/IOCINDIO meetings at NIO, Goa</td>
<td>17-23 November 1996</td>
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<tr>
<td></td>
<td>Planning Board meeting at Trivandrum</td>
<td>31 December 1996 to 1 January 1997</td>
</tr>
<tr>
<td></td>
<td>MARSIS meetings and discussions at NRSA, Hyderabad</td>
<td>16-21 February 1997</td>
</tr>
<tr>
<td></td>
<td>Board of Examiners meeting at Calicut</td>
<td>27-28 February 1997</td>
</tr>
<tr>
<td>Dr. V. Sriramachandra Murty. Head, DFD</td>
<td>Meeting of the Project Management Committee for establishment of oceanarium at Goa, held at Dept. of Ocean Development, New Delhi</td>
<td>10 July 1996</td>
</tr>
<tr>
<td></td>
<td>Review meeting of the Perspective Plan of CMFRI at ICAR, New Delhi</td>
<td>11 October 1996</td>
</tr>
<tr>
<td></td>
<td>Fourth Indian Fisheries Forum; chaired the Technical Session on ornamental fish organised by Asian Fisheries Society, Indian Branch at Cochin</td>
<td>24-28 November 1996</td>
</tr>
<tr>
<td></td>
<td>Nansen International Workshop on integrated coastal ecosystem studies; School of Marine Sciences, CUSAT, Cochin</td>
<td>25-27 February 1997</td>
</tr>
<tr>
<td>Name &amp; Designation</td>
<td>Meeting/Symposium/Workshop etc.</td>
<td>Date/s</td>
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</tr>
<tr>
<td>Dr. G. Sudhakara Rao</td>
<td>Nansen International Workshop on integrated coastal ecosystem studies; School of Marine Sciences, CUSAT, Cochin</td>
<td>25-27 February 1997</td>
</tr>
<tr>
<td>Head, CFD</td>
<td>Seminar on shrimp diseases prevention and control — organised by MPEDA, Cochin &amp; ADAK, Kerala</td>
<td>10 April 1996</td>
</tr>
<tr>
<td></td>
<td>Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Cochin</td>
<td>24-28 November 1996</td>
</tr>
<tr>
<td>Dr. N. G. K. Pillai</td>
<td>Nansen International Workshop on Integrated Coastal Ecosystem studies; School of Marine Sciences, CUSAT, Cochin</td>
<td>25-27 February 1997</td>
</tr>
<tr>
<td>Head, PFD</td>
<td>Seminar on shrimp farming - disease and remedy - organised jointly by MPEDA, ADAK and BFFDA at Cochin and presented a paper</td>
<td>10 April 1996</td>
</tr>
<tr>
<td></td>
<td>Gulf Malayalee meeting organised by Indo-Arab Confederation and Kerala State Inland Fish Farmers Association, at Kollam and gave a talk on possibilities of oyster and mussel farming in Kerala</td>
<td>23 October 1996</td>
</tr>
<tr>
<td>Dr. K. K. Appukuttan</td>
<td>Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Cochin</td>
<td>24-28 November 1996</td>
</tr>
<tr>
<td>Head, MFD</td>
<td>Inaugurated the Oyster Farming Training organised by the Kerala State Inland Fish Farmers Association, Kollam funded by MPEDA</td>
<td>2 December 1996</td>
</tr>
<tr>
<td></td>
<td>Meeting to discuss and formulate policies for 'Janakeeya Matsyakrishi' organised by Kerala State Government at Trivandrum under the Chairmanship of Hon'ble Minister of Fisheries</td>
<td>4 January 1997</td>
</tr>
<tr>
<td></td>
<td>Gave special lecture on Recent Advances in Molluscan Aquaculture in India at Mangalore</td>
<td>12 February 1997</td>
</tr>
<tr>
<td></td>
<td>Meeting at Kollam organised by Kerala State Fisheries Department on the occasion of inaugura-</td>
<td>28 February 1997</td>
</tr>
<tr>
<td></td>
<td>tion of District level training programme on aquaculture for farmers in connection with 'Janakeeya Matsyakrishi' a scheme launched by the Govt. of Kerala - Presided over the function</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meeting at Kollam organised by the Kerala State Inland Fish Farmers Association in connection with inauguration of oyster farming training at Kollam funded by State Small-scale Industries Department - presided over the function</td>
<td>20 March 1997</td>
</tr>
<tr>
<td></td>
<td>Nansen International Workshop on Integrated Coastal Ecosystem Studies; School of Marine Sciences, CUSAT</td>
<td>25-27 February 1997</td>
</tr>
<tr>
<td>Name &amp; Designation</td>
<td>Meeting/Symposium/Workshop etc.</td>
<td>Date/s</td>
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<td>-----------------------------</td>
</tr>
<tr>
<td>Dr. C. Suseelan Sr. Scientist</td>
<td>Southern Regional Workshop on “Traditional Food Products and Technologies” at Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University) at Coimbatore Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Cochin 20th meeting of Academic Council of CIFE (Deemed University) at CIFE, Mumbai</td>
<td>31 July 1996 24-28 November 1996 20 September 1996</td>
</tr>
<tr>
<td>Dr. Krishna Srinath Sr. Scientist</td>
<td>Attended meeting convened by the Fisheries Minister regarding Janakeeya Matsya Krishi, at Dept. of Fisheries, Trivandrum Delivered a lecture on experiments and experiences in rural development officials, Institute of Management of Government at Cochin Seminar on prawn farming in pokkali fields organised by the Kerala State Fisheries Department at Cochin The All India Radio Rural Programme Advisory Committee Meeting at All India Radio, Trichur</td>
<td>4 January 1997 30 January 1997 6 February 1997 4 March 1997</td>
</tr>
<tr>
<td>Dr. N. Sridhar Scientist (SS)</td>
<td>The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Kochi</td>
<td>24-28 November 1996</td>
</tr>
<tr>
<td>Dr. (Mrs) Manpal Sridhar Scientist (SS)</td>
<td>The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Kochi</td>
<td>24-28 November 1996</td>
</tr>
<tr>
<td>Dr. P. Kaladharan Scientist (SS)</td>
<td>The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Kochi</td>
<td>24-28 November 1996</td>
</tr>
<tr>
<td>Name &amp; Designation</td>
<td>Meeting/Symposium/Workshop etc.</td>
<td>Date/s</td>
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<tr>
<td>--------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Shri A.N. Mohanan Technical Officer</td>
<td>Gave a talk on &quot;Training facilities to impart scientific prawn farming&quot; in Malayalam and broadcast over all India Radio, Trichur</td>
<td>23 March 1997</td>
</tr>
</tbody>
</table>
| Dr. V.S.K. Chennubhotla Principal Scientist | The expert meeting on "Introduction of exotic aquatic species in Indian waters" at NBFGR, Lucknow  
Delivered a lecture on "Seaweed culture" for the benefit of bank officers at SBIRD, Hyderabad  
The meeting organised by the Institute of Development and Planning Studies on "Coastal Aquaculture in Visakhapatnam District" at Visakhapatnam  
The meeting organised by the Andhra Pradesh State Fisheries Department on "Preventive measures on jelly fish attack" at Visakhapatnam  
Delivered a lecture on "Seaweed culture" at a refresher course programme of the Academic Staff College, Andhra University, Visakhapatnam  
Gave a talk on "Mariculture Potentials of Andhra Pradesh coast" All India Radio, Visakhapatnam  
Gave a lecture on "Aquaculture and its economics" at the workshop for officers of Anticorruption Bureau at Visakhapatnam  
Chaired the session on "Seaweed Culture Technology" in connection with the Aquaculture Week organised by the Aquaculture Foundation of India at Mandapam Camp  
Chaired the session on Marine Algae at the National Symposium on Marine Algae and delivered a special invitation lecture at Andhra University, Visakhapatnam  
| Dr. V.S.K. Chennubhotla, Principal Scientist & Dr. G. Syda Rao, Sr. Scientist | Delivered lectures on "Seaweed culture" and "Pearl oyster culture" respectively, at an entrepreneur meeting organised by the State Bank Institute of Rural Development at Visakhapatnam  
The counselling session for Seaweed culture and onshore pearl culture respectively in connection with the Aquaculture Week organised by the Aquaculture Foundation of India at Vijayawada                                                                                                                                 | 25 May 1996, 26 January 1997 |
<table>
<thead>
<tr>
<th>Name &amp; Designation</th>
<th>Meeting/Symposium/Workshop etc.</th>
<th>Date/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. V.S.K. Chennubhotla, Dr. G. Syda Rao, Shri K.M.S. Ameer Hamsa, Shri K. Vijayakumaran and Ms. Shoba Viswanathan</td>
<td>The inaugural session of the Workshop on “Wood for Marine Structure and Craft” organised by the Institute of Wood Science and Technology, Bangalore at Visakhapatnam</td>
<td>10 February 1997</td>
</tr>
<tr>
<td>Dr. V.S.K. Chennubhotla, Principal Scientist and Dr. G. Syda Rao, Sr. Scientist</td>
<td>The inaugural function of the “International Seminar on Mangrove Ecosystems” organised by the Dept. of Zoology, Andhra University at Hotel Taj Residency, Visakhapatnam</td>
<td>26 March 1997</td>
</tr>
<tr>
<td>Dr. K. Satyanarayana Rao, Principal Scientist</td>
<td>Gave a lecture on “Mollusc Culture” at a refresher course programme of the Academic Staff College, Andhra University at Visakhapatnam</td>
<td>15 November 1996</td>
</tr>
<tr>
<td>Shri K. Vijayakumaran, Scientist (SS)</td>
<td>Delivered a lecture on “Turtle conservation and the US embargo on shrimp imports” at the meeting of the Forum of Fisheries Professionals at Visakhapatnam</td>
<td>12 June 1996</td>
</tr>
<tr>
<td></td>
<td>Participated as a panel member in the Discussion on Deep-Sea Fishing Policy organised by the Forum of Fisheries Professionals at Visakhapatnam</td>
<td>17 July 1996</td>
</tr>
<tr>
<td></td>
<td>Participated in the Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch and presented a paper.</td>
<td>24-28 November 1997</td>
</tr>
<tr>
<td>Dr. K.K. Sukumaran, Sr. Scientist</td>
<td>The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Kochi</td>
<td>24-28 November 1996</td>
</tr>
<tr>
<td>Dr. C. Muthiah, Sr. Scientist &amp; Dr. P.K. Krishnakumar, Scientist (SS)</td>
<td>The National Seminar on Coastal Zone Environment Management: An appraisal of the Contemporary Research and Development organised by the Mangalore University, Mangalore and presented a paper.</td>
<td>12-14 February 1997</td>
</tr>
<tr>
<td>Shri M. Sivadas Scientist (SS)</td>
<td>The Summer Institute on molluscan mariculture organised by CMFRI, at Tuticorin.</td>
<td>May-June 1996</td>
</tr>
<tr>
<td></td>
<td>The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch at Kochi</td>
<td>24-28 November 1996</td>
</tr>
<tr>
<td>Dr. A.K.V. Nasser Scientist</td>
<td>The National Seminar on Recent Advances in Biological Oceanography at NIO, Goa</td>
<td>29 May 1996</td>
</tr>
<tr>
<td></td>
<td>The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian Branch, at Kochi</td>
<td>24-28 November 1996</td>
</tr>
<tr>
<td>Shri P.P. Manojkumar Scientist</td>
<td>Consultative Group Meeting of FSI at Porbandar</td>
<td>29 May 1996</td>
</tr>
<tr>
<td>Name &amp; Designation</td>
<td>Meeting/Symposium/Workshop etc.</td>
<td>Date/s</td>
</tr>
<tr>
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</tr>
<tr>
<td>Dr. B. Manojkumar, Shri P.P. Manojkumar, and Shri A.P. Dinesh Babu, Scientists</td>
<td>Workshop on Fishery Resources Potential and Scope for Deepsea fishing off Gujarat at Fisheries Survey of India, Porbander, Veraval</td>
<td>23 October 1996</td>
</tr>
<tr>
<td>Dr. K.K. Joshi and Shri A.P. Dinesh Babu, Scientists</td>
<td>Ninth Five Year Plan meeting of Gujarat State Fisheries at Gandhinagar</td>
<td>4 October 1996</td>
</tr>
<tr>
<td>Dr. V.V. Singh, Scientist (SS)</td>
<td>Consultative Group meeting at FSI, Bombay</td>
<td>15 May 1996</td>
</tr>
<tr>
<td></td>
<td>National Seminar on Fisheries Education at CIPE, Bombay</td>
<td>23-24 May 1996</td>
</tr>
<tr>
<td></td>
<td>National Seminar on Recent Advances in Biological Oceanography at NIO, Goa</td>
<td>29-31 May 1996</td>
</tr>
<tr>
<td></td>
<td>Pre-Vocational Workshop for Agricultural Courses (Aquaculture) at Central Institute of Vocational Education, Bhopal</td>
<td>16 June 1996 to 20 September 1996</td>
</tr>
<tr>
<td>Dr. P.V. Sreenivasan and Shri R. Sarvesan Sr. Scientists</td>
<td>Summer Institute on Recent Advances in Molluscan Culture as Faculty Members at Tuticorin</td>
<td>May 1996</td>
</tr>
<tr>
<td>Dr. R. Paul Raj and Dr. E. Vivekanandan, Sr. Scientists</td>
<td>Meeting of the Adhoc Board of Studies in M.Sc. Aquaculture at the University of Madras at Madras</td>
<td>25 July 1996</td>
</tr>
<tr>
<td>Dr. R. Paul Raj Sr. Scientist</td>
<td>National Seminar on Corporate and Industry Competitiveness - Sector: Marine Products Organised by the Administrative Staff College of India, Hyderabad at Connemara Hotel, Madras</td>
<td>26 July 1996</td>
</tr>
<tr>
<td></td>
<td>Commemoration Day programme relating to the JRD Tata Biotechnology Centre organised by M.S. Swaminathan Research Foundation at Madras</td>
<td>29 July 1996</td>
</tr>
<tr>
<td></td>
<td>Meeting on the coastal zone management plan for Tamil Nadu organised by the Town and Country Planning Dept., Govt. of Tamil Nadu at Madras</td>
<td>January 1997</td>
</tr>
<tr>
<td></td>
<td>National Aquaculture Week and presented a paper in the Workshop sponsored by Dept. of Biotechnology, Govt. of India at Vijayawada</td>
<td>24-26 January 1997</td>
</tr>
<tr>
<td></td>
<td>National Aquaculture Week at Madras and presented a paper</td>
<td>31 January 1997 to 1 February 1997</td>
</tr>
<tr>
<td></td>
<td>Seminar on “Ways and Means of operationalizing fisheries management at the Bay of Bengal Programme of FAO at Madras</td>
<td>18 February 1997</td>
</tr>
<tr>
<td>Dr. R. Paul Raj and Dr. M. Rajagopalan Sr. Scientists</td>
<td>Workshop on ‘Biodiversity, Conservation, Prioritisation programme - Coastal Areas at the M.S. Swaminathan Research Foundation at Madras</td>
<td>18 November 1996</td>
</tr>
<tr>
<td>Name &amp; Designation</td>
<td>Meeting/Symposium/Workshop etc.</td>
<td>Date/s</td>
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</tr>
<tr>
<td>Dr. M. Rajagopalan, Sr. Scientist</td>
<td>Workshop on National Agriculture Technology Project: Planning (NATP) at TNUVAS, Madras</td>
<td>29-30 November 1996</td>
</tr>
<tr>
<td></td>
<td>National Seminar on livestock industry for self gainful employment organised by ISAPM at TNUVAS, Madras</td>
<td>September 1996</td>
</tr>
<tr>
<td></td>
<td>Northern Indian Ocean Sea Turtle Workshop at Bhubaneswar</td>
<td>13-18 January 1997</td>
</tr>
<tr>
<td>Dr. P. Nammalwar, Sr. Scientist</td>
<td>Regional Seminar on Conservation of Coral Reefs in Gulf of Mannar region at Tuticorin</td>
<td>21-22 Sept. 1996</td>
</tr>
<tr>
<td></td>
<td>National Aquaculture Week and presented papers at Madras &amp; Tuticorin</td>
<td>January and February 1997</td>
</tr>
<tr>
<td></td>
<td>International Workshop cum Seminar on Bioethics and presented a paper organised by the Dept. of Zoology, University of Madras at Madras</td>
<td>16-19 January 1997</td>
</tr>
<tr>
<td>Dr. M. Vijayakumaran, Sr. Scientist</td>
<td>Fifth International Conference and Workshop on Lobster Biology and Management and made 3 oral presentations at Queenstown, New Zealand</td>
<td>9-14 February 1997</td>
</tr>
<tr>
<td>Shri K. Dorairaj, Principal Scientist</td>
<td>Organisation Committee Meeting on National Aquaculture Week at Aquaculture Foundation of India at Madras</td>
<td>5 November 1996</td>
</tr>
<tr>
<td></td>
<td>Workshop on Coastal Regulation Zone of Tamil Nadu Coast at Anna University, Madras</td>
<td>29 January 1997</td>
</tr>
<tr>
<td></td>
<td>Meeting on Working Group of Fisheries for the formulation of IX Five Year Plan at State Planning Commission at Madras</td>
<td>30 January 1997</td>
</tr>
<tr>
<td></td>
<td>Seminars of the National Aquaculture Week conducted by the Aquaculture Foundation of India and presented papers at Vijayawada and Tuticorin</td>
<td>January and February 1997</td>
</tr>
<tr>
<td>Shri K. Dorairaj, Principal Scientist</td>
<td>Participated in the meeting on &quot;Development of GIS Based Information System for critical habitats in the coastal and marine areas in India&quot; sponsored by Dept. of Ocean Development, New Delhi at Institute of Ocean Management, Madras</td>
<td>30 December 1996</td>
</tr>
<tr>
<td>Dr. E. Vivekanandan and Dr. M. Rajagopalan, Sr. Scientists</td>
<td>Participated in the National Aquaculture Week at Madras, Mandapam Camp &amp; Tuticorin</td>
<td>January &amp; February 1997</td>
</tr>
<tr>
<td>Shri R. Marichamy, Principal Scientist</td>
<td>Delivered a guest lecture at St. Joseph's College on Resources of Marine Cultivable Organisms at Trichy</td>
<td>February 1997</td>
</tr>
<tr>
<td>Dr. D. B. James, Sr. Scientist</td>
<td>Gave felicitation address at the Inauguration of B.Sc. Zoology with industrial fish and fisheries vocational course at Kamaraj College, Tuticorin</td>
<td>11 September 1996</td>
</tr>
<tr>
<td>Name &amp; Designation</td>
<td>Meeting/Symposium/Workshop etc.</td>
<td>Date/s</td>
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</tr>
<tr>
<td>Shri S.Dharmaraj Sr. Scientist</td>
<td>Delivered inaugural address at Regional Seminar on Conservation of Coral Reefs in the Gulf of Mannar, organised by the P.G. Department of Zoology at Kamaraj College, Tuticorin Seminar on Sustainable environment organised by Madurai Kamaraj University, Madurai at Tuticorin</td>
<td>20 September 1996</td>
</tr>
<tr>
<td></td>
<td>Gave guest lecture on World Food Day Theme 'Fighting Hunger and Malnutrition' organised by Fisheries College &amp; Research Institute at Tuticorin</td>
<td>16 October 1996</td>
</tr>
<tr>
<td></td>
<td>The Fourth Indian Fisheries Forum School of Marine Sciences, CUSAT, Cochin and presented a paper</td>
<td>24-28 November 1996</td>
</tr>
<tr>
<td></td>
<td>The National Conference on Aquaculture organised by the Centre of Aquaculture Research and Extension, Department of Zoology, St.Xavier's College and presented a paper at Palayamkottai</td>
<td>18 December 1996</td>
</tr>
<tr>
<td></td>
<td>The National Aquaculture Week workshop organised by the Aquaculture Foundation of India at Tuticorin</td>
<td>7 February 1997</td>
</tr>
<tr>
<td>Shri S.Dharmaraj</td>
<td>Served as a Faculty Member in the Summer Institute on Recent Developments in mariculture of molluscs at Tuticorin</td>
<td>20 May 1996 to 8 June 1996</td>
</tr>
<tr>
<td>and Shri A. Chellam</td>
<td>Delivered lecture on Culture of commercially important molluscs in the Seminar conducted by St. Mary's College at Tuticorin</td>
<td>24 February 1997</td>
</tr>
<tr>
<td>Sr. Scientists</td>
<td>The Fourth Indian Fisheries Forum organised by Asian Fisheries Society, Indian branch at Cochin and presented two research papers</td>
<td>24-28 November 1996</td>
</tr>
<tr>
<td></td>
<td>Participated and delivered lecture on Marine Pearl culture hatchery at the National Aquaculture Week at Tuticorin</td>
<td>February 1997</td>
</tr>
<tr>
<td>Shri S.Dharmaraj</td>
<td>14th Task Force Meeting of DBT at New Delhi</td>
<td>22 January 1997</td>
</tr>
<tr>
<td>and Shri A. Chellam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sr. Scientists</td>
<td>Shri M. Feroz Khan, Scientist</td>
<td>5 July 1996</td>
</tr>
<tr>
<td></td>
<td>Delivered a talk on “What Oceanic Wealth” and broadcast through All India Radio, Calicut</td>
<td></td>
</tr>
<tr>
<td>Shri G.Subbaraju Principal Scientist</td>
<td>Workshop on “Problems and prospects in implementation of post harvest activities at Kakinada</td>
<td>16 October 1996</td>
</tr>
<tr>
<td>Dr.P.A. Thomas</td>
<td>Meeting of the Task Force on Fisheries Research, Education and Training; State Planning Board, Govt. of Kerala for formulating 9th Plan proposals at Trivandrum</td>
<td>15 November 1996</td>
</tr>
<tr>
<td>and Shri G.P.K. Achary, Senior Scientists</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name &amp; Designation</td>
<td>Meeting/Symposium/Workshop etc.</td>
<td>Date/s</td>
</tr>
<tr>
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</tr>
<tr>
<td>Dr. P.A. Thomas, Shri K. Prabhakaran Nair, Senior Scientists and Shri K.K. Philipose, Scientist (SS)</td>
<td>Meeting of the Task Force on Aquaculture; State Planning Board, Govt. of Kerala for formulating 9th Plan proposals at Trivandrum</td>
<td>18 November 1996</td>
</tr>
<tr>
<td></td>
<td>Meeting on Programme for Janakeeya Matsya Krish, sponsored by Govt. of Kerala, Trivandrum</td>
<td>4 January 1997</td>
</tr>
<tr>
<td></td>
<td>Second Executive Committee of the Centre for Development and Transfer of Mariculture Technologies (CDTMT), Vizhinjam, Trivandrum</td>
<td>24 December 1996</td>
</tr>
<tr>
<td>Shri K.K. Philipose, Scientist (SS)</td>
<td>The Executive Committee Meeting of Kerala Fisheries Society at Trivandrum</td>
<td>27 March 1996</td>
</tr>
<tr>
<td></td>
<td>Inaugural function of the Lobster Fattening Programme started by M/s A.R. Rahman at Vizhinjam</td>
<td>28 June 1996</td>
</tr>
<tr>
<td></td>
<td>Meeting on Artificial Reef Programme, organised by Secretary, Dept. of Fisheries, Govt. of Kerala, Trivandrum</td>
<td>19 August 1996</td>
</tr>
<tr>
<td></td>
<td>Workshop on “Coastal Zone Management” at Trivandrum</td>
<td>12 September 1996</td>
</tr>
<tr>
<td></td>
<td>Gave a talk on “Role of Poovar Artificial Reefs in the Regeneration of Depleted Marine Resources” at Loyola Social Service, Poovar</td>
<td>31 January 1997</td>
</tr>
<tr>
<td></td>
<td>Policy Planning Meeting on Artificial Reefs at Loyola Social Service, Poovar</td>
<td>31 January 1997</td>
</tr>
<tr>
<td>G. Maheswarudu, Scientist</td>
<td>Executive Committee Meeting of the Kerala Fisheries Society at Trivandrum</td>
<td>1 March 1997</td>
</tr>
<tr>
<td></td>
<td>National Aquaculture week 1997 organised by Aquaculture Foundation of India at Mandapam</td>
<td>February 1997</td>
</tr>
<tr>
<td>Josileen Jose, Scientist</td>
<td>National Aquaculture week 1997 organised by Aquaculture Foundation of India at Mandapam</td>
<td>February 1997</td>
</tr>
</tbody>
</table>
VISITORS

COCHIN

Shri T.K. Ramakrishnan, Hon’ble Minister for Fisheries & Culture, Govt. of Kerala

Shri G.S. Sahni, IAS, Joint Secretary, Department of Agricultural Research & Education & Secretary, ICAR, New Delhi

Shri Bharat Bhushan, IAS, Director, Ministry of Commerce

Dr. N.K. Tyagi, Director, C.S.S.R.I., Karnal

Dr. M. Aslam, Director, DARE, New Delhi

Dr. K.V. Devaraj, former Vice Chancellor, UAS, Bangalore

Dr. Hassani Kongkeo, Co-ordinator, Network of Aquaculture Centres in Asia Pacific, Bangkok

Dr. M.V. Gupta, Director, International Relations, ICLARM, Manila, Philippines

Dr. Emmanuel O. ITA, Asst. Director, National Institute for Freshwater Fisheries Research, Nigeria

Dr. Agnes M. Ajaria, Asst. Director (Extension), National Institute for Oceanography and Marine Research, Nigeria

Dr. Bernard Ezenwa, Asst. Director (Aquaculture), National Institute for Oceanography and Marine Research, Nigeria

Dr. M. Ather Ali, Biol. Udem. CP 6128, Montreal, Canada

Dr. Meryl J. Williams, Director General, International Center for Living Aquatic Resources Management, Philippines

Dr. Martin Kumar, Sr. Scientist, South Australia Research and Development Institute, South Australia

Shri C.K. Neelakanta Raj, Secretary, Dept. of Animal Husbandry and Fisheries, Govt. of Karnataka, Bangalore

Shri S.K. Mathur, Ambassador of India to Federal Republic of Yugoslavia

Dr. Purwito Marto Subroto, Fishery Resources Officer, FAO, Rome

Dr. H. Hasserth Zadick Sakafi, Director, Oman Fisheries Research Centre

Dr. S.C. Pathak, Deputy General Manager, NABARD, Bombay

Dr. Bernard Robert Smith, Co-ordinator, ACIAR, Australia

Dr. K. Alagarswami, Director, CIBA, Madras

Dr. S. Ayyappan, Director, CIFA, Bhubaneswar

Dr. Y.S. Yadava, Fisheries Development Commissioner, Govt. of India, New Delhi

Dr. P.V. Dehadrai, Deputy Director General (Fisheries), ICAR, New Delhi

Dr. R.S. Paroda, Director General, ICAR and Secretary, DARE, New Delhi

Dr. A.K. Bandyopadhyay, Director, CARI, Port Blair

VERAVAL

Shri P.K. Valera, Commissioner of Fisheries, Govt. of Gujarat, Gandhinagar

Shri N.G. Akolkar, Lecturer, College of Fisheries, Veraval
Shri V.S. Somavanshi, Director General, Fishery Survey of India, Mumbai

Mrs. Poonam Prakash, Asstt. Professor, College of Fisheries, Dhouli, Bihar

Shri Jayadeva Prasad, Operations Manager, Hindustan Lever Ltd., Chorwad, Taluka, Veraval

Dr. Srinivasa Jahageerlan, Scientist, CIFE, Mumbai

Dr. S. Shanmugham Principal Scientist, NAARM, Hyderabad

Ms. Fahmeeda Hanfee, Sr. Project Officer, WWF, New Delhi

Shri H.N. Upadhyay, Dy. Director (Statistics), Govt. of Gujarat, Gandhinagar

**BOMBAY**

Dr. Kamarul Hassan and other professors along with group of students from B.N.N. College, Bhiwandi, Dist: Thane

Dr. A.D. Diwan, Dr. Moniuddin Iftekar, Scientists from CIFE, Mumbai

Dr. Mathili Rao and Dr. Snehalata A. Gaikwad, Reader and Research Guide in Zoology from Ramnarain Ruia College, Mutunga, Mumbai

Dr. K.A. Dongre, Dy. Director (Fisheries), Maharashtra State, Mumbai alongwith 12 Asstt. Fisheries Development Officers of the Fisheries Department

**MANGALORE**

Shri V.V. Sathypalan, Malabar Aqua Forum, Forum Manager, Manjeshwar

Shri Sreekanta Sarkar, College of Fisheries, Mangalore

Dr. V. Hariharan, Professor & Head of Dept., Fishery Oceanography, College of Fisheries, Mangalore

**VIZHINJAM**

Shri P. Arunkumar, V.I.P. Export, Thiruvananthapuram

Shri K. Reji Mathew, MPEDA, Vallarpadam, Kochi

Dr. G. Crowther, Dr. R. Wright and Dr. M. Joseph, Perth, Australia

Shri B. Afzal, Govt. V.H.S.S., Poovar

Dr. K. Kathiresan and Dr. K. Patterson, Annamalai University, Porto Novo

Dr. K. Larsen, Esperas, Norway

Dr. S. Jones, Director, Polio Home, Thiruvananthapuram

Dr. Meryl J. Williams, ICLARM, Philippines

Dr. M.V. Gupta, ICLARM, Philippines

Dr. Martin Kumar, SARDI. Aquatic Sciences, South Australia

Shri G.H. Manikfan, Director of Fisheries, Lakshadweep

Shri Eapan Zakariah, Vidyanagar, Kochi

Dr. V.A. Vijayan and Group of students, Dept. of Zoology, University of Mysore

Shri K.K. Bajpai, Secretary, ASRB, New Delhi

Dr. P.V. Dehadrai, DDG (Fy), ICAR, New Delhi

Dr. Y.S. Chauhan, Sr. Scientist, NIO, Goa

Shri S.K. Mathur, Deputy Secretary, Ministry of Environment, New Delhi

Dr. P.P. Kaimal, Director, SALS, M.G. University, Pathanamthitta

Dr. P.S. Parameswaran, Scientist, NIO, Goa

Dr. B. Victor, Dept. of Zoology, St. Xavier's College, Palayamkottai
Dr. G. Sivaleela, ZSI, Port Blair
Dr. A.G. Ponniah, Director, NBFG, Lucknow
Prof. D. Venkata Rao and Party, Dept. of Pharmaceutical Sciences, Andhra University, Visakhapatnam
Shri Ignacious Dominic and Shri P. Arunkumar, International Exports, Madurai

**TUTICORIN**
Dr. M.S. Swaminathan, Chairman, M.S. Swaminathan Research Foundation, Taramani, Madras
Rev. Jason S. Dharmaraj, CSI Bishop in Tirunelveli, Tirunelveli
Shri K.K. Bajpai, Secretary, ASRB, New Delhi
Trainees from Staff Training Institute, Aquaculture Trainees Tamil Nadu Fisheries Dept., Tuticorin
Dr. R.P. Burman, Zoological Survey of India, Calcutta
Shri S.K. Singh, Dy. Commandant, Coast Guard, Tuticorin
Mr. William A. Cabill, Fort Selonga Farm, New York
Shri T.S. Sruthigirinathan, Audit Officer, AG's Office, Madras

**KAKINADA**
Shri N. Jaggaraju, Joint Director of Fisheries, A.P.
Smt. J. Suryakumari with students of A.M.G. College, Chilakaluripet

Shri J.V.S. Prasad, District Collector, East Godavari District, A.P.
Shri Bhavanisankar, Additional Director of Fisheries, A.P.
Shri M. Rajitha & students from College of Fishery Science Nellore (A.P.)
Shri Hans Andersen, Director, H. Andersen Consultancy, Switzerland
Shri Hans A. Fonnesbech, Atlas Industries A/S, Denmark
Shri O.P. Srivastava, Director, East Coast Boat Builders and Engineers Ltd., New Delhi

**VISAKHAPATNAM**
Mr. Ansen Ward, Fishery Technologist and Ms. Victoria Papadopulos, Senior Economic Research Officer, National Resource Institute, Chatham (Kent), U.K.
Dr. M. Sakthivel, President, Aquaculture Foundation of India, Madras
Shri G.S. Sahni, IAS, Secretary, ICAR and Joint Secretary, DARE, Ministry of Agriculture, Govt. of India
Dr. P.S.R. Anjaneyalu, Reader, Nagarjuna University with M.Sc. Aquaculture students
Dr. K. Radhakrishna, Former, ADG, ICAR
Shri O.P. Srivastava, Director, East Coast Boat Builders and Engineering Ltd., New Delhi; Mr. Hans Andersen, Director, H. Andersen Consultancy, Denmark and Mr. Hans Fonnesbech, ATLAS, Denmark
# CMFRI Staff List as on 31.3.1997
(Not a gradation list)

Dr. M. Devaraj
Director

**Division Wise List of Scientists / Technical Staff**

### 1. Fishery Environment and Management Division

**Scientific**

| Dr. V. Narayana Pillai, Head of Division |
| Dr. V.S.K. Chennubhotla | PS |
| Shri G. Subbaraju | PS |
| Dr. C.S.G. Pillai | PS |
| Dr. P.A. Thomas, Sr. Sci. |
| Dr. V. Kunjukrishna Pillai, Sr. Sci. |
| Dr. C.P. Gopinathan | Sr. Sci. |
| Dr. K.J. Mathew, Sr. Sci. |
| Dr. K. Rengarajan | Sr. Sci. |
| Dr. N. Kaliaperumal | Sr. Sci. |
| Dr. M. Rajagopal | Sr. Sci. |
| (Mrs.) V. Chandrika | Sr. Sci. |
| Dr. S. S. Muthusamy | Sr. Sci. |
| Shri S. Krishna Pillai | Sr. Sci. |
| Shri R.N. Misra | Sr. Sci. |
| Shri G.S. Daniel Selvaraj | Sr. Sci. |
| Shri Pon Siraimeetan | Sr. Sci. |
| Smt. Rany Mary George | Sr. Sci. |
| Shri K.G. Girijavallabhan | Sr. Sci. |
| Smt. T.S. Naomi, Sci.(SS) |
| Dr. P. Kaladharan, Sci.(SS) |
| Dr. P.K. Krishnakumar, Sci.(SS) |
| Smt. Molly Varghese, Sci.(SS) |
| Dr. Veerendra Veer Singh, Sci.(SS) |
| Smt. Reeta Jayasankar, Sci.(SS) |
| Shri K. Vijayakumar, Sci.(SS) |
| Smt. S. Jasmine, Sci.(SS) |
| Miss Asha | Sci. |
| Shri Gulshad Mohamed | Sci. |

**Technical**

| Shri M. Ayyappan Pillai | TO(T-5) |
| Shri V.K. Balachandran | TO(T-5) |
| Smt. K.S. Leelabhai | TO(T-5) |
| Smt. Geetha Antony | TO(T-5) |
| Shri R. Vasanthakumar | TO(T-5) |
| Shri A. Nandakumar | TO(T-6) |
| Shri N. Palaniswamy | STA(T-4) |
| Smt. K.K. Valsala | TA(T-II-3) |
| Shri L.R. Khambadkar | TA(T-II-3) |
| Shri K. Solaman | JTA-T-2 |
| Smt. P.M. Geetha | Museum Asstt. T-2 |
| Shri V.A. Kunhikoya | TA(T-II-3) |
| Shri A. Anasukoya | FA-T-1 |
| Shri S. Kalimuthu | TO-T-5 |
| Shri C. Kasinathan | TO-T-5 |
| Dr. K. Muniyandi | STA-T-4 |
| Shri J.R. Ramalingam | TA-T-II-3 |
| Shri K. Diwakar, | TA-T-II-3 |
| Shri A. Palanichamy | FA-T-1 |
| Shri L. Jayasankaran | TA-T-II-3 |
| Shri A. Ahmed Kamal Basha | TA-T-II-3 |
| Shri J.X. Rodrigo | STA-T-4 |
| Shri M. Selvaraj | TA-T-II-3 |
| Shri S. Rajapackiam | TA-T-II-3 |
| Shri S. Natarajan | TO-T-8 |
| Shri K. Chittibabu | STA-T-4 |
| Shri B.S. Ramachandrudu | TO-T-8 |
| Shri Vasam Shetty Abbulu | TO-T-8 |
| Shri G. Subramanya Bhat | TA-T-II-3 |
| Shri N.P. Kunhi.krishnan | TO-T-8 |
| Shri K.P. Viswanathan | TA-T-II-3 |
| Smt. P. Swarnalatha | TA-T-I-3 |
| Shri M.P. Sivadasan | TA-T-I-3 |
| Shri C. Chandran | FA-T-1 |
| Shri R. Anilkumar | FA-T-1 |
| Shri Sujit. S.K. | FA-T-1 |
| Shri Narayan G. Vaidya | JTA-T-2 |

### 2. Molluscan Fisheries Division

**Scientific**

| Dr. K.K. Appukuttan, Head of Division |
| Dr. K. Sathyanarayana Rao, PS |

| Shri B.S. Ramachandrudu | TO-T-8 |
| Shri Vasam Shetty Abbulu | TO-T-8 |
| Shri G. Subramanya Bhat | TA-T-II-3 |
| Shri N.P. Kunhi.krishnan | TO-T-8 |
| Shri K.P. Viswanathan | TA-T-II-3 |
| Smt. P. Swarnalatha | TA-T-I-3 |
| Shri M.P. Sivadasan | TA-T-I-3 |
| Shri C. Chandran | FA-T-1 |
| Shri R. Anilkumar | FA-T-1 |
| Shri Sujit. S.K. | FA-T-1 |
| Shri Narayan G. Vaidya | JTA-T-2 |
Dr. K.A. Narasimham  PS  Shri P. Soosai V. Rayan,  -do-
Dr. P.S. Kuriakose  PS  Shri N. Jesuraj,  -do-
Dr. A.C.C. Victor  Sr. Sci.  Shri P. Muthukrishnan  -do-
Dr. Kuber Vidyasagar  Sr. Sci.  Shri Sekar V. Rayer  -do-
Dr. G. Syda Rao  Sr. Sci.  Shri K. Shanmugasundaram  JTA T-2
Dr. P.V. Sreenivasan  Sr. Sci.  Shri S.M. Sathakathullah  JTA T-2
Dr. A.P. Lipton  Sr. Sci.  Shri R. Athipandian  JTA T-2
Dr. N. Ramachandran  Sr. Sci.  Shri J. Padmanathan  FA T-1
Shri D. Sivalingam  Sr. Sci.  Shri U. Jeyaram  FA T-1
Shri P. Natarajan  Sr. Sci.  Shri P. Jaiganesh  FA T-1
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3. DEMERSAL FISHERIES DIVISION

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Shri R. Marichamy  PS  
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Dr. P. Nammalwar  Sr. Sci.  
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Dr. S. Lazarus  Sr. Sci. (on deputation)  
Dr. E. Vivekanandan  Sr. Sci.  
Dr. S.K. Chakraborty  Sr. Sci.  
Shri V.S. Rengaswamy  Sr. Sci.  
Shri G. Mohanraj  Sr. Sci.  
Shri K.M.S. Ameer Hamsa  Sr. Sci.  
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Shri A. Raju  Sr. Sci.  
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Shri P.U. Zachariah  Sci.(SS)  
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Shri P.S. Alloyczious  FA T-1  
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Shri A. Dasman Fernando, Skin Diver  T-1-3  

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4. Pelagic Fisheries Division

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Shri K. Dorairaj PS
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Dr. D.B. James Sr. Sci.
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Shri P.K. Baby JTA T-2
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Shri M.R. Arputharaj TA T-II-3
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**TECHNICAL CELL**

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<td>Shri K. Pandi</td>
<td>MD T-II-3</td>
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<tr>
<td>Shri M. Xavier Mohandas</td>
<td>MD T-II-3</td>
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<tr>
<td>Shri S.K. Gurusamy</td>
<td>MD T-1</td>
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<td>Shri K. Muthuvel</td>
<td>MD T-1</td>
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<tr>
<td>Shri P. Pasupathy Rao</td>
<td>MD T-2</td>
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<td>Shri S. Duraipandian</td>
<td>MD T-1</td>
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<tr>
<td>Shri K. Dharma Rao</td>
<td>MD T-II-3</td>
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</tbody>
</table>
Shri K. Alagirisamy    MD T-2
Shri P.S. Gadenkush    MD T-II-3
Shri Shashikant R. Yadav    MD T-1
Shri Govind Nath Chudasama    MD T-I-3
Shri P. Narayana Naik    MD T-1
Shri V. Varadaiah    MD T-II-3
Shri P. Harshakumar    MD T-1
Shri S. Ramachandran Nair    MD T-II-3
Shri K.G. Radhakrishnan Nair    MD T-1

WORKSHOP STAFF

Shri M. Krishnan    Binder T-1
Shri P. Thankappan    Refrigerator Mechanic T-1
Shri M. Asokan    Painter-cum-Polisher-cum-Carpenter t-1
Shri R. Ponnaiah, Electrician T-2
Shri T.P. Haridasan    Carpenter T-I-3

BOAT CREW (VMC)

Shri P.R. Leopold    TO T9 Skipper
Shri P.K. Velayudhan    TO T8 Mate
Shri B. Ramesh    TO T5 Bosun
Shri Nirmal Mathew    -do-
Shri N.B. Gopalakrishna Menon    TO T5
Shri K.K. Prabhakaran    Cook (Boat) T-I-3
Shri A.K. Unnikrishnan    -do-
Shri M.A. Vincent    Driver (Boat) T-I-3
Shri K.K. Bose    -do- T—3
Shri K.P. Vijayan    Deckhand T-I-3
Shri K.C. Devassy    Deckhand T-2
Shri P.D. Chithambaran    Oilman-cum-Deckhand
Shri K.S. Leon, Deckhand    T-I-3
Shri M.K. Gopalakrishnan    Deckhand T-I-3
Shri P.M. Hariharan    Deckhand T-I-3
Shri T.K. Sudhakaran    Bosun T-4
Shri Mohamed Jaffer    Driver (Boat) T-I-3
Shri M. Rangan    Cook(Boat) T-I-3
Shri M. Ibrahim    Deckhand T-I-3

Shri P. Muniasamy    -do-
Shri R. Sekar    -do-
Shri P.M.A. Muheedu,    -do-
Shri S. Mohideen Meerasa    Deckhand T-I-3
Shri U. Alagumalai    Bosun T-4
Shri D. Padmanabhan    Driver(Boat) T-I-3
Shri C. Manibal    Deckhand T-I-3
Shri S. Ganesan    Deckhand T-2
Shri Vali Mohamed    Cook(Boat) T-I-3
Shri P. Feroz Khan    TO T5 Bosun
Shri D. Anandan    Deckhand T-I-3
Shri S. Enasteen    -do-
Shri R. Arockiasamy    -do-
Shri E. Sivanandan    Cook (Boat) T-I-3
Shri T.N. Sukumaran    Bosun T-II-3
Shri H. Vasu    Seran T-I-3
Shri M.P. Harikantha    Serang T-1
Shri Thomas Teles    TO T5 Bosun
Shri K.C. Gopalan    Cook T-I-3
Shri P. Hillary    Deckhand T-I-3
Shri V.P. Benzeger    -do-
Shri P. Bhaskaran    Deckhand T-II-3
Shri T.R. Sreekumaran    Oilman T-II-3

KRISHI VIGYAN KENDRA, NARAKKAL

Shri K. Asokakumaran    Unnithan T0 (Tng) T8
Dr. P.K. Martin Thompson    -do-
Shri A.N. Mohanan    TO T5
Shri P. Radhakrishnan    TO T5
Shri B. Sureshkumar    Training Asstt. T-4
Shri P.J. Sebastian    MD T-II-3

AUXILIARY STAFF

Shri C.N. Radhakrishna Pillai    Halwai
Shri M.K. Subramanian    Coupon Clerk
Shri P.M. Varughese    Coffee/Tea maker
Shri P.V. George    Bearer
Shri M.V. Devassokyutty    Bearer
Shri K.N. Purushan    Wash Boy/Dish Cleaner
List of Ministerial and Supporting staff at Headquarters and Regional/Research Centres

HEADQUARTERS

Ministerial Staff

1. Shri P. Bapaiah Sr. Administrative Officer
2. Shri A.V. Joseph Sr. Finance & Accounts Officer
3. Shri P.S. Sudersanan Administrative Officer
4. Shri K.U.K. Menon Asstt. Fin. & Accounts Officer
5. Shri P.A. Naik Asstt. Adm. Officer
6. Shri S. Subramanian Asstt. Adm. Officer
7. Smt. P.J. Sheela Hindi Officer
8. Shri K.S. Sreekumaran Superintendent (A&A)
9. Shri P.J. Davis Superintendent
10. Smt. T.K. Ponnamma -do-
11. Shri C. Balamamundinathan -do-
12. Shri A. Narayana Swamy -do-
13. Shri K. Nagarajan -do-
14. Shri C. Yohannan -do-
15. Smt. P.V. Mary -do-
16. Shri M.J. John -do-
17. Shri K.L.K. Padmanabhan Assistant
18. Shri K. Arumughan -do-
19. Shri N. Govindan -do-
20. Shri V.V. Lakshminarayanan -do-
21. Shri T.N.P. Kurup -do-
22. Shri V. Mohanan -do-
23. Smt. K. Vijayalakshmi -do-
24. Shri N. Gopinathan -do-
25. Smt. K.M. Annamma -do-
26. Smt. T. Madhavi -do-
27. Smt. M. Suseela -do-
28. Smt. Christina Joseph Assistant
29. Smt. M.O. Leela -do-
30. Miss M.A. Seetha Senior Stenographer
31. Shri K.M. Surendran -do-
32. Smt. Omana A.K Stenographer
33. Shri C.N. Chandrasekharan -do-
34. Shri C.G. Thomas -do-
35. Smt. N. Ambika -do-
36. Smt. N. Yesoda -do-
37. Smt. K.J. Malathidevi -do-
38. Smt. N.R. Lethadevi -do-
39. Smt. K.V. Sajitha -do-
40. Shri Chandrakesa Shenoi -do-
41. Shri K.N. Murali Junior Stenographer
42. Shri K. Faisal -do-
43. Smt. Lata Vijayakumar -do-
44. Shri V.P. Unnikrishnan Senior Clerk
45. Shri M.K. Abdulla -do-
46. Smt. K.C. Karthiayin -do-
47. Shri A.P. Balakrishnan -do-
48. Smt. P.K. Sreedevi -do-
49. Shri V. Chandrasekharan -do-
50. Smt. A. Ranjini -do-
51. Smt. Alice Valooran -do-
52. Smt. K.C. Girija -do-
53. Smt. M.M. Teresakutty -do-
54. Smt. K. Santha -do-
55. Shri Thomas Joy -do-
56. Smt. A.K. Kunjupennu -do-
57. Smt. V.K. Sobha -do-
58. Smt. V. Parukuttty -do-
59. Shri P.V. Devassy -do-
60. Shri P.M. Bhaskaran -do-
61. Smt. N.S. Sarala -do-
62. Shri K. Sadanandan -do-
63. Smt. P.S. Sumathy -do-
64. Shri S. Erishikesan -do-
65. Smt. I.M. Baby Rajalakshmi -do-
66. Smt. G. Ambika Junior Clerk
67. Smt. N.K. Suseela -do-
68. Shri K. Baburaj -do-
69. Smt. M.G. Chandramathi -do-
70. Shri V.C. Subhash -do-
71. Smt. K.K. Kousallia -do-
72. Shri V.C. Antony -do-
73. Smt. V. Jayalakshmi -do-
74. Shri K.J. Mathew -do-
75. Shri C.K. Sivadas -do-
76. Shri Tomy Prince M.J.  
(Place of posting at Narakkal)
77. Smt. N.G. Supriya
78. Smt. P.K. Mary
79. Smt. K. Balamani  
(Hindi Typist)
80. Shri K. Ramadasan
81. Miss N.M. Ponnamma
82. Shri Augustus Julin Raj
83. Shri K.M. Joseph
84. Smt. Binny Cherian
85. Smt. Gouri Hareendran
86. Smt. Meera. K.N.
87. Shri U. Purandara Shetty
88. Shri Rishikesh Aandi
89. Smt. D. Lalithambika Amma
90. Shri P.P. Anil Kumar
91. Shri P.K. Ravindran
92. Smt. T.C. Chandrika
93. Shri P.P. Chandrasekharan Nair
94. Miss Leela. C.A
95. Shri A. Dickson Jebaraj
96. Shri N. Ravindranathan Nair  
SGO

SUPPORTING STAFF

SS Gr. IV
1. Shri T.A. John  
Khalasi
2. Shri K.P. Joseph  
L.A.
3. Smt. N. Leela  
Daftry
4. Shri M.K. Feethambaran  
Fieldman
5. Shri M.L. Antony  
Library Attendant
6. Shri K.S. Vaidyalingam  
Fieldman
7. Shri A.P. Sebastian  
Peon

SS Gr. III
1. Shri T.A. Vijayan  
Peon
2. Shri E.F. Francis  
Watchman
3. Shri P.A. Vasudevan  
Lab. Attendant
4. Smt. R. Devalakshmi  
Messenger
5. Shri A. Gopinathan  
Messenger
6. Shri B. Zainudheen  
Messenger
7. Shri T. Sreedharan  
Messenger

SS Gr. II
1. Shri K. Velayudhan  
Watchman
2. Shri N.T. Velappan  
Peon
3. Shri G. Mithralal  
Watchman
4. Smt. K.K. Kalliani  
Safaiwala
5. Shri G. Vijayan  
Watchman
6. Shri T. Vijayakumar  
Messenger
7. Shri C.O. Viswambharan  
Fieldman
8. Miss B. Savithri  
Messenger
9. Shri N.P. Mohanan  
Safaiwala
10. Shri V.C. Gopi  
Safaiwala
11. Shri P.K. Achuthan  
Watchman
12. Shri M.P. Mohandas  
Messenger
13. Shri T.M. Abdul Aziz  
Messenger
14. Shri K.T. Rajappan  
Watchman
15. Shri R. Ravindranathan Nair  
Messenger
16. Shri T.I. Soman  
Helper
17. Shri K.C. Rajappan  
Messenger
18. Shri V.T.Ravi  
Watchman
19. Miss A. Latha  
Safaiwala
20. Shri P.K. Chellappan  
Watchman
21. Smt. Pennamma Joseph  
Messenger
22. Shri K.G. Jayaprasad  
Gardner

SS Gr. I
1. Shri P.D. Karunakaran  
Watchman
2. Shri V.A. Kuttappan  
Messenger
3. Shri K. Sankaran  
Gardner
4. Shri E.J. James  
Watchman
5. Shri S. Mohanan  
Lift Operator
6. Shri T.K. Antony  
Lift Operator
7. Shri V. Krishnan  
Messenger
8. Shri V.H. Venu  
Binder
9. Shri N.V. Thambi  
L.A.
10. Smt. J. Sudhadevi  
Cane Weaver
11. Shri S. Narayanan Achari  
L.A.
12. Shri P.B. Jeevaraj  
Fieldman
13. Shri P.V. Joy  
Fieldman
14. Shri M.K. Anil Kumar  
Fieldman
15. Shri P. Satheesh Kumar  
Messenger
16. Shri M. Radhakrishnan  
Messenger
17. Shri T.P. Aboobacker  
Messenger
18. Smt. S. Seethalakshmi  
do-
19. Smt. V.S. Savithri  
do-
20. Shri Sunil.P.V.  
Fieldman
21. Shri Sathyam. M.N.  
Fieldman
22. Shri Shaji.A.K.  
Fieldman
Messenger
24. Miss Sheela. P.P.  
Messenger
25. Smt. Usha. S.  
Messenger
26. Shri Prasad. S.P.  
Messenger
27. Smt. Usha. P.K.  
Safaiwala
28. Miss Sujatha. K.K. Safaiwala
29. Smt. Shyamala. M.P. Safaiwala
30. Shri Sreekumar. K.M. Safaiwala
31. Shri Vijayan. M.T. Safaiwala
32. Miss Sujatha. P.K. Messenger
33. Shri Ajith. K.S. Fieldman
34. Shri Gireesh. P.M. Fieldman
35. Shri Jestin Joy. K.M. Watchman
36. Shri M.J. Joseph L.A.

MANDAPAM CAMP

Ministerial Staff

1. Shri R. Kuppuswamy Asstt. Adm. Officer
2. Shri P. Ganesan Superintendent
3. Shri A. Kajendran Assistant
4. Shri S. Nagarajan -do-
5. Shri K. Maragathamadivelu -do-
6. Shri S. Jeyachandran -do-
7. Shri V. Chandran -do-
8. Shri P. Selvaraj -do-
9. Shri S. Abdulla -do-
10. Shri A. Yagappan Senior Clerk
11. Shri N. Natarajan -do-
12. Smt. S. Parisa Junior Clerk
13. Smt. M. Rameshwari -do-
14. Shri N. Ilamparuthi -do-
15. Shri S. Muthumari -do-
16. Smt. N. Gomathi Stenographer

SUPPORTING STAFF

SSGr. IV

1. Shri A. Raman Fieldman
2. Shri A. Muniasamy L.A.
3. Shri M. Ibrahimisa L.A.
4. Shri S. Muthuramalingam L.A.
5. Shri S. Mani Fieldman
6. Shri A. Subramanian Fieldman
7. Shri A. Pitchai Daftary
8. Shri. K. Muthaiah Watchman
9. Shri K Kuruvan Safaiwala
10. Shri M.R. Bharathan Deckhand

SSGr. III

1. Shri V. Santhanam L.A.
2. Shri R. Sevugan Safaiwala
3. Shri M. Muthu Safaiwala
4. Shri R. Sonai Watchman

5. Shri M. Ramu Fieldman
6. Shri P. Karuppaiah Watchman
7. Shri K. Muniasamy Watchman
8. Shri G. Saivadurai Watchman
9. Shri M. Govindaraj Watchman
10. Shri K. Vellayan Watchman
11. Shri A. Mari Safaiwala
12. Shri R. Alagan Fieldman
13. Shri K. Gurusamy Safaiwala
14. Shri L. Sathan Safaiwala
15. Shri M. Thangavelu Watchman
16. Smt. S. Nagammal Safaiwala
17. Shri G. Ankaiah Safaiwala
18. Smt. J. Kondammal Safaiwala
19. Shri R. Sonaimuthu Safaiwala
20. Shri M. Athimoolam Cook

SSGr. II

1. Shri S. Arulsamy Messenger
2. Shri S. Arumugham Safaiwala
3. Shri P. Ramu Watchman
4. Shri N. Rajavelu Watchman
5. Shri S. Murugan Safaiwala
6. Shri J. Hameed Sultan Pump Driver
7. Shri M. Kuberaganesan Fieldman
8. Shri K. Thangavel Fieldman
9. Shri Y. Balu Oilman
10. Shri G.K. Rajan Pump Driver
11. Shri V. Alagan Fieldman
12. Shri V. Narasimha Bharathy Daftary
13. Shri U. Rajendran L.A.
14. Shri M. Shahul Hameed Messenger

SSGr. I

1. Shri N. Ramakrishnan L.A.
2. Shri S. Murugabooopathy L.A.
3. Shri C. Ramadoss L.A.
4. Shri E. Natarajan L.A.
5. Shri M. Shahul Hameed Messenger
6. Shri S.M. Sikkender Patcha Fieldman
7. Shri T. Thananjayan Oilman
8. Shri I. Syed Sadiq L.A.
9. Shri M. Shanmugavelu Messenger
10. Shri V. Muniasamy L.A.
11. Shri M. Seen L.A.
12. Shri K. Shanmuganathan L.A.
13. Shri N. Nagamuthu Safaiwala
14. Shri K. Govindan  Kansama
15. Shri Y. Arul Pragasam  Binder
16. Smt. Subbulakshmi  Safaiwala
17. Shri M. Saravana Kumar  Safaiwala
18. Shri K. Anandan  Safaiwala
19. Shri K. Ganesan  Safaiwala
20. Shri K. Chandran  Safaiwala
21. Shri N. Ramamoorthi  Lascar
22. Shri B. Kathiresan  Khalasi
23. Shri M. Thayalan  L.A.
24. Shri M. Saravanan  L.A.
25. Shri K. Muniasamy  Helper
26. Shri K. Senthil Kumar  Helper

TUTICORIN

Ministerial Staff
1. Shri D. Gnanajebamani  Superintendent
2. Shri B. Bavanandam  Assistant
3. Smt. S. Leelavathi  Stenographer
4. Smt. T. Mahalakshmi  Junior Clerk
5. Miss S. Sarada  -do-
6. Smt. C. Rajeswari  -do-
7. Shri M. Samuthiram  -do-
8. Shri Jayakanthan. C.  -do-
9. Smt. C. Pushparani  -do-

Supporting Staff
SSGr.III
1. Shri D. Motcham  Daftary
2. Shri A. Francis  Watchman

SSGr.II
1. Shri P. Muthumalai  Watchman
2. Shri K. Thangaraj  Fieldman
3. Shri V. Samayamuthu  Watchman
4. Shri R. Uchimahali  Fieldman
5. Shri W. Sathyavan Neelraj  Fieldman
6. Shri P. Kandan  Fieldman
7. Shri S. Balakrishnan  Watchman
8. Shri John James  Gardner
9. Shri M. Sankaran  Fieldman
10. Shri K. Velayudham  Watchman

SSGr.I
1. Shri G.S. Rayappan  Fieldman
2. Shri I. Ravindran  Fieldman
3. Shri S. Alagesan  Fieldman
4. Shri M. Mariappan  Safaiwala
5. Shri M. Soundrapandian  Safaiwala
6. Shri M. Kalimuthu  Watchman
7. Shri K. Murugan  Watchman
8. Shri G. Kosalam  Watchman
9. Shri K. Subramanian  Safaiwala
10. Smt. B. Koncics Mary  Messenger
11. Shri S. Mariappan  Watchman
12. Shri K. Jeevanathan  L.A.
13. Shri S. Willington  Khalasi
14. Shri K. Jerald Raja  Khalasi

MADRAS

Ministerial Staff
1. Shri K.M. Karuppaiah  Superintendent
2. Shri S. Mangalam  Assistant
3. Shri S.K. Murali  -do-
4. Shri S.Balasubramanian  Senior Clerk
5. Smt. G. Abitha  -do-
6. Smt. M. Parvathy  -do-
7. Smt. A.B. Lalitha  Junior Clerk
8. Smt. Rosy Joachim  Senior Stenographer
9. Smt. P. Thankaleela  Junior Clerk

Supporting Staff
SSGr.IV
1. Shri V. Joseph Xavier  Deckhand
2. Shri S. Selvanidhi  Deckhand

SSGr.III
1. Shri R. Ananda Jyothi  Watchman
2. Shri G. Vijayarengan  Safaiwala

SSGr.II
1. Shri D. Pakkiri  Watchman
2. Shri A. Janakiraman  Watchman
3. Shri G. Chakkrapani  Watchman
4. Shri T. Nagalingam  Watchman
5. Shri M. Ravindran  Messenger
6. Shri S. Imbamani  Watchman
7. Shri M.P. Chandrasekhar  Watchman
8. Shri M. Anbu  Messenger
9. Shri R. Sunder  Fieldman
10. Shri R. Vasu  Fieldman
11. Shri P.Selvaraj  Safaiwala
SSGr. I
1. Smt. Anjalidevi. S. Peon
2. Shri S. Yuvarajan L.A.
3. Shri V. Seetharamacharyalu Helper
4. Shri Bareen Mohammed L.A.

BOMBAY
MINISTERIAL STAFF
1. Shri P.V. Shanbhag Senior Clerk
2. Shri M.R. Wadadkar -do-
3. Shri Rama D. Medar Junior Stenographer
4. Smt. Ashlesha Ashok Sawant Junior Clerk
5. Shri Vinoth P. Bhagayatkar -do-

Supporting Staff
SSGr.II
1. Shri K.G. Tawade Watchman
2. Shri S.M. Tandel Watchman

SSGr.I
1. Shri K.K. Baikar Fieldman
2. Shri M.P. Jadhav Watchman
3. Shri D.D. Jagam Watchman
4. Smt. Urmila V. Balmiki Safaiwala
5. Shri Rajani Sekharan Tambe Messenger
6. Sh. Bhangare Sunil Ramachandra Fieldman

MANGLORE
MINISTERIAL STAFF
1. Shri Balakrishna Naik Assistant
2. Shri K.M. Abdulla Senior Clerk
3. Smt. Martha R. Mascarenhas -do-
4. Shri K. Rama Naik -do-

Supporting Staff
SSGr.III
1. Shri Vasudev G. Kubal Lascar (CIFT, Goa absorption)
2. Shri Mohan S. Puthran Oilman
3. Shri U.B. Sadasiva Messenger

SSGr.II
1. Shri C.B. Shirodkar Watchman (CIFT, Goa absorption)
2. Shri D. Gangadhara Gowda Watchman
3. Shri Ramanna Sapaliga Watchman
4. Shri A. Kesava Watchman
5. Shri L.K. Suvarna L.A.

SSGr.I
1. Smt. V. Padmavathi Safaiwala
2. Smt. Savithri Fieldman
3. Shri S. Mahalinga Naik Messenger

VIZAKHAPATNAM
MINISTERIAL STAFF
1. Shri R. Appa Rao Assistant
2. Miss V. Gauri Senior Clerk
3. Shri K. Santhi Prasad -do-
4. Miss B. Madhavi Latha Junior Clerk

SUPPORTING STAFF
SSGr.IV
1. Shri R. Balakrishnan Deckhand

SSGr.III
1. Shri R. Kanaka Raju Watchman
2. Shri V. Demudu Watchman

SSGr.II
1. Shri P. Krishna Rao Messenger
2. Shri R.V.S.Subramanyan Messenger
3. Shri L. Appa Rao Messenger
5. Shri R. Dalayya Safaiwala
6. Shri P.Prasantha Kumar Das Messenger

SSGr.I
1. Shri D. Jaganna Safaiwala
2. Shri P. Nagaraju Watchman

VIZHINJAM
Ministerial Staff
1. Shri M. Regunathan Assistant
2. Shri S. Radhakrishnan Nair Junior Clerk
3. Shri Vinoth Prabhu J. Vaz -do-
4. Mrs. K. Latha -do-

SUPPORTING STAFF
SSGr.IV
1. Shri J. Ansalam L.A.
2. Shri V. Sasidharan Pillai L.A.
3. Shri Kunju Kunju L.A.
4. Shri M.T. Mani Cook (Boat)

SSGr.III
1. Shri K. Chandran Safaiwala
2. Shri V. Viswanathan Watchman
SSGr.II
1. Shri R. Madhusudanan Nair Fieldman
2. Shri V. Kochunarayanan Nair Watchman
3. Shri S. Antony Messenger
4. Shri B. Prabhakaran Messenger
5. Shri B.K. Velukkutty Messenger
6. Shri B. Babu Safaiwala

SSGr.I
1. Shri A. Yesudas L.A.

CALICUT
Ministerial Staff
1. Smt. C. Kamalakshi Assistant
2. Smt. P. Subhadra Senior Clerk
3. Shri R. Sreenivasan Junior Clerk
4. Smt. K.P. Shylaja -do-
5. Shri M. Balaraman -do-

Supporting Staff
SSGr.IV
1. Shri K. Janardhanan Fieldman
2. Shri M. Ramadasan L.A.

SSGr.III
1. Shri K.E. Joseph Victor Watchman

SSGr.II
1. Shri A. Sivadasan Messenger
2. Shri K. Chekutty Watchman
3. Shri P. Dassan Fieldman
4. Shri Haridassan Thannimukkoth Fieldman
5. Shri M.K. Chandran Safaiwala
6. Shri T.P. Renil Kumar Fieldman

SSGr.I
1. Shri Palaniappan Safaiwala
2. Shri K.T. Mohanan Messenger
3. Shri Thirumangalath Koman L.A.
4. Miss P. Renuka L.A.
5. Shri V. Rajendran Messenger

KARWAR
Ministerial Staff
1. Shri G. K. Kudalkar Assistant
2. Shri Gangadhar B. Naik Senior Clerk
3. Shri Yellappa H. Gamanagatti -do-
4. Smt. Jayashree Junior Clerk

SUPPORTING STAFF
SSGr. IV
1. Shri G.M. Korar Fieldman

SSGr. III
1. Shri D.D. Naik L.A.
2. Shri R.D. Pednekar Peon
3. Shri Menino Souza Lascar
4. Shri P.S. Morajkar Watchman

VERAVAL
Ministerial Staff
1. Shri J.N. Jambudiya Senior Clerk
2. Shri Vanvi Mansukhlat Madhavji Jr. Clerk

SUPPORTING STAFF
SSGr.II
1. Shri H.M. Bhint Messenger
2. Shri Asli Abubin Mehsan Watchman
3. Shri L.M. Waghale Watchman

SSGr.I
1. Shri Haridas Khimdas Makwana Fieldmap
2. Shri Makwana Somapitha Watchman
3. Shri Prabhakar Sankar Salvi Messenger

KAKINADA
Ministerial Staff
1. Shri S. Suryanarayana Murti Senior Clerk
2. Shri S. Appa Rao -do-
Supporting Staff
SSGr. IV
1. Shri K. Narasimha Murty  L.A.

SSGr.II
1. Shri S. Tatabhai  Messenger

SSGr.I
1. Shri G. Sainyadhpathi  Watchman
2. Shri D. Bhaskara Rao  Safaiwala
3. Shri C.H. Moshe  Watchman

MINICOY
MINISTERIAL STAFF
1. Smt. M. Safiabi  Junior Clerk

SUPPORTING STAFF
SSGr.IV
1. Shri P.I. Koya  L.A.
2. Shri C.M. Rajappan  L.A.

SSGr.III
1. Shri O. Ismail  Watchman
2. Shri N. Pookoya  Watchman

SSGr.II
1. Shri Suresh Babu. P.K.  Watchman

SSGr.I
1. Shri Mohammed Khaleel  Fieldman

KRISHI VIGYAN KENDRA,
NARAKKAL
MINISTERIAL
1. Shri B. Vijaya Kumar  Superintendent
2. Shri N.K. Mohanan  Junior Clerk
3. Shri C.D. Manoharan  Junior Stenographer

Supporting Staff
SSGr.IV
1. Shri N.K. Asokan  Fieldman
2. Shri K.P. John  Fieldman

SSGr.III
1. Shri K. Ganesan  Fieldman

SSGr.II
1. Smt. Chinnamma Anjalo  Safaiwala

SSGr.I
2. Shri P.V. Gopalan  Messenger

TRAINERS' TRAINING CENTRE,
COCHIN
MINISTERIAL STAFF
1. Smt. D. Geetha  Superintendent
2. Smt. P.K. Anitha  Junior Stenographer
3. Smt. Ponnamma Radhakrishnan  Senior Clerk

Supporting Staff
SSGr.II
1. Shri K.G. Bhaskaran Nair  Messenger