CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

Annual Report

1981-82

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COCHIN
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

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Central Marine Fisheries Research Institute
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Issued by
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Cover Photo:
CMFRI's Mariculture farm at Muttukad

CONTENTS

DIRECTOR'S INTRODUCTION

During the year 1981–82, the Institute has undertaken 121 Research Projects which included the various projects implemented by the different divisions of the Institute, Inter–Divisional projects, Inter–Institutional projects and Training programmes. Steady progress was maintained in all these projects during the year. Apart from these, good progress was also achieved in other programmes such as the Operational Research Project at Kovalam, Lab–to–Land programmes at different centres; the Centre of Advanced Studies in Mariculture at Cochin and at the Krishi Vigyan Kendra, Narakkal. The highlights of the work may be outlined as follows.

Marine Fish Production

The total marine fish landings in India during the calendar year 1981 was estimated at 1.38 million tonnes as against 1.25 million tonnes during 1980 showing an increase of about 10%. While West Bengal, Tamil Nadu, Pondichery, Karnataka, Goa, Maharashtra, Gujarat and Lakshadweep recorded higher landings, Orissa and Kerala accounted for lower catches as compared to 1980. The catch in Andhra Pradesh and Andamans remained more or less the same.

The estimated marine fish production in India during the financial year (April 1981 to March 1982) was 1.42 million tonnes. Kerala State accounted for the maximum landings of 3.05 lakh tonnes forming 21% of the all India total. Species

wise, the oil sardine formed the major catch with 2.57 lakh tonnes accounting for 18% of the total marine fish landings.

All India Census of marine fishermen, Craft & Gear

Based on the analysis of voluminous census data collected by the Institute during 1980, the Institute has brought out published information on district-wise details on the distribution of marine fishermen population, their educational status, number of fishermen actually engaged in fishing and the number of crafts and gears owned by fishermen.

The number of marine fishing villages in India (excluding Maharashtra, Andaman and Lakshadweep) is 2132, the number of landing centres being 1438. There are 3.33 lakh fishermen households with total marine fishermen population of 18.93 lakhs. The fishermen engaged in actual fishing form 23% of total fishermen population.

Pelagic Fisheries

The purse seine fishery during the 1981 post-monsoon months off Goa, Karnataka and Kerala was very active and heavy catches of oil sardine, anchovies, horse mackerel and cat fishes have been taken especially off Mangalore-Malpe as during the previous year.

Crustacean Fisheries

The decreasing trend in the over all production of prawns was maintained during the year. In the case of penaeid prawns there was conspicuous decline in the catches at Neendakara, Kerala State where the landings of *Parapenaeolpsis stylifera* declined to about one-third of the catches of the previous year. However, along the east coast, most of the centres recorded higher catches when compared to the previous year. The non-penaeid prawn catches also showed decline in centres such as Veraval and Bombay. In the estuarine environments, juvenile peaneid prawn populations showed less abundance than the previous year except perhaps in the case of *Metapenaeus dobsoni* in the Cochin backwaters. At all the observation centres except Veraval, spiny

lobster fishery recorded improved catch and catch rates during the year.

Molluscan Fisheries

Under the Molluscan Fisheries Division, the general survey of the resources of chank, pearl oysters, edible oyster, clams and mussels made good progress especially in the States of Tamil Nadu, Kerala and Karnataka. The cephalopod team laid emphasis on the survey of cephalopod resources of the Exclusive Economic Zone and also on the resources of squids and cuttle fishes in the inshore areas.

Research highlights in mariculture:
Breakthrough in breeding and rearing of pearl oyster

A significant breakthrough was achieved during the year in the development of techniques for breeding, larval rearing and production of spat of Indian pearl oyster, *Pinctada fucata* in the shellfish hatchery at Tuticorin. For the first time in India success was achieved in mass production of seed of any economically important mollusc under controlled condition. This development solves an important problem of raising adequate oyster stock for mother oyster culture in pearl culture operations. The pearl oysters were induced to spawn by biological, chemical and thermal stimulation. One of the major inputs which led to the success in spat settlement has been the use of appropriate dosages of live food microalgal organisms for the critical stages of the larvae.

Significant developments in Prawn Culture

In prawn culture, methods of mass culture of prawn seeds were standardised and perfected at the Narakkal prawn culture laboratory and greater survival rate of larval forms was achieved. Induced maturation of *Penaeus indicus* by unilateral eyestalk ablation was widely used obviating the dependence on wild spawners from the sea. Continuous third generation of *P. indicus* has been developed and maintained in the grow out ponds of Narakkal.

Based on the techniques developed at Narakkal, success has been achieved at the Kovalam field laboratory (near Madras) on the spawning and rearing of *Penaeus monodon* to stockable size.

Breakthrough in Finfish Culture

For the first time, breakthrough has been achieved in the induced maturation of the eel, *Anguilla bicolor bicolor* at Mandapam Regional Centre of CMFRI.

Experimental success has been achieved in the induced breeding of the mullet, *Liza macrolepis* at Mandapam. The larvae hatched out from viable eggs, survived for 3–4 days. Experiments to rear the larvae for longer periods are in progress.

The progress achieved in the research programmes of the different divisions and in the Education and Training programmes of Centre of Advanced Studies in Mariculture and Krishi Vigyan Kendra are given in detail in the respective chapters.

E. G. SILAS
DIRECTOR

Brief history, organisational set up and objectives:

The Central Marine Fisheries Research Institute was established in 1947 by the Ministry of Agriculture and Irrigation. It came under the control of ICAR in 1967. The headquarters of the Institute is at Cochin and it has a Regional Centre at Mandapam Camp, Tamil Nadu. Besides these the Institute has established 11 Research Centres and 29 Field Centres on both the coasts. Field experimental stations are located at Narakkal, Kovalam, Tuticorin, Mandapam, Vizhinjam and Calicut.

The *objectives* of the Institute are to conduct short-term and long-term multidisciplinary researches on the marine capture and culture fisheries of the country in order to provide *Research* support for the rational exploitation, conservation and management of the marine and salt water resources for stepping up production from the coastal water areas and the Exclusive Economic Zone and *Development* support for growth with stability of the industrial, artisanal and culture fisheries through transfer of technology, dissemination of information and *education, training* and *extension*.

Implementation of the projects:

During 1981–82, the research projects/problems undertaken during the year were implemented by the following 5 divisions:

1. Fishery Resources Assessment Division
2. Fishery Biology Division
3. Crustacean Fisheries Division
4. Molluscan Fisheries Division
5. Fishery Environment Management Division.

Advisory /Consultancy Service provided:

Dr. E.G.Silas, Director, served as:

1. Member on the joint ICAR-ICSSR Scientific Panel for Social Sciences and Agricultural Extension.
2. Member, Programme Priorities and Cruise Committee for the National Institute of Oceanography, Goa.
3. Member, Research Advisory Committee of the Kerala Agricultural University, Trichur.
4. Member, Central Advisory Committee on Exploratory Survey of Marine Fisheries.
5. Member, Tamil Nadu State Fisheries Research Council.
6. Member, Regional Committee No. 8 (Constituted by the Governing Body, ICAR).
7. Member, Scientific Panel for Fisheries Research, ICAR.
8. Member, Kerala State Fishery Advisory Board.
9. Member, High Level Aquarium Committee-Construction of a Marine Aquarium at Cochin.
10. Member, in the Committee on Fisheries and other Aquatic Resources of the State Committee on Science and Technology, Kerala.
11. Member, Central Government Employees Co-ordination Committee, Cochin.
12. Member, Faculty of Marine Sciences, University of Cochin.
13. Member, Technical Committee of the Marine Products Export Development Authority, Cochin.
14. Member, Editorial Committee for 'Indian Seafoods' of the Marine Products Export Development Authority.
15. Member, Sub-Committee of the Indian Board of Wildlife.
16. Representative of the Department of Agricultural Research and Education to the MPEDA.

17. Member, Management Committee of Central Agricultural Research Institute, Andaman & Nicobar Group of Islands, Port Blair.

18. Member–Director of the Board of Directors of the Andhra Pradesh Fisheries Corporation Limited, Kakinada.

19. Member, Standing Scientific Evaluation and Implementation Committee for the Zoological Survey of India.

20. Member, Constitution of the Consultative Group of CIFNET.

21. Member, Technical Advisory Committee on New and Renewable Energy Source, Department of Science & Technology.

22. Co-opted Member, Task Force on Marine Products, constituted by the Ministry of Commerce, Government of India.

23. Member, sub–group on coastal area planning of the task force constituted by the planning commission.

Convener, Expert panel for Living Resources Programme of the Indian Ocean Region of the standing committee of the Ocean Science Technology Agency (OSTA) of the Department of Science and Technology, Government of India.

24. Member, sub–group on coastal area planning of the task force to prepare the eco–development plan for Goa, set up by the Planning Commission.

25. Participated in the Marine Resources Survey Programme on ICUN and Department of Environment Team visiting Andaman & Nicobar for Marine resource survey.

26. Member, National Committee for Scientific Committee on Oceanic Research (SCOR) for 1981–84 under the Chairmanship of Dr. S.Z. Qasim, Department of Environment

Government of India, by Indian National Science Academy, New Delhi.

27. Member, nominated by ICAR, in the Management Committee section of Krishi Vigyan Kendra, Mitra Niketan, Vellanadu, Trivandrum for a period of 3 years from November 1981.

28. Member, Committee constituted by Government of Kerala to study the need for conservation of marine living resources during certain seasons and allied matters.

CMFRI STAFF SERVING IN DIFFERENT COMMITTEES CONSTITUTED BY OTHER AGENCIES

1. Shri K.V. Narayana Rao Scientist S-3	i) Nominated by Council as Member in Consultative Group for the CIFNET
	ii) Nominated by Director as Member in Consultative Group for the EFP base at Cochin.
2. Shri K.H. Mohamed	i) Nominated by the Director as Member for the Visiting Team for examining the proposal for establishment of KVK during VIth Plan in Kerala State.
	ii) Member in Executive Council of Marine Biological Association of India.
	iii) Member Secretary in Management Committee, KVK.
3. Dr. S. Ramamurthy Scientist S-3	i) Member Secretary in State Level Committee for Co-ordination of work on Marine Fisheries, Maharashtra.
	ii) Member in Consultative Group for the EFP, Bombay.

4.	Dr. P.V.R. Nair Scientist S-3	i) Member in Panel for Marine Disposal of Effluents CDC 26: 3:1 of the Water and Effluents Sub-committee of the I.S.I. ii) Member in Task Force Meeting on Marine Algae.
5.	Dr. P. Vedavyasa Rao Scientist S-3	i) Member in Executive Council of Marine Biological Association of India. ii) Member in Board of Studies in Mariculture, University of Cochin.
6.	Shri K. Nagappan Nayar Scientist S-3	i) Member in StateLevelCommitte for Co-ordination of work on Marine Fisheries in the State and Central sectors. ii) Member in Sub-committee of the Central Advisory Committee on Exploratory Survey of Marine Fisheries.
7.	Dr. B. Krishnamoorthi Scientist S-3	i) Central Advisory Sub-Member Committee of Exploratory Survey of Marine Fisheries of the Madras Base of EFP. ii) State Level Committee Member for Co-ordination of work on Marine Fisheries in the State & Central Sectors.
8.	Dr. K.C. George Scientist S-2	i) Member in Scientific Committee on Ocean Research and Advisory Committee of Experts on Marine Resources Research of UNESCO/FAO-ACOR/ACMRR Working Group 67.

9.	Shri G.P. Kumaraswamy Achary Scientist S-1	i) Convener of VIth Five Year Plan Task Force on Island & Estuarine Fisheries including culture programmes, State Planning Board, Government of Kerala.
		ii) Member in Task Force on Research Education and Training State Planning Board, Government of Kerala.
10.	Shri M.P. Chandrasekharan Asst. Accounts Officer	i) Member in Management Committee S.B.I., Coimbatore.
11.	Shri S. Kalimuthu Technical Assistant	i) Joint Council

CMFRI STAFF SERVING IN DIFFERENT COMMITTEES CONSTITUTED WITHIN THE INSTITUTE

1.	Dr. S.V. Bapat Joint Director	i) CMFRI Management Committee	-Member
		ii) Departmental Promotion Committee	-Chairman
		iii) Selection Committee for Foreign assignment/deputation/training etc.	-Member
		iv) Building Committee	-do.
		v) Institute Joint Council	-do-
		vi) Grievance Cell	-do-
		vii) Transfer Committee	-Chairman
		viii) Publication Committee	-do-
		ix) Official Language Implementation Committee	-do-
		x) Library Committee	-do-
		xi) High Power Committee	-Member
2.	Dr. A.V.S. Murty Scientist S-3	i) Transfer Committee	-Member
		ii) CMFRI Management Committee	-do-
		iii) Selection Committee for .. foreign assignment/deputation/ training etc.	-do-

		iv) Committee constituted for suitable security measures at CMFRI HQs.	-Member
		v) CMFRI Staff Recreation Club	-President
3.	Dr. K. Alagarswami Scientist S-3	i) Publication Committee	-Member
		ii) Selection Committee for foreign assignment /deputation/ training etc.	-do-
4.	Shri K.V.N. Rao Scientist S-3	i) Transfer Committee	-Member
		ii) Selection Committee for foreign assignment/deputation training etc.	-do-
		iii) Building Committee	-do-
		iv) Lab-to-Land Interdisciplinary Committee	-do-
		v) Inter Divisional Research Committee	-do-
		vi) Assessment Committee-Technical Officers	-do-
		vii) Fish Farm Norms Committee	-do-
		viii) Staff Research Council	-Secretary
5.	Dr. P. Vedavyasa Rao Scientist S-3	i) Library Committee	-Member
		ii) Stores Committee	-Chairman
		iii) Advisory Committee CAS in Mariculture	-Member
6.	Shri K. Nagappan Nayar Scientist S-3	i) Transfer Committee	-Member
		ii) Grievance Committee(Officers)	-do-
		iii) Local Action Group to deal with oil spillage at sea around Tuticorin	-do-
		iv) Committee for drawing norms and guidelines for development of Fish Farms.	-do-
		v) Screening Committee for screening papers giving advice to farmers/fishermen/public.	-do-
7.	Shri K.N.K. Kartha Scientist S-2	i) Publication Committee	-Member
		ii) Library Committee	-do-
8.	Shri T. Jacob Scientist S-3	i) Departmental Promotion Committee	-Member
		ii) Transfer Committee	-do-
		iii) Official Language Implementation Committee	-do-
		iv) High Power Committee	-do-

9.	Shri K.H. Mohamed Scientist S-3	i) Sports Committee	-Member
10.	Dr. M.J. George	i) Transfer Committee	-Member
	Scientist S-3	ii) Publication Committee	-do-
		iii) Library Committee	-do-
		iv) High Power Committee for assessment of field experiments	-do-
		v) Selection Committee for foreign assignment/deputation/ training etc.	-do-
		vi) Grievance Committee	-do-
11.	Shri P.T. Meenakshi Sundaram, Scientist S-2	i) Departmental Promotion Committee	-Member
12.	Dr. M.V. Pai Scientist S-2	i) Official Language Implementation Committee	-Member Secretary
13.	Shri S. Mahadevan Scientist S-2	i) CMFRI Management Committee	-Member
14.	Dr. M.M. Thomas Scientist S-2	i) Stores Committee for other than Ship Stores	-Member
15.	Shri M.S. Rajagopalan Scientist S-2	i) Stores Committee for Ship Stores	-Member
		ii) Stores Committee for other than Ship Stores	-do-
16.	Dr. K.C. George Scientist S-2	i) Stores Committee for Ship Stores	-Chairman
		ii) Committee on Construction of Mobile Laboratory	-Member
17.	Shri V.N. Bande Scientist S-2	i) Stores Committee for Ship Stores	-Member
18.	Shri M. Kumaran Scientist S-2	i) Selection Committee for the post of Curator CMFRI	-Member
19.	Shri N. Neelakanta Pillai Scientist S-1	i) CMFRI Management Committee	-Member
20.	Shri G.P. Kumaraswamy Achary, Scientist S-1	i) Grievance Committee for Officers of Class-I and above	-Member
21.	Shri S. Natarajan Field Officer	i) Stores Committee for Ship Stores	-Member
22.	Shri C. Suseelan Scientist S-1	i) Official Langauge Implementation Committee	-Member

23.	Shri V.K. Sridhar Administrative Officer	i) Official Language Implementation Committee	-Member
		ii) Grievance Committee	-do-
		iii) CMFRI Management Committee	-Member Secretary
		iv) Institute Joint Council	-do-
		v) Stores Committee for Ship Stores	-Member
24.	Shri M.P. Chandrasekharan Asst. Accounts Officer	i) Official Language Implementation Committee	-Member
		ii) Grievance Cell	-do-
		iii) Institute Joint Council	-do-
		iv) Budget Monitoring Unit	-do-
		v) Stores Committee	-do-
25.	Shri K. Kanakasabhapathy Sr. L.D.A.	i) Official Language Implementation Committee	-Member
26.	Shri S. Natarajan Field Officer	i) Stores Committee for Ship Stores	-Member
27.	Shri P. Natarajan Scientist S	i) Institute Joint Council	-Member
		ii) Grievance Cell	-Chairman
28.	Dr. B. Krishnamoorthy Scientist S-3	i) Management Committee of ORP of CMFRI	-Member
29.	Shri N.S. Radhakrishnan Scientist S-1	i) Institute Joint Council	-Member
30.	Shri G. Soundararajulu Lab Attendant	i) Institute Joint Council of of CMFRI	-Member
		ii) Grievance Cell	-do-
31.	Shri S. Kalimuthu Tech. Assistant (T-4)	i) Grievance Cell	-Member
32.	Shri V.M. Mariappan Assistant	i) Grievance Cell	-Member
		ii) Institute Joint Council	-do-
33.	Shri M.R. Arpudaraj Tech. Assistant	i) Grievance Cell	-Member
34.	Shri R. Dorairaj Superintendent	i) Official Language Implementation Committee	-Member
35.	Shri M.P. Lakshmanan Superintendent	i) Official Language Implementation Committee	-Member
36.	Miss A. Rajeswari Menon Hindi Translator	i) Official Language Implementation Committee	-Member
37.	Shri Varughese Jacob Technical Assistant	i) Institute Joint Council	-Member

Engagements:

Dr. E. G. Silas, Director attended the following meetings:

ICAR Directors' Conference at New Delhi, 12–13 January. Meeting of the Central Co-ordination Committee of Fisheries Survey of India, at New Delhi.

Twenty fourth meeting of the Marine Products Development Authority and the Technical Sessions of the IV Indian Sea Food Fair at Madras.

Ninetyfifth executive committee meeting of the Kerala Agricultural University at Trichur, 12th February.
Convention on International Trade in Endangered Species of the Wild Fauna and Flora (CITES)

Meeting called by the Member, Planning Commission for discussion on brackishwater coastal engineering at Delhi, 13th May.

Meeting of the Scientific panel for Fisheries at ICAR, 14–15 May.

Meeting convened by the Member (Agriculture), Planning Commission, regarding inland and coastal aquaculture and the role of ICAR Institutes on fisheries development projects proposed for UNDP assistance at Delhi, 25th May.
Twentyfirst Meeting of the Tamil Nadu Fisheries Research Council at Kodaikkanal, 28th May.

Ninth Meeting of the Project Working Committee of UNDP/ICAR assisted projects, at New Delhi, 2nd June.
Workshop on Crustacean Biochemistry and Physiology organised by the Centre of Advanced Studies in Mariculture, at Madras, 15th June.

Tamil Nadu State Fisheries Research Council Meeting at Madras, 16th June.

Discussion with the Hon'ble Minister for Agriculture, Seychelles, relating to setting up of the fishermen corpo-

ration as instructed by Director, DARE, at Bombay, 3rd August.

Central Board of Fisheries Meetings at Delhi.

Expert Committee Meeting of *R.V. Skipjack* at GRSE, Calcutta.

Meeting of the Technical Advisory Committee on new and renewable resources of the Department of Science and Technology, at Madras, 1st July.

The Second Meeting of the Expert Panel for Living Resources Programme, at Madras, 2nd July.

Parliamentary Consultative Committee Meeting, at New Delhi.

Meeting convened by Hon'ble Minister of Fisheries and Forests to discuss Kerala Fisheries Ordinance and connected issues at Trivandrum.

Fourth Meeting of the Task Force for Marine Products set up by the Ministry of Commerce, Government of India at New Delhi, 25th July.

FAO Advisory Committee of Experts on Marine Resources Research (ACMRR), at Rome, 2–6 November.

Third Management Committee Meeting of the Operational Research Project at Madras 26th November.

XXIV Meeting of the General Council and 108th meeting of the Executive Committee of the Kerala Agricultural University at Trichur, 28th November.

The 108th Meeting of the Executive Committee of the Kerala Agricultural University at Calicut, 4th January.

Visiting team of ICAR to inspect the research set up etc. at the Bangalore University and to recommend to the University for recognition of ICAR, 4th January, 1982.

Inauguration of Workshop on Aquaculture at Fisheries College, Tuticorin.

The third meeting of the Central Co-ordination Committee and National Fishery Survey of India at Krishi Bhavan, New Delhi, 20th March.

Dr. A.V.S. Murthy and **Dr. P.V. Ramachandran Nair,** Scientist S-3 and **Shri V. Kunjukrishna Pillai** and **Shri K.J. Mathew,** Scientists S-1, attended the Seminar on Environmental Studies in India organised by the Centre for Earth Sciences Studies at Trivandrum, 26-28th March.

Dr. M.S. Prabhu, Scientist S-3 participated in the Seminar on Ocean Features, Next Twentyfive Years, at National Institute of Oceanography, Panaji, Goa, 3-5 March.

Dr. V. Balakrishnan, Scientist S-3, participated in *Krishi Mela* organised by the Kerala Agricultural University under Lab-to-Land Programme at Vytila Centre.

Dr. B. Krishnamoorthi, Scientist S-3, **Shri P.T. Meenakshi Sundaram,** Scientist S-2, **Shri Girija Vallabhan** and **Smt. Geetha Bharathan,** Scientist S-1 attended the Seminar on Algae and their Utilisation at Madras University.

Shri V.M. Deshmukh, Scientist S-2, attended the seminar on the Management of Indian Exclusive Economic Zone organised by the Central Institute of Fisheries Education, Bombay, 16th December.

Dr. K. Satyanarayana Rao, Officer-in-charge, Mangalore Research Centre attended the meeting of the officers and scientists of the Central Government, State Government and University of Agricultural Sciences to discuss interinstitutional collaboration in research work, convened by the University of Agricultural Sciences at Bangalore.

Dr. A. Laxminarayanan, Scientists S-1, **Shri S. Dharmaraj,** Tech. Assistant and **Shri B.S. Ajitha Kumar,** Senior Research Fellow, attended the first Indo-Pacific Symposium on Invertebrate Reproduction at Marine Water, University at Aurangabad, 27-29 December.

Dr. S. Ramamurthy, Scientist S–3 attended the meeting convened by State level committee for Co–ordination of work on Marine Fisheries, 14th Meeting, at Bombay 24th April and 18 November.

Dr. K. Radhakrishna, Scientist S–2, **Shri P. Mojumdar** and **Shri K.R.M. Nair** attended the Symposium and celebrations in connection with ninth World Environment Day at Andhra University, 5th June.

Dr. P.S.B.R. James, Joint Director, participated in IV Workshop of All India Co-ordinated Research Project (ICAR) on Brackishwater Fish Farming at Kakinada, 24–25 October.

Dr. K. Radhakrishna and **Dr. T. Appa Rao,** Scientists S–2, **Shri Appanna Sastry** Scientist S–1 and **Shri R.K.M. Nair,** participated in the Bay of Bengal programme meeting at the invitation of Fisheries Department, Andhra Pradesh, at Waltair, 27th November.

Scientists of Waltair Research Centre attended the meeting on Oceanographic Research organised by Dr. E.G.La Fond at Andhra University, 16–17 November.

Dr. S. Ramamurthy, Scientist S–3 attended the Seminar on Prospects of Aquatic Fish Experts from India, organised by MPEDA in assistance with Central Institute of Fisheries Education, Bombay, 11th February.

Shri S. Mahadevan, Scientist S–2, attended All India Symposium on Fish Diseases organised by Fisheries College, University of Agricultural Sciences, at Mangalore, 1–4 March.

Shri P. Karunakaran Nair, Senior Technical Assistant at KVK attended the Rural Programme Advisory Committee Meeting of All India Radio, Trichur.

Dr. P.K. Martin Thompson, Senior Training Assistant at KVK participated in the Summer Institute on Farming System,

Integrating Livestock, Agriculture and Fish Culture conducted by CIFRI, Barrackpur, 6th July–4th August.

Smt. Geetha Bharathan, Scientist S–I participated in the Summer Institute on Genetics at the Punjab Agricultural University for 1 month from 12th June.

Shri V.S. Krishnamoorthy Chennubhotla, Scientist S–2, participated in a training centre on Gracilaria Algae and other species organised by South China Fisheries Development Programme under UNDP/FAO, Marine Science Centre, University of Phillippines, Quezan City.

Shri P. Karunakaran Nair, Senior Training Assistant at KVK attended the meeting of the representatives from Agricultural financing agencies including fisheries to discuss problems faced by farmers in availing loan facilities.

Shri S. Mahadevan, Scientist S–2, was deputed to undergo advanced training in fish diseases under FAO/UNDP training programme at Virginia Institute of Marine Sciences, Marine Laboratory Abudeen and in the Institute of Aquaculture, University of Stirling for three months from 8th September.

Shri K. Nagappan Nayar and **Dr. P. Vedavyasa Rao,** Scientists S–3, participated in the World Conference on Aquaculture Trade Show at Venice, Italy and visited fisheries research laboratories in Italy, Spain and France under FAO/UNDP training programme for observation and study tour, September–November.

Dr. M.J. George, Scientist S–3, attended the Workshop in the Scientific basis for the management of penaeid shrimps at Key West, Florida, U.S.A., 18–24 November.

Shri K.A. Narasimham, Scientist S–2, participated in the Workshop on Bivalve culture jointly organised by the Primary production department of Ministry of National Development, Singapore and International Development Research Centre, Canada at Singapore from 16–19 February.

Shri M. Srinath and **Smt. Krishna Srinath,** Scientist S-1 attended Trade Fair at New Delhi, 14th November-4th December.

Shri N.S. Radhakrishnan, Shri J.C. Gnanamuthu, Dr. T. Appa Rao, Shri S. Ruben and Shri Sam Bennet, Scientists S-1 attended the IXth Orientation course in Agricultural Research Management at the National Academy of Agricultural Research Management, Hyderabad from 1st December.

Radio Programmes:

A discussion on the feasibility of culture of tiger prawns led by Shri P. Karunakaran Nair, Senior Training Assistant, Krishi Vigyan Kendra, was broadcast over All India Radio Trichur 31st January.

Dr. B. Krishnamoorthy Scientist S-3 gave a talk on Management of Fishery Resources under the auspices of the Agricultural Refinance Development Corporation, Madras, 11th December.

An interview with Shri P. Karunakaran Nair, Senior Training Assistant, KVK on Salient points of scientific prawn culture was broadcast over All India Radio, Trichur, 9th April.

A talk on role of Krishi Vigyan Kendra, Narakkal by Dr. V. Balakrishnan, Officer-in-charge, KVK was broadcast over All India Radio, Trichur, 15th April.

Prawn varieties for Pokkali fields, a talk by Shri K.V. George, Senior Training Assistant, KVK, was broadcast over All India Radio, Trichur, 9th April.

An article entitled Chemmeen in Malayalam by Shri A.K. Unnithan and P. Radhakrishnan, Senior Training Assistants, KVK was published in Kerala Karshakan, 1st July.

Distinguished visitors to the Institute
Headquarters, Cochin (bf)

1. Shri Rao Birendra Singh, Hon'ble Union Minister for Agriculture and Rural Reconstruction and President of the ICAR visited the Institute on 17 May 1981. Dr. O.P. Gautam, Director General, ICAR accompanied the Minister.

2. Dr. J.P. Troadec, Chief, Fisheries Department and Planning Service, FAO, Rome and Dr. D.H.R. Iyengar, Senior Officer, Trust Fund Operation Services.

3. Prof. George R. Allen, Consultant, International Fund for Agricultural Development, England accompanied by Shri Arjun Tapan, Under Secretary, Fund Bank Division, Department of Economic Affairs, Ministry of Finance, Govt. of India 22–24 September.

4. Mrs. Agnes Ajana, Principal Research Officer, Nigerian Institute for Oceangography and Marine Resources, Nigeria.

5. Dr. S.C. Venama, Fishery Resources Officer of FAO and Mr. Bergestran, Bay of Bengal Project, UNDP, 19–21 November.

6. Shri Fransico Sardinha, Minister of Agriculture, Government of Goa.

7. Dr. P.G. Padlar, Senior Aquaculturist and Dr. J. Kovari Aquaculture Engineer, Fisheries Department, Rome.

8. Dr. B.A. Huser, FAO/UNDP consultant at Tamil Nadu Agricultural University.

9. Dr. M.H. Ravindranath, Department of Zoology, University of Madras.

10. Dr. K. Gopalakrishnan, Aquaculture specialist, Department of Natural Sciences, Hawai.

11. Dr. C. Somerville, Expert in Fish Pathology, University of Stirling, U.K.

12. Dr. Ronald J. Robert, Director, Institute of Aquaculture Univresity of Stirling, U.K.

Bombay Research Centre :

5.7.81 : Shri Sujan Singh, Member of Parliament and Member of Governing Body, ICAR.

10.1.82 : Dr. R.M. Acharya, D.D.G. (Animal Science), ICAR New Delhi.

20.2.82 : Dr. Tibor Faruas, Institute of Biochemistry, Biol Res. Centre, Hungarian Academy of Sciences' Hungary.

Karwar Research Centre :

12.6.81 : Miss Sobha Nambisan, DRDS, Project Director, Karwar.

Mr. R.K. Torvi, Deputy Conservator of Forests, Karwar.

20.6.81 : Dr. S. Dutt, Professor & Head, Dept. of Marine Living Resources, Andhra University, Waltair.

24.6.81 : Dr. S.B. Jigalur, Dept. of Chemistry, S.S.K.B., College, Basavakalyan.

16.9.81 : Dr. R.R. Kamath, Rural Dev. Senior Instructor in A.H.Training Centre, Kudige.

22.9.81 : Dr. K.V.Ramana Murthy, Reader, Dept. of Marine Living Resources, Andhra University, Waltair.

5.12.81 : Mr. N.M.Kamat, Head Master, The Popular New English School, Chendia.

16.12.81 : Dr. G.Raju, Regional College of Education(NCERT) Mysore.

28.12.81 : Prof. P.D.Deodhar, Zoology Dept. KJ. Somaiya College of Science, Vidyavihar, Bombay-77.

29.12.81 : Mr. P.V.Arvil, Lecturer in Zoology, Christ College, Bangalore.

4.1.82 : Prof. S.S.Bandgar, D.B.J. College, Chiplun, Dist. Ratnagiri.

11.1.82 : Ch. Venkateswar Rao, Head of Dept. of Zoology, R.V.V.N. College, Dharnikota, (Guntur Dist.) A.P.

13.1.82 : Prof. R.D. Patil, Zoology Dept., S.S.V.P. Science College, Dhulia (Maharashtra.)

Prof. B.B. Pawar, Zoology Dept., S.S.V.P. Science College, Dhulia (Maharashtra).

27.1.82 : Prof. V.A. Ozarla, A. G. College Pune-4.
Prof. A. D. Maratha, A. G. College Pune-4
Prof. S. S. Pingale, A. G. College, Pune–4.

4.2.82 : Dr. V.S. Ranganathan, Dr. M.R. Delvi, Dr. Radha Sharnea and Dr. Chandrasekhar Reddy, Zoology Dept., Bangalore University, Bangalore–56.

Mangalore Research Centre :

1.4.81 : Dr. M.D.K.Kuthalingam, Dean, Fisheries College, Tuticorin.

3.4.81 : Shri S.R.Sreerangasamy, Dean (Basic Sciences) T.N.A.U. Coimbatore.

27.4.81 : Dr. T.C.N.Singh, Member of the Governing Body of ICAR, Vittal Rao Road, Bolar, Mangalore–1.

15.9.81 : Mr. Singsourinha Pengkeo, Head of Fisheries, Directorate of Livestock, Ministry of Agriculture, Lao PDR.

–do– : Mr. Thongsa Zaisauh, Chief of Livestock and Veterinary Division, Pakse Province, Lao PDR.

–do– : Mr. Phitsarath Ouday, Manager of State Farm, Vientiane Province, Lao PDR.

–do– : Mr. Sourya Boun Xth, Manager of State farm, Savanseakhet province.

–do– : Mr. Phirrasone Phomna, Chief of Livestock and Veterinary Division, Luangprabang Province.

-do- : Mr. Thoorphavanh Chanthy, Assistant Chief of Agriculture Division, Xam Mena Province Lao PDR

13.2.81 : Shri R. Badouis, C.I.F.E., Bombay.

Calicut Research Centre :

14.5.81 : Shri K.P. George, Joint Director, Dept. of Fisheries, Kerala.

5.11.81 : Shri Moideen Koya, Deputy Director, Public Relations, Calicut-20.

5.1.82 : 65 students and teachers from G.F.T. High School for Girls, Madappally.

18.2.82 : 60 students and 15 teachers from A.N.M.U.P. School, Edava, P.O. Ellumannam, (Via) Manantody.

2.3.82 : 60 students and teachers from Govt. High School for Girls, Parayancherry.

Vizhinjam Research Centre :

S.K. Bhadury, Joint Director (Engg.), Exploratory Fisheries Project, Bombay.

Dr. G. Krishnan Kutty, Prof. of Economics, N.S.S. College, Shertallay.

Shri P. Rajan Nair, Director, ICP, 'Bangkok' Co., Bangkok, Thailand.

Shri D.V. Rama Sarma, Reader in Zoology, Andhra University, Waltair.

Dr. M.P. Nair, Project Officer, District Rural Development Authority, Trivandrum.

Shri K. Jayanthan Namboothiri, Asst. Project Officer, District Rural Development Authority, Trivandrum.

Sr. Secunda, Professor of Zoology, Mercy College, Palghat.

P. Sulochanan, Deputy Director, Exploratory Fisheries Project, Cochin.

Shri T.E. Sivaprakasam, Joint Director, Exploratory Fisheries Project, Bombay.

Line Gery, French Consortium for the Fisheries Development, France.

Dr. C.C. Panduranga Rao, Director, Central Institute of Fisheries Technology, Cochin.

Shri A.S. Nagaraj, College of Fisheries, Mangalore.
Shri P.K. Thomas, Director, Central Tuber Crops Research Institute, Trivandrum.

Dr. T.J. Varghese, Prof. of Aquaculture, College of Fisheries, Bombay.

Dr. Akio Kanazawa, Faculty of Fisheries, Kagoshima University, Japan.

Shri Y. Sreekrishna, Professor (Fisheries Technology) Central Institute of Fisheries Education, Bombay.

Shri G. Santhanakumar, Professor of Zoology, G.V.N. College, Kovilpatti, Tamil Nadu.

Shri S. S. Vaidendaran, Audit Officer, Office of the Director of Audit Course, Madras.

Tuticorin Research Centre :

21.8.81 : Mr. K. Lakshmi Kanthan Bharathi, I.A.S., Commissioner and Secretary to Government, Forests and Fisheries Department, Tamil Nadu.

12.10.81 : Dr. Anand Saraya and Dr. Kasement Chalayandeja, Brackish Water Fisheries Division, Dept. of Fisheries, Thailand.

13.11.81 : Mr. S.N. Kumar, Assistant Educational Adviser, British Council , Mount Road, Madras.

6.1.82 : Dr. Akio Kanazawa, Faculty of Fisheries, Kagoshima University, Japan.

20.2.82 : Dr. A. Prakash, WHO consultant and party from Central Pollution Central Board, New Delhi.

10.3.82 : Mr. K.K. Varghese, Technical Officer, ARDC, Regina Mansion, Madras.

13.3.82 : Dr. David Happell, Curator, Molluscan Royal Scotish Museum, Edinburgh, Scotland.

Mandapam Regional Centre :

5.1.81 : Shri Krishnappa, Registrar, University of Agricultural Sciences, Bangalore.

5.1.81 : Shri H.M. Nagabushna, Comptroller, University of Agricultural Sciences, Bangalore.

3.7.81 : The Hon'ble Union Minister for Home Affairs, Shri Yogendra Makwana, made an unscheduled visit to this Regional Centre.

14.10.81 : Anant Saraya, Ph.D., Brackishwater Fisheries Division, Department of Fisheries, Ministry of Agriculture & Co-operatives, Bangalore, Thailand.

Ka. Semsant Chalagondesja, B.S.M.S. (Fisheries), Senior Fisheries Biologist, Brackishwater Fisheries Division, Polthep Building, Kasetsart Unit Campus, Bangkhen, Bangkok-9.

21.10.81 : Captain A.K. Mehra, Indian Navy, Coast Guard, Headquarters, New Delhi.

21.10.81 : Capt. O.A. Nair, Coast Guard, New Delhi.

21.10.81 : F.J. Vaz, Commissioner & Secretary, Forests and Fisheries, Tamil Nadu.

16.12.81 : Y.R. Runov, Vice Consul, USSR Consulate, General, Madras.

17.12.81 : K.A. Jacob, Additional General Manager, Southern Railway, Madras.

8.1.82 : His Excellency the Governor of Tamil Nadu, Shri Sadiq Ali, visited the Regional Centre.

20.2.82 : Dr. Salim Ali, a renowned Ornithologist along with his colleague Dr. S.A. Hussain visited the Regional Centre, for studying the migratory pattern of birds from India to Sri Lanka and vice versa.

5.1.82 : Dr. Akio Kanazawa, Kagoshima University, Japan.

14.3.82 : Dr. David Heppell, Curator, of Rotaz Scottish Museum, Edinburgh.

Madras Research Centre :

1.4.81 : Lt. Col. J. C. Sawhney (Retd.), Executive Secretary, World Wild Life Fund–India, Lalbag, Parel, Bombay-12.

23.5.81 : Dr. Vijai Dev Singh, Deputy Commissioner (Fisheries) Ministry of Agriculture, Krishi Bhavan, New Delhi.

–do– : Shri P.G. Padlan, Aquaculture Development and Conservation Programme, Fisheries Dept., FAO, Rome.

–do– : Shri J. Kovari, Aquaculture Development and Conservation Programme, Fisheries Dept., FAO, Rome.

9.7.81 : Dr. M.D.K. Kuthalingam, Dean, Fisheries College, Tuticorin.

11.7.81 : Shri R. Vijayakumar, I.A.S., Sub–Collector, Chingelpattu District, Tamil Nadu.

22.7.81 : Dr. Newit Popper, Research Dept., Israel.

18.9.81 : Shri K. Palasanthian, Managing Director, Cey–Nor Development Foundation, Calcutta.

20.9.81 : Mr. H.D.R. Iyengar, FAO, Rome.
Mr. S.S. Trordec, FAO, Rome.

3.10.81 : Mr. K. Chalayondeja, Dept. of Fisheries, Ministry of Agriculture and Co–operatives, Bangkok, Thailand.

–do– : Dr. A. Saraya, Dept. of Fisheries, Ministry of Agriculture and Co–operatives, Bangkok, Thailand.

23.10.81 : Dr. J. Templeton, Fisheries Development Ltd. Consultant to E.E.C. & M.P.E.D.A.

1.11.81 : Mr. M.N. Sadaphal, A.D.G. (Cdn.), ICAR, Krish Bhavan, New Delhi.

8.11.81 : Mr. E.Q.E. Odiong, Fisheries Division, Calabar, Nigeria.

–do– : Mr. A.A. Aserourmu, Fisheries Division, Calabar, Nigeria.

–do– : Mr. L.O. Abuah, Fisheries Division, Calabar, Nigeria.

8.11.81 : Mr. A.A. Akinde, Fisheries Division, Nigeria.

8.11.81 : Mr. D.A.S. Gnandoss, FAO, Lagos, Nigeria.

9.12.81 : Mr. D. Sundaresan, Zonal Co-ordinator, Lab-to-Land Programme.

27.12.81 : Mr. B.S. Sarma, Secretary, Fisheries Department, West Bengal.

3.1.82 : Dr. H.C. Srivastava, Hindustan Lever Research Centre, Andheri East, Bombay-99.

15.1.82 : Mr. K.K.G. Menon, Hindustan Lever Research Centre, Andheri East, Bombay-99.

10.2.82 : Dr. R.M. Acharya, Deputy Director General, ICAR, New Delhi.

18.2.82 : Mr. S. Joseph, Wild Life Warden, Madras-20.

18.3.82 : Mr. S. Sreenivasan, I.A.S., Secretary, Dept of Fisheries, Tamil Nadu.

Kovalam Field Laboratory :

8.4.82 : Shri A.M. Mohamed Hussain, Additional Chief Conservator of Forests, Madras-6.

28.4.82 : Shri Ajoyendra Pyal, I.A.S., Assistant Collector, Chingelpet District, Tamil Nadu.

28.5.82 : Shri R. Rajamani, Joint Secretary, P.M.'s Office, New Delhi.

23.9.82 : Dr. P.V. Salvi, Vice Chancellor, Konken Krishi Vidyapeeth, Dapoli, Maharashtra.

23.9.82 : Dr. Kirti Singh, Dean, Narendra Dev University of Agriculture and Technology, Faizabad, U.P.

20.11.82 : Dr. K.M. Jauncey, Research Lecturer, Institute of Aquaculture, University of Stirling, Scotland, U.K.

27.11.82 : Dr. A.N. Bose, IIT, Kharagpur, West Bengal.

17.2.83 : Dr. R. Raghu Prasad, Emeritus Scientist, ICAR, MRC of CMFRI, Madras-105.

13.2.83 : Shri Kiranmay Nanda, Minister-in-charge of Fisheries, Govt. of West Bengal.

18.3.83 : Shri P. Sivakami, I.A.S., Sub-Collector, Chingelpet District, Tamil Nadu.

Kakinada Research Centre :

16.2.82 : Shri Edel Dteves, Socio-Economist, C/o F.A.O., Madras.

13.9.82 : Prof. P.N. Ganapathi, Emeritus Scientist, Dept. of Zoology, Andhra University, Waltair.

5.10.82 : Shri G. Raghavan, Project Director, DRDA, E.G. District.

16.11.82 : Shri Cherian Kurian, Zamoron International, Cochin.

PARTICULARS OF SCIENTISTS DEPUTED ABROAD DURING 1981–82

Sl. No.	*Name & Designation*	*Purpose*	*Duration*	*Place/country*
	1981			
1.	**Shri V.S.K. Chennubhotla** Scientist S–2	To undergo training course on Gracilaria Algae organised by the South China Fisheries Development Programme under FAO/UNDP Programme at the University of Philippines.	1—30 April, 1981	Philippines
2.	**Shri S. Mahadevan** Scientist S–2	To undergo advance training in fish diseases at Virgenia Instt. of Marine Sciences at the Marine Laboratories, Aberdeen and in the Instt. of Aquaculture University of Stirling under FAO/UNDP	3 month from 8.9.81	USA & Scotland
3.	**Shri K. Nagappan Nayar** Scientist S–3	Deputed abroad to participate in World Conference on Aquaculture and International Aquaculture Trade Show at Venice, Italy from 21–25 Sept. 81 and to visit laboratories in Italy, Spain and France under FAO/UNDP Programme (Study tour)	12.9.81 to 17.11.81 (8 weeks)	Italy, Spain & France

1	2	3	4	5
4.	**Dr. P. V. Rao** Scientist S–3	–do– and to visit labs. in Italy, France & U.K.	7 weeks from 16.9.81 to 5.11.81	Italy, France & U.K.
5.	**Dr. E.G. Silas** Director	To attend meeting of FAO Advisory Committee of Experts on Marine Resources Research (ACMRR) at Rome, Italy.	6–16 November 81	Rome
6.	**Dr. M. J. George** Scientist S–3	To attend workshop on the Scientific Basis for the Management of Penaeid Shrimp at Key West, Florida, USA.	18—24 November 1981	Florida, USA
	1982			
7.	**Shri K. A. Narasimham** Scientist S–2	Deputed to Singapore to participate in a workshop on Bivalve Culture at Singapore organised by IDRC Canada and the Primary Productor Dept. of Singapore Ministry of National Development.	16—19 February 1982	Singapore

LIBRARY AND DOCUMENTATION

During the year 1981, a total number of 1033 books and 2900 periodicals/reports were added to the headquarter's library. The libraries at the Regional and Research Centres of CMFRI were also strengthened with addition of essential books and periodicals.

The inter-library collaboration was continued as usual and the library facilities available at the Institute were utilised by a wide cross section of researchers, scholars and students belonging to different institutes and organisations in India and also from abroad. The following publications were issued by the Institute during the year and the library looked after their distribution:

1. Indian Journal of Fisheries
   Volumes 25, 26 and 27

2. CMFRI Bulletin No. 30-A
   Proceedings of the seminar on the role of small-scale fisheries and coastal aquaculture in integrated rural development, 6-9 December, 1978, Madras.

3. CMFRI Bulletin No. 30-B
   Present status of small-scale fisheries in India and a few neighbouring countries.

4. Marine Fisheries Information Service-
   Technical and Extension Series Nos. 27 to 33

5. CMFRI Special Publication No. 7
   Manual of research methods for Crustacean biochemistry and physiology.

FINANCE :

The actual expenditure incurred by the Institute during the financial year 1981-82 under Plan and Non-Plan is as follows.

(Rupees in lakhs)

	PLAN	NON-PLAN
Pay, Allowances & T.A.	3.93	99.87
Recurring Contingencies	48.75	13.78
Non-Recurring Contingencies		
1. Equipment	5.53	0.95
2. Works	51.42	—
3. Others	5.28	0.40
Total Non-Recurring Cont.	62.23	1.35
Total	114.91	115.00

PROGRESS OF RESEARCH

FISHERY RESOURCES ASSESSMENT DIVISION

Sample Survey for Estimation of Marine Fish Production and effort expended (FSS/FRA/1.1)

Annual production of marine fish

The estimated total marine fish landings in India during 1981 was about 1.38 million tonnes as against 1.25 million tonnes during 1980, showing an increase of about 10%. While West Bengal, Tamil Nadu, Pondicherry, Karnataka, Goa, Maharashtra, Gujarat and Lakshadweep recorded higher landings, Orissa and Kerala accounted lower catches as compared to 1980. The catch in Andhra Pradesh and Andamans remained more or less the same (Table-1).

Table – 1

Statewise total marine fish landings in India during the years 1981 *and* 1980 (*in tonnes*)

Sl. No.	State	1981	1980
1.	West Bengal	20,107	*6,097
2.	Orissa	35,655	39,375
3.	Andhra Pradesh	1,16,143	1,16,013
4.	Tamil Nadu	2,21,296	2,17,394
5.	Pondicherry**	10,755	9,390

* Contai coast only.
** Excluding Mahe and Yenam which are included in Kerala and Andhra Pradesh respectively.

Sl. No.	State	1981	1980
6.	Kerala	2,74,395	2,79,543
7.	Karnataka	1,53,349	1,15,322
8.	Goa***	34,498	24,490
9.	Maharashtra	2,72,587	2,31,763
10.	Gujarat	2,34,510	2,03,494
11.	Andamans	1,862	1,803
12.	Lakshadweep	3,300	2,909
13.	Private Trawlers‡	—	2,244
	TOTAL	13,78,457	12,49,837

STATEWISE MARINE FISH PRODUCTION

West Bengal

During 1981, the total marine fish landings in West Bengal were estimated at about 20,000 tonnes in comparison to 6,000 tonnes in 1980. However, it may be noted that during 1981, 24 Parganas district was covered for the first time in addition to Contai Coast of Midnapore district in the regular survey programme for marine fish catch estimates in West Bengal. The species that were landed in substantial quantities were catfishes (4,400 tonnes-22%), pomfrets (3,300 t-16%), hilsa shad (2,700 t-13%), other clupeoids (2,400 t-12%), non-penaeid prawns (1,300 t-6%) and seer fish (1,100 t-5%).

Orissa

The total catch declined by about 3,700 t (9%) in 1981 as compared to previous year. The reduction in the total landings was mainly due to a fall in the catches of pomfrets and hilsa shad whose catches were lower by about 5,400 and 3,000 t. respectively. The catch of catfishes and lesser sardines, however, increased by about 4,000 and 2,600 t. respectively.

*** Excluding Daman and Diu which are included in Gujarat.

‡ Partial coverage of larger trawlers. Comparable figure for 1981 is not available.

Andhra Pradesh

The total landings in Andhra Pradesh remained more or less stationary in 1981. The species that showed an increase in their landings were white baits, silver bellies, catfishes, lesser sardines, penaeid prawns and perches, the increase being 7,600, 6,100, 1,900, 1,800, 1,500 and 1,000 tonnes respectively. This was offset by the decrease in the landings of ribbon fish, *Thryssa*, mackerel, non-penaeid prawns and sciaenids, the decrease in their landings being 7,400, 4,800, 2,900, 2,700 and 2,500 tonnes respectively.

Tamil Nadu

The total landings in Tamil Nadu during 1981 increased marginally by about 4,000 tonnes as compared to 1980 with a significant increase in the landings of silverbellies to the extent of about 13,000 tonnes. The catch of penaeid prawns, other crustaceans and *Thryssa* also showed an increase of about 4,500, 3,300 and 1,400 tonnes respectively. A decline in the landings of croakers, lesser sardines, white baits, elasmobranchs and seer fish by about 6,400, 5,500, 4,800, 2,200, 1,700 tonnes respectively was also noticed.

Pondicherry

An increase of about 1,400 tonnes (15%) in the total catch was noticed during 1981 when compared with that of 1980. While the landings of carangids, flying fish and perches increased by 1,200, 600 and 300 tonnes respectively, the catch of lesser sardines declined by about 1,400 tonnes.

Kerala

The total catch in Kerala during 1981 declined marginally by about 5,100 tonnes (2%) compared to the previous year. A significant increase in the catch of oil sardine by about 77,000 tonnes was noticed. However, another major fishery of this state, prawn fishery suffered a set back with a decline of about 30,000 tonnes. This was to a great extent due to the

fall in the catches of prawns in Sakthikulangara, to the tune of about 27,000 tonnes in 1981 as compared to 1980. The other important species that showed a decline in their landings were perches, ribbon fish, tunnies, catfish, white baits, lesser sardines and croakers, the reduction being 9,300, 5,900, 5,100, 4,400, 3,500, 3,400, and 3,000 tonnes respectively.

Karnataka

In Karnataka, the total marine fish landings showed a substantial increase of about 38,000 tonnes (33%) during 1981 as compared to 1980. The catch of oil sardine increased significantly by about 23,000 tonnes contributing substantially to the increase in the total catch of the state. The landings of catfishes, tunnies, lesser sardines and penaeid prawns also increased by about 2,100, 1,600, 1,200 and 1,000 tonnes respectively. The catch of silverbellies, ribbon fish, croakers and perches however showed a decline of about 3,000, 1,300 1,200 and 700 tonnes respectively.

Goa

An increase of about 10,000 tonnes (41%) in the total landings was noticed during 1981 as compared to 1980. While the landings of oil sardine, mackerel, catfishes and perches increased by about 5,200, 1,500, 1,100 and 900 tonnes respectively. ribbon fish catch showed a decline of about 400 tonnes.

Maharashtra

The total marine fish catch in Maharashtra during 1981 was estimated at 2.73 lakh tonnes. The important fisheries of the state viz. Bombay duck, non-penaeid prawns, penaeid prawns, croakers, pomfrets and catfishes landed about 30, 20, 8, 6, 6 and 4 per cent respectively of the total catch.

Gujarat

In Gujarat, the total marine fish landings increased by about 31,000 tonnes (15%) during 1981 as compared to 1980.

Bombay duck, the major fishery of this state, showed an increase in the catch by about 17,400 tonnes. The other species that showed increase in their landings were other crustaceans, pomfrets, catfishes, croakers, perches and carangids the improvement being 11,600, 6,600, 5,100, 3,600, 2,400 and 2,100 tonnes respectively. The catch of eels, penaeid prawns and ribbon fish showed a decline of about 6,200, 3,500 and 2,500 tonnes respectively.

Andamans

A marginal increase of about 60 tonnes (3%) in the total catch was noticed during 1981 as compared to 1980. While catches of silverbellies and white baits increased by 170 and 90 tonnes respectively, the catch of perches showed a decline of about 110 tonnes.

Lakshadweep

The total marine fish catch in Lakshadweep showed a marginal increase of about 400 tonnes (13%) during 1981. This is mainly due to higher landings of tunnies which showed an increase of about 500 tonnes. Elasmobranchs and perches, however, showed a decline of about 100 and 60 tonnes respectively.

Table – 2

Composition of marine fish catch in India during 1980 *and* 1981 (*in tonnes*)

Sl. No.	*Name of fish*	1981	1980
1.	Elasmobranchs	56,009	57,862
2.	Eels	5,027	12,082
3.	Catfishes	59,390	43,745
4.	*Chirocentrus*	11,794	12,805
5. (a)	Oil Sardine	221,026	115,744
(b)	Lesser Sardines	61,980	67,053
(c)	*Hilsa ilisha*	5,407	6,996

Sl. No.		Name of fish	1981	1982
	(d)	Other *Hilsa*	18,267	9,127
	(e)	*Anchoviella*	33,383	33,684
	(f)	*Thrissocles*	13,637	19,342
	(g)	Other *Clupeids*	44,999	38,270
6.	(a)	*Harpodon nehereus*	137,790	95,505
	(b)	*Saurida & Saurus*	10,982	11,332
7.		*Hemirhamphus & Belone*	1,799	1,653
8.		Flying fish	3,109	1,255
9.		Perches	31,325	38,541
10.		Red Mullets	3,453	2,416
11.		Polynemids	4,248	6,056
12.		Sciaenids	82,686	89,360
13.		Ribbon fish	41,569	62,690
14.	(a)	*Caranx*	9,166	24,265
	(b)	*Chorinemus*	4,985	4,182
	(c)	*Trachynotus*		40
	(d)	Other carangids	23,194	945
	(e)	*Coryphaena*		302
	(f)	*Elacate*		379
15.	(a)	*Leiognathus*	69,449	54,400
	(b)	*Gazza*		186
16.		*Lactarius*	8,211	7,415
17.		Pomfrets	48,728	38,231
18.		Mackerel	48,660	55,279
19.		Seer fish	27,553	25,986
20.		Tunnies	17,803	20,371
21.		*Sphyraena*	2,125	1,782
22.		*Mugil*	2,155	2,030
23.		*Bregmaceros*	464	916
24.		Soles	15,864	13,633
25.	(a)	Penaeid Prawns	83,539	112,037
	(b)	Non-penaeid prawns	61,430	58,700
	(c)	Lobsters	1,481	679
	(d)	Other Crustaceans	43,934	25,386
26.		Cephalopods	9,548	11,335
27.		Miscellaneous	52,288	65,840
		TOTAL	13,78,457	12,49,837

Pelagic and demersal group of fishes

The pelagic group of species comprises of *Chirocentrus,* oil sardine, lesser sardines, hilsa shad, other shads, *Anchoviella, Thrissocles,* other clupeids, Bombay duck, *Hemirhamphus* & *Belone,* flying fish, ribbon fish, carangids, mackerel, seer fish, tunnies, *Sphyraena, Mugil,* and *Bregmaceros.* The elasmobranchs, eels, catfishes, lizard fishes, perches, red mullets, polynemids, sciaenids, silverbellies, *Lactarius,* pomfrets, soles, prawns, lobsters and cephalopods form the demersal group.

While the total pelagic fish catch increased from 631,115 tonnes in 1980 to 759,681 tonnes in 1981, the demersal catch during 1981 remained the same as compared to 1980, the respective figures being 618,776 and 618,722 tonnes.

Pelagic Group of Fishes

Oil Sardine

During 1981, the oil sardine landings showed an increase of about 1,05,000 tonnes (91%) as compared to 1980. Both Kerala and Karnataka landed substantial quantities contributing to the total all India oil sardine catch, their individual share being 66% and 30% respectively.

Mackerel

The catch of mackerel during 1981 showed a decline of about 6,600 tonnes (12%). While Tamil Nadu, Andhra Pradesh and Kerala recorded lower landings by about 3,300, 2,900 and 2,300 tonnes respectively, Goa accounted for an increase of about 1,500 tonnes.

Bombay Duck

The Bombay duck catch during 1981 increased by about 42,000 tonnes (44%). Higher landings in the states of Maharashtra and Gujarat accounted for the significant increase in the total catch of Bombay duck in India. While Maharashtra showed 59% Gujarat recorded 30% of the country's total catch of Bombay duck.

Lesser Sardines

The total catch of lesser sardines declined by about 5,100 tonnes (8%). Reduced landings in the states of Tamil Nadu, Kerala and Pondicherry by about 5,500, 3,400 and 1,400 tonnes respectively brought down the total all India catch. Andhra Pradesh and Karnataka, however, recorded higher landings by about 1,800 and 1,200 tonnes respectively.

Demersal Group of fishes

Penaeid Prawns

A decline to the extent of about 28,000 tonnes (25%) was noticed in the total catch of penaeid prawns during 1981 as compared to 1980. This decline was mainly brought about by a sharp fall in Kerala particularly in Sakthikulangara area where the fall in the catch was to the extent of about 27,000 tonnes. In Gujarat and Maharashtra also there was a decline to the tune of about 3,500 and 1,700 tonnes respectively in 1981 as compared to 1980. However in Tamil Nadu, Andhra Pradesh and Karnataka the landings increased by about 4,500, 1,100 and 1,100 tonnes respectively.

Non-penaeid prawns

The landings of non-penaeid prawns during 1981 showed a marginal increase of about 2,700 tonnes (5%). While Maharashtra and Gujarat recorded higher landings by about 5,500 and 600 tonnes respectively, the landings in Andhra Pradesh and Kerala declined by about 2,700 and 1,500 tonnes respectively.

Sciaenids

The landings of sciaenids during 1981 showed a decline of about 6,700 tonnes (7%) as compared to 1980. The states of Tamil Nadu, Kerala and Andhra Pradesh, recorded lesser landings to the extent of about 6,400, 3,000 and 2,500 tonnes respectively. The landings in Gujarat and Maharashtra, however, increased by about 3,600 and 3,500 tonnes respectively.

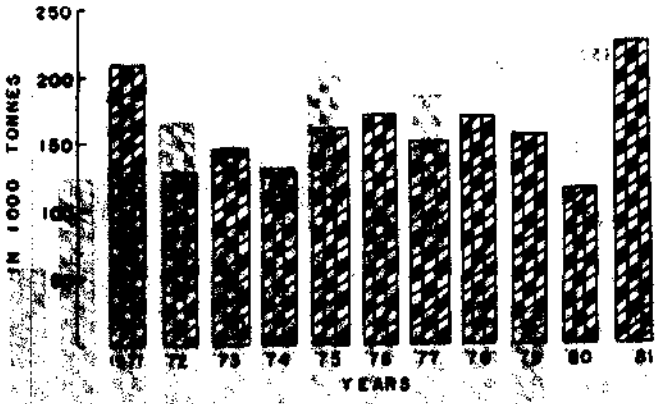

Fig. 1. Landings of oil sardine during 1971 *to* 1981.

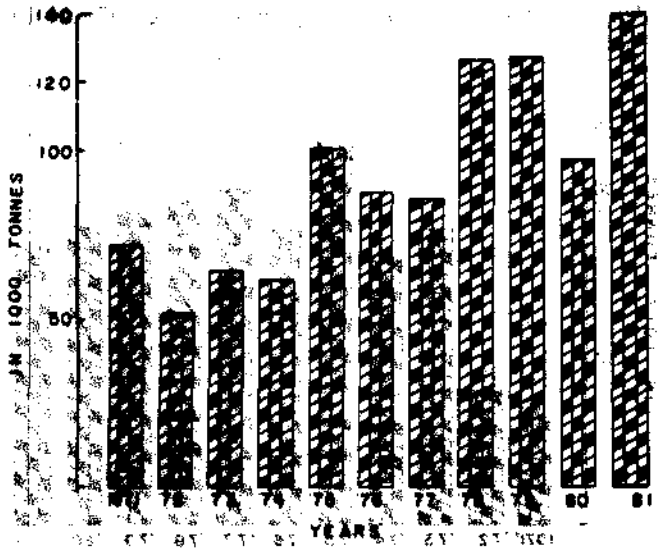

Fig. 2. Landings of Bombay duck during 1971 *to* 1981.

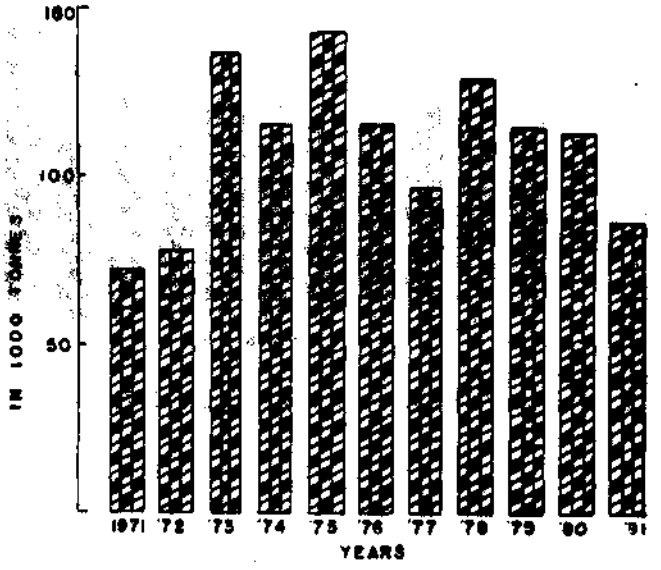

Fig. 3 *Landings of Penaeid prawns during* 1971 to 1981.

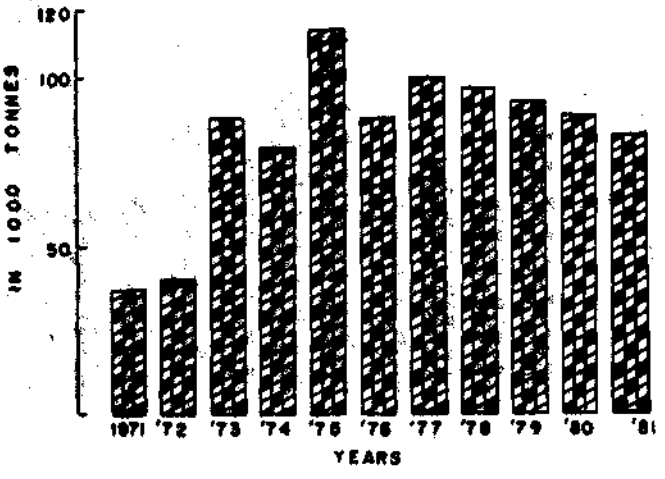

Fig. 4. *Landings of Sciaenids during* 1971 to 1981.

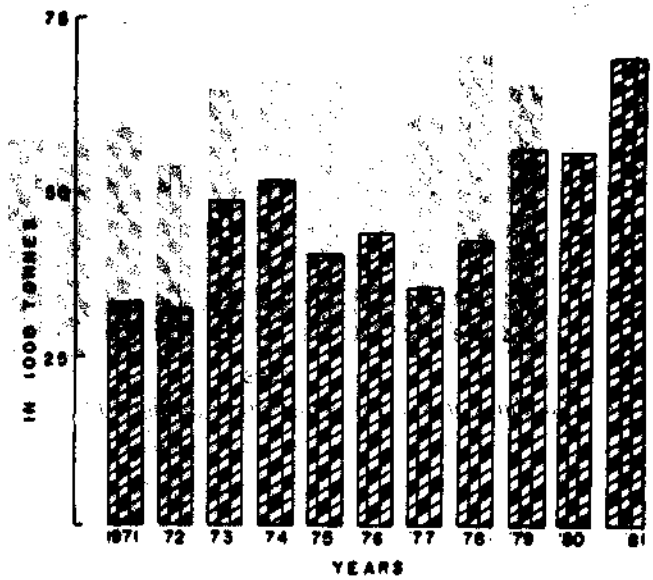

Fig. 5. *Landings of Silver bellies during* 1971 to 1981.

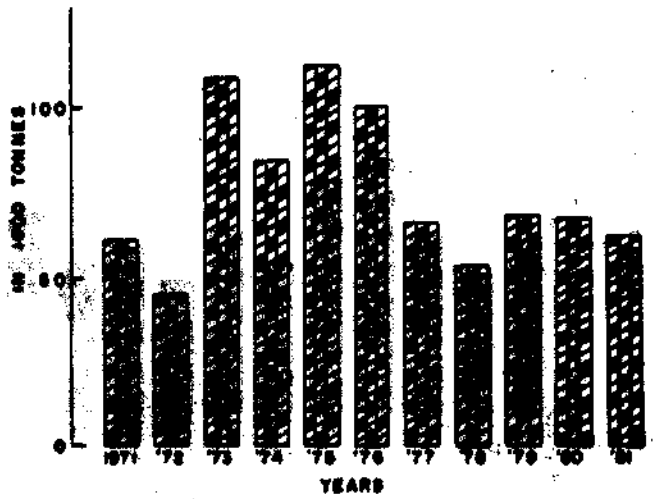

Fig. 6. *Landings of lesser sardines during* 1971 to 1981.

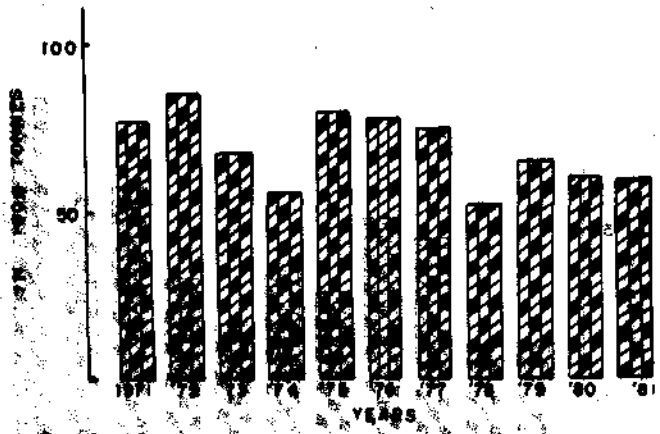

Fig. 7. *Landings of Non Peaneid-Prawns during* 1971 *to* 1981.

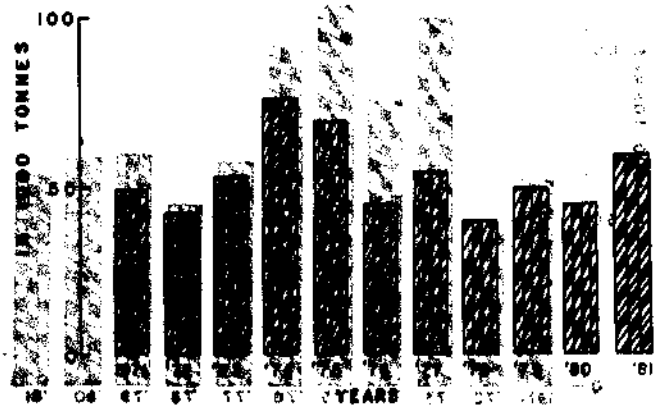

Fig. 8. *Landings of Cat fishes during* 1971 *to* 1981.

Catfishes

A substantial increase to the extent of about 15,600 tonnes (36%) in the total catch of catfishes was noticed during 1981 as compared to 1980. This was possible by comparatively higher landings of catfishes in the states of Gujarat, Maharashtra, Karnataka and Andhra Pradesh to the extent of about 5,100, 2,400, 2,100 and 1,900 tonnes respectively. Kerala, however, recorded lower landings by about 4,400 tonnes.

Elasmobranchs

The landings of elasmobranchs during 1981 declined marginally by about 1,900 tonnes (3%). While Tamil Nadu, Kerala and Gujarat accounted for the decline by about 2,200, 1,900 and 1,100 tonnes respectively, the landings in Maharashtra and Karnataka increased by about 1,900 and 1,200 tonnes respectively.

Silverbellies

An increase of about 15,000 tonnes (27%) in the total catch of silverbellies was seen during 1981 as compared to 1980. This was mainly due to higher landings in the state of Tamil Nadu and Andhra Pradesh. the increase being about 13,000 and 6,000 tonnes respectively. However, Karnataka and Kerala recorded lower landings to the extent of about 3,000 and 1,300 tonnes respectively.

Marine fish production during the financial year 1981–82

The total marine fish production in India during the financial year 1981–82 was 1.42 million tonnes (Table–3). Kerala State accounted for the maximum landing with 3.05 lakh tonnes forming about 21% of the total all India landings. The other leading maritime states in the order of abundance were Maharashtra, Gujarat, Tamil Nadu, Karnataka and Andhra Pradesh, the total landings in these states respectively being 2.56 lakh tonnes (18%), 2.45 lakh tonnes (17%), 2.35 lakh tonnes (16%), 1.63 lakh tonnes (11%) and 1.08 lakh tonnes (8%).

Oil sardine formed the major catch with 2.57 lakh tonnes constituting about 18% of the total marine fish landings in India. Among other major fisheries, Bombay duck, accounted for 1.33

lakh tonnes (9%), penaeid prawns 0.88 lakh tonnes (6%), croakers 0.87 lakh tonnes (6%), silver bellies 0.68 lakh tonnes (5%), catfishes 0.65 lakh tonnes (5%), other sardines 0.58 lakh tonnes (4%) and non-penaeid prawns 0.51 lakh tonnes (4%).

Frame Survey (FSS/FRA/FS 1.2)

The voluminous census data collected during 1980 were processed in detail and the results were published in *M.F.I.S.* No. 30 in August 1981. Some of the important results are as follows.

Among the maritime states, the maximum number of fishermen population is found in Kerala (6.40 lakh). The number of fishermen per km. coast line is also the highest in Kerala (1,143) followed by Karnataka (418), Tamil Nadu (396), Andhra Pradesh (336), Goa (261), Orissa (244), West Bengal (139) and Gujarat (125). The average family size at the all India level is 5.7. Among the states Karnataka records the maximum family size (7.2).

An interesting feature noticed is that the percentage of fishermen engaged in actual fishing is more or less the same in all the states (around 23%). Among them, the percentage of fishermen engaged in full time fishing ranges from about 70 to 90 in all the maritime states except in West Bengal (47).

The total number of mechanised boats in the country is about 19,000. The maximum number of them is found in Maharashtra (4,718) followed by Gujarat (3,413), Kerala (3,038), Tamil Nadu (2,757), Karnataka (2,004) and Goa (908). In other states the number is less than 900.

Among non-mechanised fishing crafts, out of 38,000 plank built boats, 30% are found in Andhra Pradesh, 24% in Tamil Nadu, 12% in Kerala, 10% in West Bengal. In the remaining states they constitute less than 10% each. In the case of catamarans Tamil Nadu (43%) leads followed by Andhra Pradesh (30%) and Kerala (16%). Kerala ranks first with (48%) of total dug-out canoes, Karanataka coming second (21%). followed by Tamil Nadu (10%) and Andhra Pradesh (8%).

Out of 2.16 lakh drift/gill nets, Tamil Nadu accounts for 55%, Andhra Pradesh 20%, Kerala 11% and other states less than 5% each. As regards 49,000 fixed bagnets, Gujarat has 45%, Andhra Pradesh 30% and West Bengal 13%. Almost 90% of total number of boat seines are found in the states of Kerala (33%), Andhra Pradesh (33%) and Tamil Nadu (24%).

Stock assessment and estimation of potential yield of commercially important fishes (FSS/FRA/1.3)

Catch and effort data on prawn landings from Cochin area have been compiled for a period of 7 years. The work of compilation of length frequency and other related data was taken up.

National Fishery Data Centre (FSS/FRA/St. 1)

As a prelude to computerisation, codes have been updated in respect of fin and shell fishes and other living resources. Coding and punching of fishery data continued. Restructured schedules accommodating codes have been prepared for the use of field staff.

Standardisation of Fishing effort (FSS/FRA/1.4)

The data on gearwise estimates of catch and effort of the landings of oil sardine and mackerel in Karnataka for the years 1977 to 1981 were analysed for arriving at standardised fishing effort.

Survey of esturarine fisheries (FSS/FRA/1.5)

Stratification of Vembanad lake area into 8 zones was carried out and a pilot sampling scheme has been developed.

Exploited marine fishery resources of maritime states (FSS/FRA/1.6)

A detailed report on statewise, districtwise and gearwise estimates of catch and effort in India for the year 1980 was finalised.

Socio-economic surveys of small scale fisheries at selected centres for an integrated development of coastal rural sector (FSS/FRA/1.7)

A socio-economic survey was undertaken in Alantalai Village in Tirunelveli district of Tamil Nadu coast. The study showed that the initial investment for a catamaran unit came to about Rs. 9950. The annual gross income from a unit worked out to Rs. 9,300. Excluding the family labour and operational cost, the net income came to about Rs. 4050. The detailed report is under publication.

During the year, a survey was taken up in Kanyakumari and Tirunelveli districts of Tamil Nadu to study the impact of motorisation of catamaran units. The relevant data have been collected and were being processed.

Impact of purse-seine operations on the socio-economic conditions of traditional fishermen (FSS/FRA/1.8)

A detailed survey was carried out covering 41 landing centres from Quilon to Manjeswar in Kerala State. The information gathered under this survey and the data on biological aspects were being examined to assess the impact of purse-seine operations.

The impact of mechanised fishing on the socio-economic conditions of fishermen in Sakthikulangara—Neendakara area (FSS/FRA/1.9)

The study showed that fishing and fishery related activities provided employment for about 2,100 persons in 1953, 5,800 persons in 1968 and about 7,500 persons in 1980, showing an increase of employment by more than $3\frac{1}{2}$ times from 1953 to 1980. It was seen that the families in the middle and higher income groups were more benefited by the additional income generated by mechanised fishing. The detailed results have been published in *MFIS* No. 29, July 1981.

Price spread at selected fish markets (FSS/FRA/1.10)

During the year, the price data were collected at the producing centre Sakthikulangara near Quilon in Kerala and also

from the consumer markets, such as Punalur, Kottarakkara, Kozhencherry, and Chengannur (all in Kerala). In order to study the marketing margins, information on transportation and handling charges was also collected and the data were being analysed.

Predicting trends of major fisheries in the maritime states of India using suitable forecasting techniques (FSS/FRA/1.11)

By using exponential smoothing method for a two parameter model, forecast for 1981 was made. The forecast value of production at all India level was 1.386 million tonnes for 1981 which agreed closely with the estimated fish landings namely 1.378 million tonnes.

Economics of mechanised fishing units (FSS/FRA/1.12)

Cost and earnings data from 50 trawlers pertaining to a period of 8 years in Calicut area were collected and being analysed.

Economic evaluation of paddy-cum-prawn culture (FSS/FRA/1.13)

Seventy sample holdings of 'pokkali' farms have been selected covering 16 villages in Narakkal–Parur area in Ernakulam district of Kerala State. The data regarding cost and returns of paddy cultivation were collected. The work of collection of data regarding prawn filtration was initiated.

A study of the role of women in small scale fisheries at Vypeen area (Kerala) (FSS/FRA/1.14)

Data pertaining to role of fisherwomen were collected from 500 households spread over 11 villages in Vypeen area and were being analysed.

Training in fishery resources assessment including population dynamics (CMFRI/TR/6)

During the period training in fisheries statistics and population dynamics was imparted to a batch of 11 trainees from Research Institutes, State Government Departments and Universities.

Personnel associated with the various projects of the Division

T. Jacob, G. Venkataraman, K. Alagaraja, S. K. Dharma Raja, K. Narayana Kurup, K. Balan, K. K. P. Panikkar, R. Sathiadas, M. Srinath, B. Prasanna Kumari, K. Vijayalakshmi, M. G. Dayanandan, C. R. Shanmughavelu, Syed Basheeruddin, S.S. Dan, G. Balakrishnan, U.K.Satyavan, Varughese Philipose, Varughese Jacob, G. Krishnankutty Nair, P.Sivaraman, V.Rajendran, V.P. Annam, A.Kanakkan, S. Haja Najumudeen, C.J. Prasad, P.L. Ammini, K. Santhakumari, C.V.Seshagiri Rao, K.V.S. Seshagiri Rao, P. Ananda Rao, G.C. Lakshmaiah, A. Hanumantha Rao, M. Mohamed Sultan, S. Manivasagam, K.S. Krishnan, R. Guruswamy, N. Retnaswamy, I.P. Ebenezer, K. Ramakrishnan Nair, Jacob Jerold Joel, R. Bhaskaran Achari, T.G. Vijaya Warrier, M. Babu Philip, C.K. Krishnan, A.A.Thankappan, T. Girijavallabhan, K. Soman, S.B. Chandrangathan, P.K.Mahadevan Pillai, P. Karunakaran Nair, K.C.Yohannan, A. Ganapathy, K. Thulasidas, S. Siddalingiah, Sapan Kumar Ghosh, K. Dhanaraju, K. Ramasomayajulu, T. Chandrasekhara Rao, H. Kather Batcha, L. Chidambaram, A. Srinivasan, C. Kansinathan, S. Russel Conrad Samuel, K. Ramdas Gandhi, M. Shriram, K. Chittibabu, S.K.Balakumar, Joseph Andrews, V. Sivaswamy, T.S.Balasubramanian, J.L.Oza, Y.D.Savaria, K.B.Waghmare, V. Thanapathi, S. Subramani, O.M.J.Habeed Mohamed, N. Palaniswamy, K. Muthiah, D. Sundararajan, V. Achutha Rao, M. Radhakrishnan, S. Satya Rao, M. Bose, S. Sankaralingam, P. Palani, V.S.Gopal, Ahamed Kamal Basha, S. Mahadevaswamy, N. Chennappa Gowda, T. Krishnankutty, K. Chandran, N. Narayana, P.M.Dalwadi, M. Chellappa, J. Krishna Babu, M. Chandrasekhar, N. Varatharajan, R. Somu, B. Sreedhara, Y.V.Venkatachalamurthy, S.S.Sugwekar, M. Padmasekhara, A. Prosper, D.G. Jadav, S.K.Sonar, A. Vijayakumar, U.B. Pawar, S.D. Dhuri, C.J. Josekutty, J.R. Dias Johny, Hameed Batcha, M.B. Seynuddeen, K.P. George, S. Sreenivasan, P.P. Pavithran, M.R. Beena, P.T. Mani, M. Manivasagam, R. Subramanian, Sukdev Bar, M.S. Naik, P.B. Dey, C. Balasundaram.

PELAGIC FISHERIES DIVISION

The major areas of research activities, in the Pelagic Fisheries Division, were mainly on Catpure fisheries carried out through 13 projects. The investigations carried out were concerned with monitoring and evaluation of resource characteristics and stock assessment of the oil sardine, Bombay duck, lesser sardines, mackerel, tunas and billfishes, anchovies, pomfrets and other major exploited pelagic fisheries. Good progress has been achieved under various projects during the year.

Resources of tunas and bill fishes (FB/PR/3.1)

E. G. SILAS, MADAN MOHAN, C. MUTHIAH, T. M. YOHANAN, P. P. PILLAI, A. A. JAYAPRAKASH, PON SIRAIMEETAN AND S. SRINIVASA RANGAN.

Major part of the research activities under the project was concentrated on the collection of information on the resources, present trend of exploitation and biology of tunas and bill fishes taken by various gears from the inshore waters of the mainland of India and from around Minicoy Island.

All India tuna landings in 1981 have been estimated as 17,803 tonnes which indicate a decline of about 2,568 tonnes from the landings in 1980. Analysis of the state-wise landings of tunas indicated that except in Orissa, Pondicherry, Gujarat and U.T. of Lakshadweep, in all the other states tuna landings showed a declining trend. About 34% of the total all India tuna landings was from Kerala and Tamilnadu. Maha-

rashtra and U.T. of Lakshadweep accounted for 8.0% and 13.7% of the total tuna catch respectively.

Among the tuna and billfish resources landed at the centres observed, tunas constituted more than 90% of the toal catch of the above resource. The percentage composition of different species of tunas and billfishes observed in different centres are given in Table 6. *K. pelamis* and *T. albacares* formed about 78% and 21% of the total tuna catch respectively at Minicoy. In all the centres, except at Tuticorin *E. affinis* formed the major species (>55%) in the tuna catch. At Tuticorin, *A. thazard* constituted about 62% of the total catch followed by *E. affinis* (28%) and other species. At Goa, 44.3% of the total catch was contributed by *T. tonggol.*

Centre-wise estimated total effort, catch and the CPUE of tunas and billfishes by different gears are given in Table 4. In all the centres except Minicoy, Vizhinjam and Tuticorin, tuna landing during 1981-82 indicated an increasing trend when compared to that during 1980-81. At Minicoy, pole and line (live-bait) fishery landed an estimated catch of 310 tonnes which was less than half of the catch in 1980. Purse seiners operated from Mangalore base has been responsible for the increased landing 1777 tonnes at this centre. At Vizhinjam, an estimated total catch of 414 tonnes have been landed mainly by drift gillnets and hooks and lines which indicate a decrease in the landing when compared to that in the previous year (652 tonnes). Drift gillnet fishery concentrated at Veerapandiapatnam and nearby centres during June to August landed 98% of the total annual landing of tunas at this centre. At Waltair, an estimated total catch of 36 tonnes were landed by the fishery employing hooks and lines.

Month-wise estimated CPUE of tunas at different centres are given in Table 5. The productive period for tuna fishery at different centres is summarised (based on the CPUE) as follows:

Minicoy	:	January—May
Goa	:	September—June
Mangalore	:	September—November
Calicut	:	April—June

Cochin	:	April—July
Vizhinjam	:	April—June
Waltair	:	April—July
Madras	:	April—July
Tuticorin	:	July—August

Table 4

Estimated Total Effort, Catch and CPUE for Tunas and Billfishes at Different Centres, April 1981—*March*, 1982.

(ANNUAL)

Centre		*Total catch (Kg)*	*Effort (Units)*	*CPUE*
Minicoy	PL :	310,352.0	1201	259.0
	STR :	10,269.0	131	79.0
Goa	DGN :	43,265.0	4642	9.3
Mangalore	DGN :	140,916.0	35136	4.0
	PS :	1766,514.0	103905	17.0
Calicut	DGN :	123,951.0	4248	29.2
Cochin	DGN :	1274,919.0	21566	59.1
	PS :	124,158.0	10001	12.4
Vizhinjam	DGN :	353,840.0	19638	18.0
	H&L :	60,388.0	77123	0.8
	SS :	896.0	1020	0.9
Tuticorin	DGN :	1226,878.0	6944	176.7
	STR :	1,059.0	2649	0.4
Madras	DGN :	39,152.0	13012	—
Waltair	SS :	304.0	1144	0.3
(B)	DGN :	224.0	7228	0.03
	H&L :	35,074.0	36718	0.95

DGN : Drift gillnet; PL : Pole and line; STR : Surface trolling; PS : Purse seine; H & L : Hooks and line; (B)DGN : Bottom set gillnet.

Table 5

Month-wise CPUE for Tunas and Billfishes at different Centres

(*Unit : Kg*)

		CENTRES / GEAR					
		Minicoy		*Mangalore*			*Calicut*
		PL	*STR*	*DGN (NM)*	*DGN (M)*	*PS*	*DGN*
April	1981	423.6	545.0	—	—	4.0	52.8
May	1981	156.0	387.6	—	—	—	72.8
June	1981	5.3	74.8	—	—	0	73.4
July	1981	—	52.8	—	—	—	30.2
August	1981	1.5	30.4	—	—	—	24.7
September	1981	4.6	64.5	3.1	34.9	15.8	44.0
October	1981	138.9	15.8	10.3	28.5	80.9	84.9
November	1981	240.1	30.1	4.5	9.9	28.6	17.4
December	1981	148.2	86.8	3.4	4.3	2.9	14.9
January	1982	180.9	123.9	0.1	0.2	—	9.8
February	1982	418.4	281.1	—	0.01	—	1.7
March	1982	363.7	—	0.63	0.1	0.7	18.4

		Cochin		Vizhinjam				Tuticorin	
		DGN	*PS*	*DGN(NM)*	*DGN(M)*	*H&L*	*SS*	*DGN*	*STR*
April	1981	122.1	56.7	14.9	—	3.7	—	7.3	0.03
May	1981	60.8	6.4	33.7	90.9	2.9	—	6.3	0.5
June	1981	103.9	—	64.7	90.3	—	—	35.0	—
July	1981	117.4	—	—	—	0.04	—	424.8	—
August	1981	32.3	—	—	—	1.05	0	242.1	—
September	1981	42.2	—	3.1	13.3	—	—	0.1	—
October	1981	11.6	7.0	11.7	33.9	0.01	—	6.2	—
November	1981	4.9	39.6	14.2	23.9	6.68	—	1.1	—
December	1981	2.5	—	5.4	—	0.3	2.9	0.1	2.6
January	1982	4.7	5.8	3.8	—	0.2	—	5.0	0.2
February	1982	28.7	6.1	5.3	—	0.2	—	8.4	—
March	1982	26.9	—	7.9	—	0.8	3.5	4.6	0.4

PL : Pole and line; STR : Surface trolling; PS : Purse seine; H&L : Hooks and line; SS : Shore seine; DGN(NM) : Drift gillnet; non-mechanised; (DGN(M) : Drift gillnet, mechanised

Table 6

Estimated total catch, Gear-wise catch (%) and species-wise percentage Composition of Tunas and Billfishes at different centres (April 1981–March, 1982)

(ANNUAL)

Centre	Gear	Catch	Gearwise %	E. affinis	A. thazard	A. rochei	T. tonggol	T. albacares	S. orientalis	K. pelamis	Billfishes (Total)
Minicoy	PL	310,352	96.8	0.1	0.1	—	—	21.1	—	77.9	0.6
	STR	10,269	3.2								
Goa	DGN	43,265	106.6	55.7	—	—	44.3	—	—	—	—
Mangalore	DGN	140,916	7.4	81.8	13.0	1.6	2.2	—	0.02	—	1.3
	PS	1766,514	92.6								
Calicut	DGN	123,951	106.6	84.1	12.1	3.8	—	—	—	—	—
Cochin	DGN	1274,919	91.1	60.9	33.6	1.5	1.7	0.1	1.6	0.5	0.6
	PS	124,158	8.9								

Centre	Gear	Catch	Gearwise %	E. affinis	A. thazard	A. rochei	T. tonggol	T. albacares	S. orientalis	K. pelamis	Billfishes (Total)
Vizhinjam	DGN	353,840	85.2	71.7	17.2	1.5	—	2.0	3.2	0.6	3.8
	H & L	60,388	14.5								
	SS	896	0.3								
Tuticorin	DGN	1226,878	99.9	28.0	61.7	0.02	2.5	5.2	0.01		
	STR	1,059	0.1	28.0	61.7	—	0.02	2.5	5.2	0.01	2.3
Madras	DGN	39,152	100.0	68.2	14.5	—	—	5.5	—	11.8	—
Waltair	SS	304	0.9	55.6	—	—	—	7.5	—	8.0	28.9
(B)	DGN	224	0.6								
	H & L	35,074	98.5								

PL : Pole and line; STR : Surface trolling; PS : Purse seine: DGN : Drift gillnet; H & L : Hooks and line; SS : Shore seine; (B) DGN : Bottom set drift gillnet.

Biological investigations on size distribution, sex ratio and maturity were carried out at different centres.

Observed ranges in the size of different species and the dominant modes are presented in Fig. 1. Small sized specimens of major species of tunas were recorded over wide area and period during the current year.

Studies on the sex ratio and maturity stages of tunas were carried out at Minicoy and Mangalore. At Minicoy, the incidence of developing specimens (Stage III and IV) of *K. pelamis* and *T. albacares* was relatively high during the period November to March. At Mangalore maximum number of *E. affinis* and *A. thazard* in the developing stages (Stage IV) was recorded in October. The percentage composition of gravid (Stage V) specimens of *A. rochei* and resting stage of *T. tonggol* were recorded at this centre during September and December respectively.

At Minicoy, studies were carried out on the availability of tuna live-baits. During 1981–82, the main bait-fishes used in the live-bait fishery were *Apogon* spp. and *Chromis* spp. Non-availability of *Lepidozygus tapeinosoma* during the main fishing season (December to April) was found to have adversely affected the pole and line live-bait fishery during the current year.

Based on the long line fishery data of tunas and related species from the Indian Ocean area, a comprehensive study on these resources has been made, indicating that great opportunities exist for the increased production of these resources from the EEZ and contiguous areas.

Resource characteristics of pomfrets (FB/PR/5.4)

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Investigations on the resource characteristics of pomfrets were vigorously continued at centres Veraval, Bombay, Karwar, Mangalore, Calicut and Cochin. At all these centres, the landings of pomfrets were better.

The highlight of landings were that the silver pomfret formed the exclusive catch at Veraval and Bombay, whereas at Karwar, Mangalore, Cochin and Calicut, in addition to the above species, *Parastromateus niger* also constituted the catches. *Pampus chinensis* were caught in trawl nets in appreciable numbers at Karwar.

At Veraval, the estimated catch of silver pomfret amounted to 387 tonnes showing an increase of 61% over the previous year. The most productive quarter being October–December. The trawl catch amounted to 284.5 tonnes forming 73.0% of the total catch and rest being accounted by the gill net. The cpue of trawl net and gill net was 6.0 and 3.5 kg. respectively. At Navabundar (Veraval) the catch amounted to 104 tonnes showing a slight increase over the previous year. At Bombay (Satpati) the estimated catch of gill net was 770 tonnes with cpue of 235 kg., showing a marginal improvement over the previous year. At Karwar, the resource investigations were initiated during the year. The catch estimated was about 49 tonnes, exclusively landed by trawlers. Silver, black and grey pomfret constituted 59% 29% and 12% of the catches respectively. At Mangalore about 102.5 tonnes of pomfret were landed, the trawlers alone accounting 93 tonnes, the share of silver and black pomfret being 75% and 25% respectively. At Kaup, the estimated catch was 50 tonnes, the black pomfret forming 33% and the rest by the white pomfret. The cpue of trawl net for silver pomfret was as high as 23 kg. The fishing at Calicut was good during September and October. *Pattenkolli*, gill net and *odam vala* contributed 81.5, 30.9 and 25.4 tonnes. The black pomfret alone constituted 138.5 .tonnes, forming 91% of the pomfret catch. The rest was accounted by *Pampus argenteus*. The estimated production of pomfret at Cochin during the year was 180 tonnes which was 98% more than the previous year. Drift net contributed to 87% of the total. Maximum catch rate was registered in August. The estimated catch at Pentakota (Puri) was 36 tonnes showing a three-fold increase over the previous year. The third quarter was the most productive.

By and large *P. argenteus* measuring more than 150 mm supported the fishery at most of the centres. An interesting

feature was the occurrence of small-sized fish of this species (40 mm onwards) during all the months excepting the quarter July–September at Veraval. At Bombay as small as 20mm silver pomfret occurred from September to November whereas at Karwar the smallest size was 40 mm during December.

The black pomfret *Parastromateus niger* formed the fishery at Mangalore, Karwar, Calicut and Cochin from July to April within a size range of 150–560 mm. However, fish measuring more than 196 mm dominated the catches. At Karwar, small-sized black pomfret (50 mm onwards) were available in the trawl catches right from November onwards. With a size range of 70 to 270 mm and with modes during February and March were at 110 and 180 and 200 mm respectively *P. chinensis* contributed to the fishery at Karwar.

At Veraval, from November to February the females were dominant; however, most of these were in resting stage. At Calicut, the females were dominant except during January, September and February. Immature fish supported the fishery Gravids were dominant from, April to August whereas the resting ones from September to December.

Unit stocks of oil sardine, mackerel and Bombay duck (FB/PR/6.1)
M.K.GEORGE AND S.MUTHUSWAMY

The investigations on the unit stocks of pelagic fish could not make much progress during the period under report due to malfunctioning of the equipments.

During February and March 1982 different buffer systems and buffer combinations were tried to resolve and detect starch gel electrophoretic patterns of soluble proteins like lactate dehydrogenase, esterase, Sodium dismutase eye-lens proteins in different species like Bombay duck, oil sardine, mackerel and thread-finbream. The preliminary tests indicate clear inter species electrophoretic patterns. However, more intensive species-wise tests for considerable period are essential to discover possible intra-species variations of some soluble proteins which alone will provide basic data required for unit stock separations of the species in question.

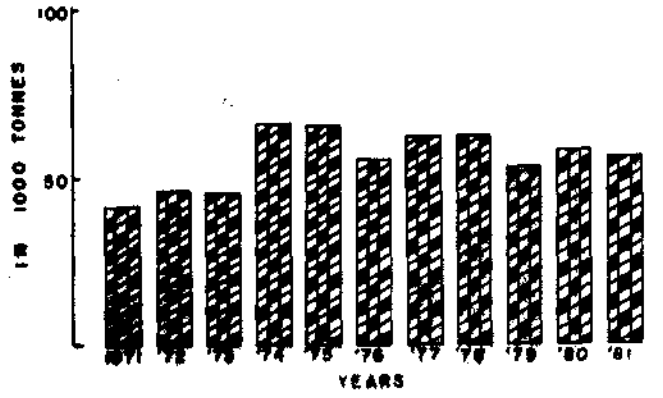

Fig. 9. *Landings of elasmo branchs during* 1971 to 1981.

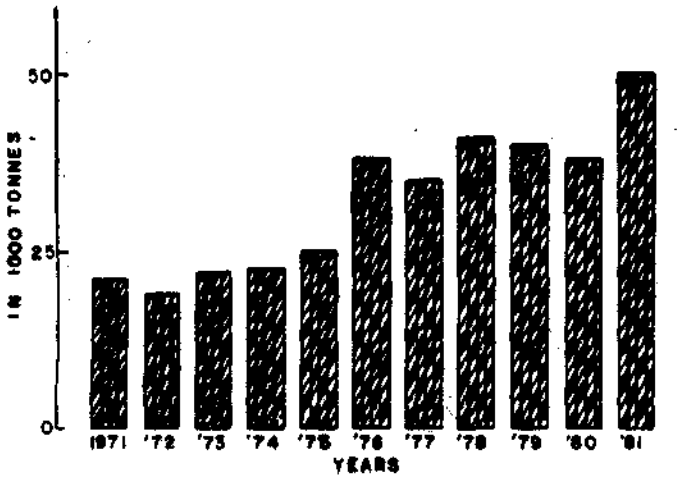

Fig. 10. *Landings of Pomfrets during* 1971 to 1981.

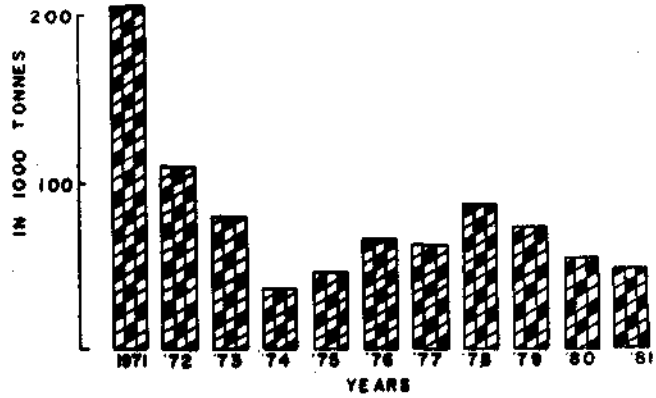

Fig. 11. *Landings of mackerel during* 1971 *to* 1981.

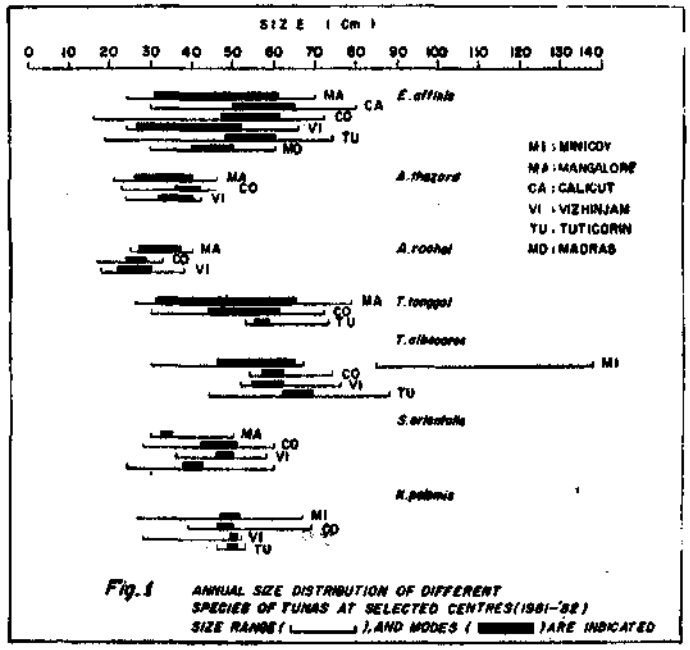

Fig. 12. *Annual size distribution of different species of tunas*

Evaluation of the distribution and abundance of spawners and of young fish (FB/PR/7.1)

K.V.NARAYANA RAO, P.T.MEENAKSHISUNDARAM, S.REUBEN, G.GOPAKUMAR, P.DEVADOS, A.A.JAYAPRAKASH AND S.SOUNDERARAJAN

Monitoring of the distribution and abundance of spawners and young ones of pelagic fish was continued during the year at observation centres Mangalore, Cochin, Vizhinjam, Madras and Waltair. Seasonal trends in the catches, catch rates, size distribution of juveniles of predominant pelagic fish were studied and indices of abundance of both the spawners and juveniles were obtained.

An estimated catch of 705 tonnes of young oil sardine and 12 tonnes of juvenile mackerel were landed at Mangalore by purse seines. The abundance of juveniles of the oil sardine and mackerel were recorded during September (129.5 kg/net/day) and in October (47 kg/net/day) respectively. The maximum abundance of spawners of both these species was recorded during June–September months.

At Cochin a total catch of 557 tonnes of young fish was landed mainly by purse seiners (99.5%) and trawlers (0.5%). The predominant species were oil sardine (80.3%), *Caranx kalla* (13.9%), whitebait (0.2%), pomfrets (0.3%) and mackerel (0.02%). As at Mangalore, the mature fish of oil sardine and mackerel were abundant during the South west monsoon months.

Considerable reduction in the landings of young fish at Vizhinjam was observed during the current year with 3.4 tonnes. Compared to 22.3 tonnes of the previous year. This was partly due to the lower contribution of boat seines and partly due to lower abundance of young fish during the current year. The catches were mainly landed by the shore seines (60.2%) and boat seines (39.8%). Their catch rates were 2.2 kg. and 0.03 kg. respectively. The major constituent species were *Sardinella spp.* (32.2%), *Trichiurus lepturus* (12.7%), *Decapterus dayi* (3.7%) and mackerel (3.7%). The maximum abundance of mature fish

of mackerel was during April-May, of whitebait during May-July and October-December.

An estimated catch of 0.72 tonnes of juveniles of pelagic species were landed at Madras during the year. The main periods of their abundance were during October-November and February March months. They were caught by the boat seines and shore seines. The predominant species were seer fish, lesser sardine (*S. gibbosa*) and white baits.

At Waltair an estimated catch of 399.5 tonnes of young fish were landed during the year. In the total catch the share of the shore seines, boat seines and shrimp trawlers was 1.1 tonnes, 10.7 tonnes and 387.7 tonnes respectively. Two peaks of abundance of young fish were observed in May (42 kg/unit/day) and in November (12.7 kg/unit/day) in the catches of shore seine. Similar trends in the abundance of young fish was evident in the catches of boat seine (13.9 kg/unit/day and 24.2 kg/unit/day) and of shrimp trawl (8.2 kg/hr and 2.8 kg/hr.) during June and September respectively. The predominant species at this centre were *D. dayi, S. devisi, D. lajang, S. fimbriata* and *I. lepturus*. The mature fish of the predominant species were generally abundant over a number of months with two peaks; one in September and the other in February. This is in conformity with the abundance of young fish in the area. Most of the pelagic fish were found to be multiple spawners with a prolonged spawning and also occur seasonally.

Evaluation of the fishery and resources of oil sardine (FB/PR/9.1)

V. BALAN, G.G. ANNIGERI, M. KUMARAN, P. DEVADOS AND P.N. RADHAIRISHNAN NAIR

During the year under report, as in the preceding two years, due to the lucrative and proliferating purse seine fishery, the oil sardine landings at Mangalore surpassed tremendously (40,675 tonnes) those of the Cochin, Vizhinjam, Calicut, Karwar and Goa centres. Compared to the previous year, there were considerable improvements in the landings at Cochin, Mangalore, Karwar and Goa. At Mangalore alone, the landing indicated

a two and a half times increase compared to previous year. However, it is noteworthy that the indigenous gears at Calicut, obtained only remarkably less catches during the year, though the decrease was only marginal compared to the previous year. The catches made by the indigenous gears continued to be small at the Vizhinjam, Mangalore and Karwar regions. During the seasons, average catch rate by purse seine was highest at Mangalore (2.2 tonnes/unit/day) followed by Cochin (1.5 tonnes/unit/day).

Table 7

Age composition of oil sardine in the catch per unit effort of non-selective gear at different centres during the period April 1981 *to March* 1982.

Place	*Gear*	*Year*		*Class*
		0–year	1+year	2–year & above
Goa	Purse seine	11308	2526	1568
Karwar	Purse seine	54852	1153	128
	Rampan	20414	416	502
	Yendi	66	117	23
Mangalore	Purse seine	117875	15801	3087
Calicut	Pattenkolli	8619	2031	877
	Nethal vala	44337	3130	477
Cochin	Purse seine	55438	13214	894

Age 0–year (<149, mm)1–year (150–179 mm), 2–year (180mm+)

Purse seine in the mechanised sector, Rampan and Pattenkolli in the traditional non–mechanised sector were the important gear that contributed to the bulk of the landings at the major centres.

The oil sardine fishery during the year was mainly sustained by the fish with dominant sizes at 60–90 mm, 100–135 mm, 160–185 mm and 200 mm total length. It was observed that the occurrence of small and medium sized fish was more frequent in the areas north of Mangalore than in the southern areas.

The age composition of the oil sardine in the catch per unit effort of non-selective gear at different centres during the period is given in the accompanying table (Table-7). It is seen that the 0-year recruits had the highest preponderance in purse seine catches at the Karwar, Mangalore, Cochin and Goa regions (in the order of abundance), followed next in abundance by the 1+year olds as in the preceding year. At the Karwar region, the c.p.u.e. of the 0-year group had the maximum abundance (97.73%) followed by Mangalore during the year, compared to the other three purse seine regions.

In the gill net catches of Vizhinjam 2+year group dominated, followed by the 1+year olds. At Calicut, the 0-year group dominated followed by the 1+year olds in Pattenkolli catches as in the previous year. At Karwar, in Rampan, the 0-year had the highest abundance. In yendi, the 1+year olds predominated; the 0-year recruits had only a secondary importance.

Biological studies on the sex-ratio and maturity cycle of the species indicated that females were generally predominant in the landings at all centres except at Goa and Karwar. Fishes in Gravid condition (IV-VI) were generally abundant during April-August in most centres. Thereafter fishes in spent condition predominated in the catches.

Evaluation of the fishery and resources of lesser sardines (FB/PR/9.2)

P. SAM BENNET, G. G. ANNIGERI, J. C. GNANAMUTHU, P. N. RADHAKRISHNAN NAIR, P. DEVADOS AND R. THIAGARAJAN.

The fishery for lesser sardines was good during the year at all the centres of observations. Very good landings were reported from Mandapam, whereat, 2333 tonnes of lesser sardines were landed as compared to 955 tonnes during 1980. Tuticorin had good fishery for lesser sardines during the year with total landings of 3659 tonnes. The region between Madras and Vizhinjam appeared to be good for the lesser sardines. However, good landings of lesser sardines were reported from the commercial purse seine catches of Karwar and Goa. The centrewise production of the lesser sardine and the principal gear employed in the fishery are given in the table below:

Annual catch of lesser sardines

Centres	*Catch in tonnes*	*Principal gears used*
Madras	343.9	Gill net
Mandapam	2332.9	Gill net, shore seine
Tuticorin	3659.3	Gill net
Vizhinjam	261.4	Gill net, boat seine, shore seine.
Mangalore	79.7	Purse seine
Karwar	698.7	Purse seine
Goa	802.4	Purse seine

Many species of lesser sardines contributed to the fishery during the year. Among them *Sardinella gibbosa, S. dayi, S. sirm, S. fimbriata, S. sindensis* and *S. albella* were important.

Data on biological characteristics of predominant species of lesser sardines were studied at most of the centres.

Sardinella gibbosa:

This species ranging in length from 9.5 to 16 cm with mode at 13.5 cm, from 5 to 15.5 cm and modes at 7 cm & 13 cm, from 10 to 17.5 cm and with mode at 13.5 cm, from 7 to 18 cm with modes at 8 cm, 11 cm & 16 cm and from 7.5 to 18 cm with modes at 8.5 cm and 13 cm contributed to the fishery during the year at Madras, Mandapam, Tuticorin, Vizhinjam and Karwar respectively. Generally younger fish in the non-selective gears and older fish in the selective gear were predominant.

In the catches females predominated at all the centres, except at Vizhinjam where males were more abundant. The significant feature is that immature fish contributed to the major portion of the landings at all the centres. Gravid fish were observed at Madras during January–March and again in July–August. Similar trend was evident also at Tuticorin. At Vizhinjam gravid fish were abundant from April to June while spent

fish were observed at Karwar in several months; no gravid fish was encountered.

Sardinella albella:

Biological observations were made at Mandapam and Karwar only. Mandapam fishery composed of fish from 5.0 cm to 16.0 cm with two modes at 8.5 cm and 12.5 cm. Major portion of the catch composed of fish between 10.0 cm and 13.0 cm. At Karwar fish from 13.0 cm to 15.5 cm entered into the fishery with the mode at 15.0 cm. Studies on the gonadial condition were not made at Mandapam. At Karwar females were more in number than males. Gravid and spent fish contributed to the bulk of the catch during February and March.

Sardinella dayi:

Observations on this species were made at Karwar only during the year. The size range of *S. dayi* was 9.0 cm to 18.0 cm and the mode was at 15.0 cm. Females dominated males in the catches. Fish in the resting stage and spent recovering condition formed the major portion of the catch. Gravid fish were not encountered.

Sardinella fimbriata:

Studies were made on this fish at Karwar and Goa only. At Karwar this species had the size range of 11.0 cm to 20.5 cm with three modes at 12.0 cm, 13.0 cm and 15.5 cm. At Goa fish from 7.5 cm to 18.5 cm entered into the fishery, the 10.0 cm and 14.5 cm size groups dominating the catch. As in the case of other species females were more in number in the samples than males at Karwar. Immature fish dominated the catches at Karwar and spent fish were noticed during October, November, January and February. At Goa males were more in number than females. Commercial catch composed mostly of immature fish. Mature fish occurred during October and March. Spent fish were noticed during January.

Sardinella sindensis:

Biological observations were made at Vizhinjam only. Fish from 7.0 cm to 18.5 cm were observed during the year. Three distinct modes were noticed at 8.5 cm, 12.5 cm and 16.0 cm. Females were dominant in the samples. Most of the fish were in the development stage of maturity. Gravid fish were seen in the samples during April to June. Spent fish appeared during April and May.

Sardinella sirm:

Studies were made at Vizhinjam. Gill net samples contained fish from 10.0 cm to 23.0 cm. For the younger group the mode was at 10.5 cm. Larger fish were dominated by fish in the mode of 19.0 cm and 20.5 cm. There was slight preponderence of males over females. Most of the fish observed were in the gravid stage during January to March and April to May. Spent fish occurred during January and February.

The fishery and resource characteristics of anchovies (FB/PR/9.3)

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Investigations on this Project were continued at six centres namely, Mangalore, Cochin, Vizhinjam, Madras, Kakinada and Waltair. Purse seining in Mangalore area continued to yield the largest of the anchovy landings along the Indian coast.

At Mangalore the anchovy landings comprised entirely *Stolephorus*. Purse seine landed 93% of the annual *Stolephorus* catch of about 2814 tonnes and bottom trawl landed the rest. This current year's catch is less than that of last year's 4600 tonnes. The catch rates of purse seine and trawl net this year were 162.8 kg and 6.0 kg respectively, compared with 322.3 kg and 2.0 kg during 1980. Major bulk (98%) of purse seine anchovy catch comprised *S. devisi* whereas trawl catches comprised mainly *S. devisi* (40%) and *S. bataviensis* (59%). Adult fish comprised the major bulk of the landings of both the species.

Juveniles were observed during April, February and March in purse seine and April and May in trawl for *S. devisi,* and during April, May and March in trawl for *S. bataviensis.* Though fish in advanced stages of maturity (V–VII) were observed throughout the observations, they were common from October to March for both the species. Males generally dominated in *S. devisi* but sex ratio was generally equal in *S. bataviensis.*

An estimated catch of 231 tonnes of anchovies was landed at the Fisheries Harbour, Cochin. Gear-wise, purse seine accounted for 50.7% and the rest by trawl net; and species-wise *Stolephorus* contributed to about 82% and the rest by *Thryssa* of the total anchovy landings. The most productive period for the *Stolephorus* was during October–December and for the *Thryssa* was during January–March.

The predominant species of the whitebait (*Stolephorus*) fishery were *S. devisi* and *S. bataviensis* and *S. commersonii.* Their size ranged from 65 to 100 mm with a mode at 80 mm for both the former species and from 85 to 115 mm with a mode at 100 mm for the latter species. All the samples of the common species examined during March–May and October–December months were dominated by the fish in gravid condition indicating peaks in breeding periodicity. In general males appeared to be in dominance in the catches.

At Vizhinjam a total of 388 tonnes of *Stolephorus* was landed during the year compared with 191 tonnes in 1980–81. Bulk (93%) of the annual catch was landed during June–October period, and boat seine accounted for 92% of the annual landings with the annual catch rate at 8.4 kg. Highest catch rate of 23 kg. was obtained in October. *Stolephorus bataviensis* was the dominant species of *Stolephorus* in boat seine and *S. devisi* in shore seine and gill net (Netholi vala). *S. buccaneeri* was the third important species in the catches. Juveniles were observed during April–June for *S. devisi* and during May–August in the case of *S. bataviensis.* Fish in advanced stages of maturity (V–VII) were observed during April–July, November, December and March for *S. devisi* indicating that this species spawns mainly during November–July period in the area. In the case of

S. bataviensis on the other hand fishes in advanced of maturity were, however met with during April, July to September and December. *S. buccaneeri* in similar maturity condition was met with during June–August, November–December periods. Males were dominant over females for the three species.

Thryssa landings amounted to 6 tonnes. Bulk (89%) of this catch was landed by gill net (Chala vala). *T. setirostris* was the most dominant species followed by *T. mystax* and *T. dussumieri.*

At Madras a total of 49 tonnes of *Stolephorus* and 33 tonnes of *Thryssa* were landed. Bulk (88%) of the *Stolephorus* catch was landed by trawl net at a catch rate of 1.60 kg. The catch and catch rates were above the annual average during April, June–October. Shore seine landed good catches during February March. *S. devisi* (53.9%) and *S. bataviensis* (32.6%) accounted for the bulk of *Stolephorus* catch in trawl net.

Trawl accounted for the bulk (62%) of the landings of *Thryssa* also. The annual catch rate was 0.8 kg. The catch and catch rates were better during August–September and December–January. *Thryssa dussumieri* and *T. mystax* were the dominant species of *Thryssa* in trawl and gill net landings.

At Kakinada (Uppada) a total of 58 tonnes of anchovies were landed compared with the catch of 66 tonnes of last year. *Stolephorus* accounted for the bulk (66.7%) of the anchovy landings followed by *Thryssa* (32.9%) and *Setipinna* (0.4%). Shore seine and boat seine accounted most of the *Stolephorus* landings; gill net and shore seine accounted for the bulk (96%) of *Thryssa* landings. Most of the catch of *Stolephorus* was landed in April, of *Thryssa* in September–January and of *Setipinna* was in October. *Stolephorus commersonii, S. indicus, Thyryssa hamiltonii, T. dussumieri, T. kammalensis, T. mystax* and *Setipinna taty* were the important species of anchovies met with.

At Waltair a total of 137 t. of *Stolephorus* and 72 tonnes of *Thryssa* were landed. About 93% of both these groups was landed by shrimp trawl at catch rates of 0.64 kg and 0.34 kg

respectively. The catch rates in the shrimp trawl were good in September (2.55 kg/hr) for *Stolephorus* and in June (1.17 kg/hr) for *Thryssa*. The catch and catch rates for *Stolephorus* were better during January–February in shore seine, during September in boat seine, *S. devisi, S. bataviensis, T. mystax* and *T. dussumieri* were the dominant species in the landings; having size range of 30–99 mm, 35–109 mm, 85–149 and 100–224 mm respectively. In *T. mystax* a growth of 11.3 mm per month was observed for fish between 117 cm and 162 mm length.

Partially spent and fully spent fish were most common for *S. devisi* and *S. bataviensis*. Males were dominant in both the species.

Evaluation of the fishery and resources of mackerel (FB/PR/9.4)

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As in the previous year, there was no mackerel landings at Panjim during April–July 1981. However, in August–March 408 tonnes of mackerel were landed in the current year which was 53% lower than that of previous years catch. The catches at Karwar were better in the current year, showing an increase of 9.2%. In 1981–82, 854 tonnes were landed in place of 710 tonnes of 1980–81. The fishery for the year started in September with good catches. In the following months the catches gradually reduced and by January the fishery was almost over. The most productive period was July–September when 580 tonnes of mackerel forming 68% of the annual total was landed. The mackerel landings by the traditional gear at Baikampady and Ullal (Mangalore) were 18 tonnes in 1981–82 as against 30 tonnes of 1980–81. The landings by the purse seine at Mangalore also showed a decline of 70% in the current year, the estimated total catch being 286 tonnes against 4875 tonnes of 1980–81. During 1981–82, the mackerel landing at Calicut was 236 tonnes and it was extremely poor in comparison to 543 tonnes of 1980–81. Bulk of the catches in the current year came in the months of September and October. The landings at Cochin in 1981–82

amounted to only 1986 tonnes as against 6006 tonnes of the corresponding period of last year. The bulk of the catch was realised in the current year in September and October alone. In 1981–82, 115 tonnes of mackerel were landed compared to 198 tonnes of 1980–81 at Vizhinjam. The fishery which is generally good during July–November was poor in this year. The total mackerel landings at Keelakarai was 9 tonnes and at Pamban 11 tonnes in 1981–82. The fishery was absent during June–December 1981 at Keelakarai and May–December at Pamban. At Madras an estimated catch of 9 tonnes of mackerel were landed. The principal gears were *Madavalai, Aravalai* and *Edavalai*. A total of 71 tonnes of mackerel were landed at Lawson's Bay (Waltair) in 1981–82 and compared to the catches of the yesteryear it showed three-fold increase. The mackerel landings at the Outer Harbour Jetty in Waltair was 32 tonnes.

The number of purse seines operated at Panjim during 1981–82 was 3643, and its cpue was 112 kg with maximum catch rate of 378 kg in August. The gears operated at Karwar were purse seine, *Rampan* and *Yendi* accounting for 92.8%, 7.15%, and 0.1% respectively of the annual total catch. The number of purse sienes showed an increase of 30% over the one that of the previous year. At Mangalore purse seine and Rampani were the principal gears employed in the fishery; accounting for 99.3% and 0.5% of the catch respectively. The former registered highest catch rate (1062 kg) in September and latter in April (385 kg). The *Pattenkolli* landed 58.9% of the mackerel at Calicut showing the best cpue of 152.5 kg in September though it caught only 17.6 kg per unit in the year as a whole. The *Ayila chalavala* which is the next important gear at Calicut had a cpue of 13.2 kg only. At Cochin, purse seine was the major gear that landed mackerel accounting for 97% of the total landings. Higher catch rates were registered in April (584 kg) and in September (346 kg). At Vizhinjam, the maximum catch of mackerel at an annual cpue of 3.9 kg was made by the drift net that were operated from the traditional craft. The catch of the traditional drift net unit (61.8%) was followed by Konchu vala (17.5%). At Keelakarai in Gulf of Mannar and at Pamban gill net registered catch rates of 10.6 and 24.6 kg respectively. The bulk of the catch (86.3%) in Lawson's Bay, Waltair was

made by the bottom set gill net at a cpue of 8.43 kg. shore seine (7.43%) at a cpue of 4.59 kg & boat seine (5.07%) at a cpue of 1.59 kg were the other important gear employed in the fishery.

At Panjim the size of mackerel in the fishery ranged from 90–255 mm with modes at 130 mm, 185 mm, and 235 mm. At Karwar in Purse seine fishery, the size of the fish ranged from 60 to 265 mm with dominant modes at 120 mm, 205 and 235 mm. The purse seine fishery at Mangalore was mainly sustained by fish ranging in total length from 195 to 265 mm with dominant size at 225–240 mm. The traditional fishery at Calicut, during the year was supported by mackerel having size range of 95–265 mm with modes at 110 mm, 190 mm and 245 mm. It may be observed that the recruitment was late and poor. This year the products of premonsoon spawning are not found to have been recruited to the fishery in the normal magnitude and the offsprings of the secondary post monsoon spawning are contributing to the fishery.

At Vizhinjam the catch from drift net ranged in length between 210–275 mm with the mode at 230 mm and in Chalavala between 115–175 mm with mode at 135 mm. The fishery both at Keelakarai and at Pamban was supported by size groups at 225–235 m. The length of the fish in the landings at Madras ranged from 75 to 239 mm with multiplicity of modes. At Waltair the mackerel had an overall range of 70 mm to 250 mm size with prominent modes at 95 mm, 125 mm, 190 mm, and 230 mm. The recruitment of young fish was observed in August at Goa, in November at Karwar and in several months at Vizhinjam and east coast centres.

Except at Cochin where females predominated in the landings, sexes were equal at all other centres. The studies on the maturation cycle of the species during the year revealed that at most of the centres on the west coast gravid fish were recorded during the May–August months and spent fish thereafter. At the east coast centres, however, gravid fish were recorded during April–July and February–March months.

The food of the mackerel at Vizhinjam during the year under report composed of mainly algae, copepods, amphipods, Alima larvae of *squilla* etc. The feeding on the whole was poor. At Waltair the diatom *Coscinodiscus* and Alima larvae of *Squilla* were the dominant food items encountered in the stomachs of the mackerel. The feeding here also appeared to be poor especially in January–March period.

Evaluation of the fishery and resources of seer fishes (FB/PR/9.5)

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During the year under report, investigations on the fishery and resources of seer fishes were conducted at Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin and Waltair.

The estimated total catch of seer fishes at Mangalore was 996 tonnes landed by Drift gill nets of 95–135 mm mesh. An increase of 17% in the total catch was recorded during this year inspite of the decline in the total effort by 17.5%. The annual cpue also showed an increase of 8.3% over that of the previous year. Maximum catch (324 tonnes) and cpue (51.8 kg) were recorded in November whereas in 1980–81 it was so in October.

The king seer (*Scomberomorus commerson*), spotted seer (*S. guttatus*) and streaked seer (*S. lineolatus*) supported the fishery to the extent of 87.7%, 12.2% and 0.1% respectively. The king seer was best taken in November (299 tonnes) and the spotted seer in October (41 tonnes); in the preceding year, both were best taken in October. The king seer ranged in size from 19 to 117 cm the dominant size group being 57.5 cm. Fishes in the size range 40 to 95 cm supported the fishery. The spotted seer varied in length between 16 and 64 cm. The size groups 36–39 cm, 39–42 cm, and 42–45 cm formed the core of the fishery.

The drift net, ozhukkuvala and the Ayila chalavala were the gears at Calicut that brought in 102 tonnes of seer fishes during the year. In the previous year, the landings aggregated

to 90 tonnes. As in 1980-81, the third and fourth quarters were most productive. The highest catch (19 tonnes) was recorded in December and cpue (122 kg) in July. Drift net was the only effective gear (catch: 10 tonnes and cpue of 23.8 kg) in the fishery. The king seer constituted 99.7% of the landings followed by the spotted seer and streaked seer.

S. commerson ranged in size from 40 to 109 cm in drift net landings. The bulk were in the size-range 50-74 cm with a mode at 62.5 cm.

Drift net units at the Cochin Fisheries Harbour landed 238 tonnes of seer fishes as against 250 tonnes of the previous year. The annual cpue was 11.1 kg as compared to 10.7 kg of last year. The third and fourth quarters of the year together accounted for 67.6% of the total catch. The highest catch (53 tonnes) and cpue (42.2 kg) were registered in November.

The king seer and spotted seer comprised the catches, the former constituting most of them. For *S. commerson*, the overall size-range during the year was 20 to 149 cm. From first through the second half of the period, a gradual increase in sizes supporting the fishery was noticed. Small-sized king seer landed by purse seiners in March measured around 27.5 cm in length. The spotted seer, *S. guttatus*, ranged in size 33 to 66 cm with modes at 42.5 cm and 52.5 cm in September, 47.5 cm in October and November and 52.5 cm in February.

In all, 56 tonnes of seer fishes were landed at Vizhinjam as compared to 110 tonnes in the previous year. The third quarter accounted for 74.6% of the annual landings. In the current period, drift nets operated from non-mechanised and mechanised boats yielded 69.2% and 27.3% respectively of the total catch. The highest catch and cpue of seer fishes in drift net were in October-November months. The king seer was the dominant species. Small landings of spotted seer were recorded from October to December. Only few specimens could be measured for length data.

The seer fish fishery at Tuticorin was studied at five centres in the Tuticorin area during the year, viz. Tuticorin North,

Punnakayal, Kavalpattinam, Veera pandian pattinam and Vaipar. Drift nets ('Paruvalai' and 'Podivalai'), troll lines, hand lines, long lines and bottom set nets accounted for the landings. In all, 251 tonnes of seer fishes were landed as compared to 324 tonnes of previous year. The drift net, 'Paruvalai' was the important gear accounting for 55.5% of the seer fish catches of the area; the cpue of the gear for the year stood at 19.4 kg. At Tuticorin, the third and fourth quarters accounted for 58.8% of the total catch of this year. The highest catch (18 tonnes) and catch rate 45 kg of 'Paruvalai' were registered in April.

The king seer, *Scomberomorus commerson* constituted 86% of the total landings of seer fishes. The streaked seer, *S. lineolatus* followed by spotted seer, *S. guttatus* occurred to a small extent. The Wahoo, *Acanthocybium solandri* occurred in meagre quantity only at Tuticorin.

In the 'Paruvalai' catches, the king seer ranged in size from 35 to 125 cm with a dominant annual mode at 87.5 cm. The size range upward of 70 cm and upto about 95 cm supported the fishery. In 'Podivalai' catches, the king seer was in the size-range 10 to 80 cm with a dominant annual mode at 27.5 cm. The size range from 25 to about 50 cm constituted the core of the catches. Juveniles of king seer of size 14 to 26 cm were found to be indeterminates; more than 94% of them had empty stomachs. These occurred in good quantities during the third quarter.

Estimated seer fish landings at Waltair during the year aggregated 107 tonnes, as against 77 tonnes in the previous year. The current years' landings, forming 14.7% of catches of 'all fish', were accounted for mainly by hooks and line (97 tonnes) followed by bottom set gill net (10 tonnes). As against 2.31 kg of last year, the current periods cpue for hooks and line was 2.63 kg. The highst catch (2 tonnes and catch rate rate (5.4 kg/unit) of hooks and line were recorded in January. The highest catch (4 tonnes) and cpue (6 kg) in the bottom set gill net were in October. Thus December and January were productive months for the line fishery. The period, August–October was productive for bottom set gill net fishery.

The fishery was mainly supported by the spotted seer and king seer to the extent of 63 tonnes (58.7%) and 44 tonnes(41.3%) respectively. Overall, the highest catch (13 tonnes) of king seer was obtained in January. The highest catch (9 tonnes) of spotted seer was in May. Landings were good in June and from September through January.

Evaluation of the fishery and resources of Bombay duck (FB/PR/9.6)

V.M.Deshmukh, Alexander Kurian and Mohammad Zafar Khan

Along the Saurashtra coast at fishing centres, Nawabunder, Rajpara and Jaffrabad, an estimated catch of 6,830; 22,449 and 18,079 tonnes of Bombay duck (*Harpodon nehereus*) with the annual catch rate of 82.6 kg, 131.5 kg, and 149.4 kg per haul respectively was landed for period April '81 to March '82. For the previous year of corresponding period an estimated catch from these centres was 5,927; 12, 887 and 12,359 tonnes respectively. Compared to previous year the fishery this year was better; and might be due to increased effort. The fishery was good during September to November period. The highest monthly catch per haul (357 kg) was recorded during June at Nawabunder while at Rajpara and Jaffrabad it was 321 kg and 276 kg respectively observed in November.

In the catch the size of Bombay duck ranged from 30 mm to 345 mm at these centres. In most of the months the catches were dominated by smaller size group less than 60–75 mm in addition to this in certain months the size groups ranging between 115–165 mm and 240–255 mm constituted to form bulk of the catch.

The annual average size of Bombay duck at Nawabunder during the year was 130.9 mm. The maximum monthly average size 177 mm was observed during September, while the minimum was 91 mm in March. At Rajpara the annual average size was 129.4 mm and the monthly maximum being 161 mm in October. Similarly the annual average size of the fish at Jaffrabad was 126.6 mm and maximum monthly size 154 mm

in October. The fishery at these centres was mainly supported by 0 year class except in certain months; at Nawabunder in June it was supported by 1+year class and in September by 2+year class while at Rajpara by 1+year class in April and by 2+year class in October. In the catches off the Saurashtra coast the sex ratio for males to females of Bombay duck was 48 : 52. Females having developing ovaries formed high percentage in the catch. Large number of gravid females were observed during December compared to other months.

At Arnala in Maharashtra the Bombay duck fishery during the year in general showed a decline and the landings during the period was estimated at 328 tonnes with the annual catch rate of 22.6 kg per haul while last year the annual catch rate was 62.1 kg per haul. The peak landings of 81 tonnes and the highest catch rate of 54.2 kg per haul was observed during December. The average size of the fish landed was 149.9 mm. The mean survival rate was estimated at 54% and the annual total mortality 46%. The exploitation rate was 36.4%. At Versova, the Bombay duck catch was estimated at 826 tonnes and the fishery was good in the first quarter (April to June). The annual catch per haul for the year 1981–82 was 17.6 kg against 10.6 kg per haul for the previous year. The maximum monthly catch rate of 184.6 kg was recorded during September. The annual average size of Bombay duck was 177 mm, almost the same as that of last year. The maximum monthly average length of 205 mm was noted during March.

At Arnala, the size of the fish ranged from 7 mm to 315 mm in the catches. In most months the catches were dominated by size groups 105–120 mm and 195–210 mm. The fishery at this centre was mainly constituted by O–year class. The ratio of males to females during the period was 1 : 2 and gravid females dominated. Food items constituted of juvenile Bombay duck and non–penaeid prawns. At Versova the minimum length of the fish was 30 mm while the maximum was 345 mm in the catches. In most months the catches were dominated by 195–210 mm and 120–135 mm size groups while in June a bigger size group of 225–240 mm dominated the catch. The fishery at this centre was mainly constituted by 1+year class. The ratio

of males to females during the period was 35 : 65 and females with developing ovaries dominated.

Along the East Coast at Kakinada the Bombay duck catch was estimated to be 48 tonnes during the period by trawl nets and gill-nets. The catch rates were very low by these gear.

Evaluation of the fishery and resources of Carangids (FB/PR/9.7)

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Investigations on the fishery and biology of certain commercially important carangids were carried out at Waltair, Kakinada and Tuticorin on the east coast, Vizhinjam, Cochin, Mangalore, Bombay and Veraval on the west coast.

At Waltair carangid catches by the indigenous gears at the Lawson's Bay totalled 55 tonnes which formed 7.6% of the total catch. The catches showed an increase of 155% over those of last year. On the other hand the landings of the shrimp trawlers totalled 336 tonnes showing a decline of 64% over those of last year. Best catch rates for shore-seine (26.3 kg/unit) and boat-seine (8.6 kg/unit) were recorded in May. The shrimp trawlers registered highest catch rates during the last quarter. *Decapterus dayi* dominated the landings of shore-seine (77.0%), boat-seine (58.0%) and of trawl (77.1%). *Megalaspis cordyla* was the dominant carangid in the catches of gill-net (43.0%), bottom-set gill-net (32.0%) and hook and line (90.4%).

The length range of *M. cordyla* examined for growth was 65–384 mm. New brood of *M. cordyla* entered the fishery during August–September. Four year classes of *M. cordyla* were noticed in the fishery 70% of the fish belonged to the 0-year class. Males of *M. cordyla* had slight predominance over females. Gravid females were observed in May while spent fish were noticed in March–May. *Stolephorus* among fish, *Squilla* and *Acetes* among crustaceans were important in the diet of *M. cordyla*.

The lengths of *D. dayi* and *D. lajang* examined for growth ranged from 30 to 195 mm and 70–124 mm and in total length, respectively. *D. dayi* observed in April and May belonged to the 0-year class while one year olds almost entirely comprised the fishery during January–March. Females of *D. dayi* dominated males. All the gonads observed during February–April were in partially spent and spent condition. *Stolephorus sp. Sphyraena* and *Leiognathus* among fish, *Lucifer, Acetes* prawn remains and copepods among crustaceans were important items of food.

Shrimp trawler catches of carangids totalled 2129 tonnes, which formed 15% of the total catches at Kakinada. They showed an increase of 224% over those of last year. *Decapterus dayi* (86.3%) and *D. lajang* (10.5%) contributed to the bulk of the catch. Peak catch rates of carangids were observed in May (120.4 kg/unit) and February (188.3 kg/unit). At Uppada 57 tonnes of carangids were landed by the indigenous gears. The bulk of the catch was landed by gill-net with Nava (79.8%). The catch rates were good during June–August. *Scomberoides* sp (12.4%) was the important fish landed at Uppada.

D. dayi examined for growth ranged from 95 to 205 mm in total length. Fresh recruitment into the fishery was observed during May–June when the 0-year groups (less than 130 mm) dominated the fishery. It was the 1st year group that dominated during the rest of the year. General predominance of males over females was observed. Mature and ripe gonads dominated during January–March. Teleosts, Prawns and other crustaceans were important items of food.

The catches of carangids landed by the indigenous gears at Tuticorin North landing centre, Punnakayal, Kayalpattinam, Veerapandianpattinam and Vaipar totalled 175 tonnes which formed 12.5% of the total fish catches. The catch contribution was maximum at Tuticorin North (51.1%) and Kayalpattinam (27.1%). The drift nets, 'Paruvalai' (56.1%) and 'Podivalai' (34.7%) landed the bulk of the carangid catch. Peak catch rates for 'Paruvalai' were observed during June–November, January–March, while 'Podivalai' had peak catch rates during June–August, October–December.

Caranx spp (46.8%) *C. stellatus* (19.4%) *C. carangus* (11.0%) and *Scomberoides* sp were dominant in the catches of hand line (39.8%). The length range of *C. carangus* observed for growth was 140-430 mm; while *C. stellatus* varied from 25 to 110 mm in total length. Fishes of the 0-year class mostly contributed to the fishery.

A total of 582 tonnes of carangids were landed at the Vizhinjam. This formed 10.7% of the total catches. The present landings marginally declined by 2.3% over those of last year. Hook and line accounted for the bulk of (56.2%) the catch. Boat-seine (18.4%) and drift net (15.8%) were the other important gears. Three peaks of abundance during the year in April (20.4 kg/unit), August (16.1 kg/hr) and February (20.6 kg/unit) were noticed. *D. dayi* was the dominant species in the landings of hook and line (43.4%), boat-seine 17.6%, shore-seine (16.1%), Chalavala (67.5%). The annual catch composition of the carangids was *D. dayi* 30.2%, M. *Cordyla* 1.12% and other carangids 68.64%.

D. dayi examined for growth ranged in total length from 135 to 244 mm. Young fish were recruited into the fishery during April. The fishery almost exclusively comprised of fish in their second year of growth. Females (61%) dominated males (39%). Gravid (26.7%), partially spent (29.8%) and fully spent (17.07%) fish were met with in all the months indicating a prolonged spawning season. *Stolephorus* fish larvae, *Acetes Alima* larvae and bivalve larvae were important items of food noticed.

The studies on the carangid resources at Cochin centre were initiated during the year. The fishery was mainly based on purse seining. In 1981-82, out of an estimated catch of 514 tonnes of carangids, the contribution of purse seine landings amounted to 78%. The peak abundance was recorded in April September and December.

The species contributing to the fishery in the order of abundance were *Alepes djeddaba, Megalaspis cordyla* and *Scomberoides tol.* The biology of *A. djeddaba* was investigated. It ranged from 170 to 345 mm in the commercial catches. Juvenile

fish with a size range of 80–110 mm and mode at 85–95 mm were abundant during December–February. Gravid and spent fish were caught in large number during the same period. Alima, Lucifer, mysids and Juveniles of *Stolephorus* formed the main component of its diet.

An estimated 1926 tonnes of carangids was landed at Mangalore. Purse-seine contributed to the bulk (85%) of the landings while trawlers (15%) accounted for the rest. September-November period for Purse-seine and January–March for trawlers were the peak periods. The highest catch rate of 342.75 kg/unit was obtained for purse-seine in September while trawlers yielded the best catch rate of 20.91 kg/unit in February. *Alepes kalla* (78.6%) dominated the purse-seine landings followed by *M. cordyla* (21.4%). The trawler landings entirely comprised of *A. kalla.*

A. kalla ranging from 70 to 194 mm total length were examined for length frequency studies. An examination of the size groups in the purse-seine and trawl fishery revealed the presence of two dominant modes each at 127 mm and 162 mm. In addition to these another dominant mode at 92 mm, representing smaller size groups was present in the trawl fishery. Females slightly dominated males. Gravid fish were met with in September, January and March. Partially and fully spent fish were observed from September to March indicating a prolonged spawning period.

338 tonnes of carangids were landed by trawlers at the Sassoon Docks Bombay. The best catch rate for trawlers was registered in July (7.4 kg/hr). *M. cordyla* with a contribution of 49.8% dominated the landings. *Scomberoides tala* (29.2%) and *S. commersonianus* (16.9%) were the other important carangids landed by trawlers.

Gravid females of *M. cordyla* were observed during July-September and November–December period. Ripe females of *C. malabaricus* and *A. atropus* were also noticed from September to December. The feeding condition could be described as moderate and Prawn remains and fish larvae were important in the diet of the above species.

297 tonnes of carangids was landed at Veraval by the mechanised craft.

The bulk of the landings was contributed by trawlers (65.4%) while the gill-netters accounted for the rest. The best catch rate for trawlers was realised in December 8.8 kg/unit while July was the best month for gill-netters landing at the rate of 43.1 kg/unit. *A. atropus* and *M. cordyla* with a catch contribution of 60% were the dominant fish landed by trawlers and gill-netters, respectively.

M. cordyla examined for growth ranged from 200 to 524 mm in total length. A single year class, probably in its second year of growth, mostly comprised the fishery. The length of *A. atropus* examined ranged from 100 to 424 mm.

Assessment of the fishery and resources of ribbon fishes (FB/PR/9.8)

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The total catch of ribbon fish at Madras for the year 1981-82 was 185 tonnes which formed 7.5% of the total fish landings during the year. The fishery started in June and the peak landings were observed in November. At Kasimode (Madras) fish landing centre, trawl nets were operated by mechanised boats and at Triplicane (Madras), only boat seines landed Ribbon fish during June to November and the peak reached in November which formed 92.43% of the total catch.

The fishery comprised of a single species, *Trichurus lepturus*. The fish landed by Trawl nets ranged from 200 to 580 mm, in total length. Modes were observed in 28-30 cm, 34-36 cm, 42-44 cm and 46-48 cm groups. The fish caught by boat-seines were smaller and their size ranged from 120 to 519 mm in total length with dominant modes at 18-20 cm, 24-26 cm, 28-30 cm, 36-38 cm, 44-46 cm and 48-50 cm groups. Mature specimens were observed in July and August while fishes in maturing condition were seen in all the months. The stomach contents consisted of *Stolephorus, Thryssa* and prawns.

Work at Waltair was initiated in July 1981. Data from small commercial trawlers based at Visakhapatnam and inshore gears of Lawson's Bay area were collected. The small commercial trawlers collectively landed 545 tonnes and inshore gears get only 7 tonnes of ribbon fish respectively. The percentage of ribbon fish in all fish was 12.1%. In trawlers Ribbon fish catches were high during August–October period and *T. lepturus* was the dominant species that contributed to 93.7% in total ribbon fishes. Among the inshore gears operated only boat-seine and bottom net gill net got 6 tonnes and 1 tonne respectively of ribbon fish. Individuals of T. *lepturus* represented only 0–1 and 1–2 year old groups.

The annual yield from the ribbon fish fishery at Vizhinjam during the period, comprising a single species *Trichurus lepturus*, was 2360 tonnes which formed about 43.3% of the total fish landings during the year. Ribbon fish landings during the season 1981 were 583 tonnes. September followed by July witnessed peak amounts of catch. During 1981 the fishery lasted from June to September with peak landings during July. Boat seine has been the chief gear for the fishery, landing nearly 99% of the annual catch of ribbon fish, hooks and line and gill net accounting for the rest. Boat seine is operated in the area so long as the ribbon fish fishery season lasts in the area. Thus 97.8% of the annual boat seine effort was expended during June to October. The catch per boat seine (C/E), ranged between 41 and 100 kg during the season with the average at 55 kg.

The fish landed by boat seine ranged in length between 30 cm and 104 cm, bulk of the catches ranging between 50 cm and 80 cm. Modes were noticed in the length frequency distribution at 34–36 cm, 38–40 cm, 46–48 cm, 56–58 cm, 62–64 cm, 66–68 cm, 84–86 cm, 90–92 cm and 100–102 cm. Females outnumbered males in all the months, the overall sex ratio being 37 : 63 F in boat seine and 25 : 75 F in hooks and line. Bulk of the fish (about 95%) was with gonads in resting and developing state of maturity, the remaining fish being with gravid and spent gonads. Thus the ribbon fish after spawning elsewhere, moves into the inshore waters of this area. Fish with empty stomach comprised bulk (68%) of the catches. In others

Stolephorus, whose fishery coincides with the *Trichiurus* fishery, ranked as the chief item of food, followed by prawns, *Loligo*, carangids, *Decapterus*, *Sillago*, *Ambassis*, *Thryssa*, *Arius*, ballistids, Sciaenids, *Leiognathus* and *Trichiurus*.

At New Ferry Wharf at Bombay an estimated catch of 1940 tonnes was landed by trawlers. A decline of about 210 tonnes was noticed as compared to same period during previous year. As compared to the same period of previous year the catch per hour in kg has also gone down to 5.8. At Sassoon Dock landings, ribbon fish by trawl net this year compares favourably with the landing of previous year. The landing by indigenous gear a tSassoon Dock by 'dol' net showed sharp decline from 172 tonnes during the same period last year to 87 tonnes this year.

At New Ferry Wharf the catch consisted exclusively of *T. lepturus*. At Sassoon Dock the trawl landings were *T. lepturus* but 'dol' net landed *T. lepturus*, *T. savala* and *E. mutieus* in equal proportions.

Length frequency study was done at New Ferry Wharf for *T. lepturus*. The modal groups obtained in various months are: 701–720 mm (April)681–700 mm (May), 841–860 mm (Sept), 801–820 mm (October), 861–880 mm (November), 941–960 mm (December), 781–800 mm (January), 781–800 mm (February) and 821–840 mm (March). Juvenile recruitment was observed during June through October. The size range was from 111 mm to 231 mm. Food analysis was done for the juveniles of *T. lepturus* and *T. savala*. *Acetes* was found to be the major food item.

Evaluation of stocks of major pelagic fish resources (FB/PR/9.9)

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The studies on the evaluation of stocks of major pelagic fish resources could not make much headway, during the period

under report, due to the delay in the commissioning of R.V. SKIPJACK and consequently no resources surveys could be undertaken in the shelf waters. However, catch data of the exploited pelagic resources by the artisanal and purse seine fisheries at the observation centres were analysed to study the seasonal distribution and abundance of important pelagic species. A brief summary of the results is given below.

The drift net fishery at Veraval yielded an estimated catch of 2551 tonnes pelagic fish which formed 86% of the total landings by the gear. The major components of pelagic fish landings off this coast were *Hilsa* (28.6%), shark (15.3%), *Chirocentrus dorab* (11.0%), Pomfret (10.9%), ribbon fish (10.3%), Seer fish (9.3%). *Ilisha filigera* (6.1%) and tuna (4.2%). Along this coast maximum abundance for *Hilsa* and ribbon fish was recorded during March–May, for shark and *Chirocentrus* sp. during January–March, for Pomfret during April–June and November–December, for both seer fish and tuna during September–October and January–March and for *Ilisha filigera* during November–January and in May.

Both at the Sassoon docks and New Ferry Wharf (Bombay), an estimated catch of 5975 tonnes pelagic fish was landed by trawl. Highest catch and catch rates were obtained in June and November. The major component species were ribbon fish (50.6%), elasmobranchs (38.5%), tuna (6.0%), and Pomfret (3.4%). Along this coast the maximum commercial concentration of ribbon fish was registered during October–March, elasmobranch during April–June and November–February, tuna in March and October–November and Pomfret during February–March and in November.

At Cochin Fisheries Harbour, an estimated catch of 18,837 tonnes of pelagic fish were landed by purse seine and drift gill net; of which the share of purse seine was 91.2% and drift gill net 8.8%. Off this coast, the predominant species in the pelagic fish landings were the Oil sardine (77.6%), Mackerel (10.5%), tuna (7.4%). Carangids (2.7%), and seer fish (1.3%). However, while the oil sardine and mackerel contributed to the bulk (96.4%) of the purse seine landings, tuna and seer fish formed

about 91.2% of the pelagic fish landings by the drift gill net. In the area, the maximum abundance of the species like Oil sardine was recorded during October–December and February–March and mackerel during September–October and February–May. The peak abundance for tuna was in April and June–July and seer fish during October–November.

The small scale artisanal fishery at Vizhinjam landed 4467 tonnes of pelagic fish by miscellaneous gear. The pelagic fish catch constituted about 81.9% of the total fish landings. About 64.4% of the pelagic component was landed by boat seine, 12.3% by drift gill net, 11.9% by hook and line and 6.2% by Chalavala (gill net). The most abundant pelagic resources in the catches off this area were ribbon fish (43.3%), Carangids (10.7%), tuna (7.6%), white bait (7.1%), lesser sardine (4.8%) and mackerel (2.1N).

Most of the ribbon fish catch (98.9%) was landed by boat seine during June–October with peak landings in September. The scad (*Decapterus dayi*) and the horse mackerel (*Megalaspis cordyla*) contributed to 29.9% of the Carangid fishery. Their abundance in the area was in May and August–September. Tuna formed the bulk (59.2%) of the drift gill net landings. Good fishery for the tuna was recorded during March–June and October December. About 93% of the annual white bait (*Stolephorus*) catch was landed during June–October, mainly by boat seine (92%). The bulk of the lesser sardine catch was obtained by 'Chalavala' and the fishery for this resource was more productive during April–May and October–November. The drift net contributed to the bulk (61.8%) of the mackerel catch. Its fishery was successful during April–May.

The pelagic fish resources off Mandapam area were exploited mainly by three different types of drift gill nets, viz., 'Choodai Valai' (30 mm), 'Maya valai' (60 mm) and 'Vali valai' (90 mm mesh) effective for capturing the small, medium and big-sized pelagic species. It was estimated that about 3391 tonnes of pelagic fish by 'Choodai valai' 160 tonnes by 'Maya valai' and 565 tonnes (January–March 1982) by 'Vali valai' were landed. The major components of pelagic species in the former were

lesser sardine (94.6%). In 'Maya valai' landings, mackerel (22.0%), *Hilsa kelee* (16.1%), *Chirocentrus* (13.9%), sharks (9.2%), Belonids (8.8%) and seer fish (6.5%) formed the major species. The major contributors in the 'Vali valai' landings were *Chirocentrus* (43.1%), seer fish (16.0%), shark (11.0%), *Caranx* sp (9.8%) and Pomfret (8.7%). In the area, maximum catch and catch rates for lesser sardine, mackerel, *Chirocentrus* and *Hilsa* were recorded during April–June for belonids and shark during July–September and for seer fish and Pomfret during February–March. The results of the high opening bottom trawling in the sub-areas 9–79/48 & 4C during February–March indicated that these grounds were highly productive for pomfret and rainbow sardine (*Dussumieria sp*).

At Waltair an estimated catch of about 1372 tonnes of pelagic fish was landed by different gear. To the total pelagic fish catch component trawl contributed to 76.9%, Hooks and line 9.2%, bottom set gill net 5.8% and gill nets 3.7%. Species-wise, the bulk of the pelagic catch was contributed by the ribbon fish (37.7%), Scad (20.2%), mackerel (10.3%), white bait (9.9%), seer fish (7.8%) and lesser sardines (7.2%). The seasonal abundance of the predominant pelagic species of the area is being studied.

DEMERSAL FISHERIES DIVISION

In the Demersal Fisheries Division, the major areas of research were investigated through seven projects in capture fisheries and four projects in culture fisheries. Investigations included in the former concerned with resource characteristics and stock assessment of cat fishes, perches, threadfin breams, silver bellies and other major exploited demersal fisheries. Culture of milk fish, mullets, sand whiting, eels, pearl spot and mass production of mullets were some of the investigations included in the latter. The salient findings in respect of each project are as follows:

Estimation of stocks of cat-fishes (FB/DR/1.8.1)

B. KRISHNAMORTHI, V. N. BANDE, N. GOPINATHA MENON, M. K. GEORGE, H. MOHAMED KASIM AND P. MOJUMDER.,

At *Waltair* out of 176 tonnes of cat–fish realised, the major contribution was made by private mechanised boats (113 tonnes) followed by indigenous, non–mechanised craft (59 tonnes) with the Government of India Exploratory trawlers contributing the least (4t). As during last year, of the two species that supported the cat–fish fisheries, the share (65%) of *Tachysurus thalassinus* was greater than that of *T. tenuispinis* (35%).

With four modes at 130, 170, 250 and 370 mm, the 2046 specimens of *T. thalassinus* ranged in sizes from 100 to 439 mm. Most of them were in immature and maturing stages of

maturity with 1 : 1 sex ratio. Feeding was maximum in May and from November to February periods. Crab, fish and prawn dominated the food. In 282 specimens of *T. tenuispinis* measured over a size range of 140 to 459 mm, there were 3 modes at 180, 260 and 360 mm. With 1 : 1 sex ratio, spent specimens were noticed in November. Feeding was intense in June and September with polychaetes and crabs dominating the food.

With an estimated catch of 855 tonnes, the cat-fish fisheries at *Cochin* showed a 10% improvement over those of last year (716 tonnes). Mainly sustained by the drift nets (59%), the contributions of the trawl nets and the purse seines were respectively 39% and 2%. Forming 48% in drift nets and 52% in trawl nets, *T. serratus* and *T. tenuispinis* respectively dominated the cat fish component of the fisheries at this centre. With two modes at 40 and 65 cm, *T. serratus* ranged in sizes from 25 to 95 cm; while *T. tenuispinis* ranged from 10 to 40 cm with a single mode at 30 cm. Off South Karnataka large schools of *T. tenuispinis* with eggs in mouth, were observed suggesting that this area may serve as a nursery only.

An estimated catch of 2,999 tonnes of cat fish was landed at *Bombay* and their percentage contribution varied from 5 in December to 11 in February. *A. sona* and *A. jella* were the two important species that constituted the cat-fish fisheries at this centre. They matured at 50 and 32 cms respectively.

Out of an estimated catch of 383 tonnes of cat-fishes landed at *Veraval*, the contribution of the trawlers (261 tonnes) was thrice that of the gill netters (103 t.). While *T. thalassinus* was the dominant species (42%) in the trawl catches; in the gill net catches it was *T. dussumieri* (68%). In both the gears, *T. thalassinus* ranged in sizes from 25 to 74 cms. But *T. dussumieri* ranged in sizes from 15 to 54 cm in trawl catches and 25 to 89 cms in gill net catches.

Resource characteristics of Perches (FB/DR/1.8.2)

P. SAM BENNET, P.A. THOMAS AND K.S. SUNDARAM

Investigations on perches were carried out at three centres viz., *Vizhinjam, Tuticorin* and *Bombay*. With estimated landings

amounting to 132.6 tonnes, the perches formed 2.8% of the total fish catch at Vizhinjam. Nemipterids and Lethrinids with respective contributions of 46% and 18% were the chief contributors in hooks and line, drift net, boat seine and shore seine landings. At Tuticorin, Lethrinids and Sciaenids constituted the major catches in the fisheries for perches. Perches formed only a minor fishery at Bombay with *Lutianus sanguineus* and *Epinephelus tauvina* forming the major portion of the catch.

Resource characteristics of threadfin bream (FB/DR/1.8.3)

V. SRIRAMACHANDRA MURTHY, T. APPA RAO, E. VIVEKANANDAN, A.A. JAYAPRAKASH, K.V. SOMASEKHARAN NAIR, GRACY MATHEW AND M.K. GEORGE.

Compared with the catches of the previous year, there was a fall by about 42% in the fisheries for threadfin breams during the year (777 tonnes) at *Waltair*, with peak catches recorded in January–March period. Among the five species occurring in the catches, *Nemipterus mesoprion* was the dominant species (75%) followed by *N. japonicus* (23%). Ranging in sizes from 70 to 235 mm, *N. japonicus* was represented in the catches by the '0' and '1' year classes with the former age group dominating (83%).

In contrast to Waltair, at *Kakinada* an improvement by about 17% in the catches of the threadfin breams (707 t.) was noticed over those of last year. Peak catches were observed during October '81, and January/February '82 periods. Furthermore, unlike in Waltair the contribution of *N. japonicus* was higher (62%) than that of *N. mesoprion* (34%). At this centre also the '0' and '1' year classes dominated, together forming 98% of the catches, though 4 age groups ('0'—III) were observed. The exploitation rate being 0.34, the total annual stock and the standing crop were estimated respectively at 1227 and 569 tonnes. Since the present yield of the species is only 439 tonnes, the fisheries for *N. japonicus* can presently stand an increase in fishing pressure.

Forming 17.4% of the total catches, an estimated catch of 688 tonnes of threadfin breams was landed by the trawlers

at *Madras* with peak catches recorded during October '81 and January/February '82. *N. japonicus* (43%) and *N. mesoprion* (21%) were the main contributors. At this centre also, the fisheries for *N. japonicus* was supported by the 'O' and 'I' year classes with a range in sizes from 50 to 259 mm. Adults with ripe gonads were observed in August–March period.

A three-fold increase during the year was noticed in the catches of the threadfin breams (2673 tonnes) when compared with those of last year at *Cochin*. *N. japonicus* was the main supporter. Ranging in sizes from 90 to 270 mm, the species in the catches was represented by four age groups ('O' to III), the 'O' and 'I' year classes forming 90% of the catch by numbers. Mainly supported by immature fishes, in September '81 and January '82 a few gravid adults were noticed. In June and December–March, feeding was high.

At *Calicut*, an estimated catch of 94 tonnes of threadfin breams wholly constituted by *N. japonicus* was landed. The species ranged in sizes from 70 to 245 mm with the length group 100–140 mm forming the bulk of catches.

An estimated catch of 1834 tonnes of threadfin breams was landed at *Bombay* by the trawlers forming 4.4% of the total. Although 4 species occurred in the catches, *N. japonicus* was the dominant species (86%). Peak catches were noticed in January–March period with fresh recruitment taking place in March.

Assessment of Sciaenid resources (FB/DR/1.8.4)

T. APPA RAO, V. SRIRAMACHANDRA MURTHY, GRACY MATHEW, S. K. CHAKRABORTHY, E. VIVEKANANDAN AND V. SOMASEKARAN NAIR.

By far the largest contribution to the fisheries for sciaenids at *Waltair* was made by the private mechanised boats (509.6 t.), the contribution by the Govt. of India trawlers being only 0.6 tonnes. When compared with the catches of last year, there was a 43% fall in the fisheries for sciaenids during the current

year as a result of decrease in effort by 31%. *Johnius carutta* (44.4%), *J. maculatus* (27.3%) and *K. axillaris* (28.2%) were the main contributors to the sciaenid fisheries. Specimens ranging in sizes from 105 to 160 mm dominated the catches of *J. carutta*. Females were more in number and gravid adults were noticed in April–June. In majority of specimens examined, stomachs were either empty or everted.

As in Waltair, in *Kakinada* also a fall by about 18.7% was noticed in the fisheries for sciaenids. An estimated catch of 850 tonnes of sciaenids was landed by the trawlers. Peak catches were recorded in April–May, November '81 and February '82. The indigenous craft and gear landed an estimated catch of 19 tonnes at Uppada where maximum catches were landed by the gill nets and shore seines. *J. vogleri, O. ruber, J. carutta, A. nibe, N. maculata* and *C. aureus* were some of the important contributors both in the trawls and non-mechanised boats. *J. carutta* ranged in sizes from 115 to 185 mm in the trawl catches and from 75 to 175 mm in indigenous gear. Specimens with ripe gonads were noticed in April–May and majority of them were with either empty or everted stomachs.

An estimated catch of 39.3 tonnes of sciaenids was landed at *Madras* (*Kasimode*) by the trawlers with a peak in May '81. A decline was noticed during the latter half of the year. *Pennahia aneus, N. maculata, J. carutta* dominated. *P. aneus,* measuring 170–179 mm contributed to the bulk of the catches and were in spent condition during May–June. Prawns and *Squilla* were the main items of food.

Sustained by *Johniops sina, J. dussumieri, O. ruber* and *K. axillaris,* the estimated landings of sciaenids were 219 tonnes at *Cochin*. With three modes (90, 100, 125 mm) in November, two (125 and 135 mm) in December, three (90, 135 and 150 mm) in January, two (125 and 140 mm) in February and two (135 and 160 mm) in March, *J. sina* ranged in sizes from 65 to 170 mm during the year. *K. axillaris* ranged in sizes from 70 to 120 mm with one mode each in November, January, February and March at 90, 105, 110 and 110 respectively.

At *Calicut,* an estimated catch of 84.3 tonnes were realised during the later half of the year where investigations on sciaenids were commenced at this centre. *J. sina. J. dussumieri, O. ruber* and *O. argenteus* were the main contributors.

Resource characteristics of Silver bellies (FB/DR/1.8.5)

J.C. GNANAMUTHU, V. SRIRAMACHANDRA MURTHY AND N. GOPALAKRISHNA PILLAI.

An estimated total catch of 14,745.4 tonnes of silver bellies was landed during the year at *Mandapam.* At both Rameswaram and Pamban where the estimated catches amounted to 10,201.1 tonnes and 998.1 tonnes respectively an improvement in the fisheries for silver bellies was noticed over those of last year. But at Mandapam (3546.2 tonnes), a decline was observed which was due to a fall in both day and night landings. Reduction in day trips and migration of fishermen to fishing grounds off Madras were other factors responsible for decreasing catches. While *L. jonesi* was the dominant species both at Mandapam and Rameswaram, at Pamban *L. dussumieri* dominated. Furthermore, at both centres fish in 1+year class in the size range of 80–100 mm supported the fishery. The male to female ratio was more in favour of the females. Larval bivalves, copepods and diatoms formed the food of the species. *L. dussumieri* ranged in sizes from 60 to 150 mm with two modes at 80 and 120 mm. February to July was the peak spawning period when percentage occurrence of fish in stages IV to VII was high.

Forming 5.3% of the total trawl catch, the estimated catches of silver bellies at *Kakinada* amounted to 779 tonnes in trawlers and 44 tonnes in the catches of indigenous units. While *L. bindus* and *S. insidiator* together contributing 82% of the catch were the dominant species in the trawler landings; in the indigenous units, *L. equalus* was also landed along with the two previously-mentioned species together forming 90% of the catches. *L. bindus* in both the gears ranged in sizes from 32 to 97 mm with mature fish occurring in Arpil and May and January–March periods. *S. insidiator* ranged in sizes from 37 to 117 mm with smaller fish forming a mode at 57 mm occurred in April, July

and February. Ripe females were observed during May–July and December–February periods.

A three-fold increase was noticed in the fisheries for silver bellies at *Madras* where an estimated catch of 781 tonnes was landed. Peak catches were observed in the III quarter (October–December). *L. bindus* and *S. insidiator* were the dominant species and formed 20.4% of the total trawler landings. *L. bindus* ranged in sizes from 50 to 123 mm and the 1+year class in sizes between 80 and 110 mm contributed to the fishery. Percentage of mature females was high in April, October and December.

Culture of marine fishes (FB/CUL/1.1.1)

P.S.B.R.James, K.Dorairaj, R.S.Lal Mohan, A.Raju, V.S.Rengaswamy, S.Lazarus, R.Mariachamy and D. Kandasamy.

Culture of milkfish (*Chanos*) and mullet (*Valamugil seheli*) was undertaken at *Mandapam* in two mariculture systems viz. in ponds and in net enclosures. In fertilised ponds while *Chanos* with an average size of 91.6 mm (10.6 g) were stocked in September '80; *V. seheli* with an average size of 50.6 mm (28 g) were stocked in October '80. The fishes were harvested in July '81. The total yield as well as survival rate recorded were 1266.7 kg/ha (60.8%) for *Chanos* and for mullet 333.3 kg/ha (5.7%). In the unfertilised ponds, *Chanos* with an average size of 65.9 mm (2.6 g) and *V. seheli* with an average size of 57 mm (3 g) were stocked in September and October '80 respectively. At the time of harvest in June '81, the yield/ha and survival rates were 1205.5 kg (65.1%) for *Chanos* and 216.7 kg (42.9%) for mullets. The yields and the survival rates were, therefore, slightly better in fertilised ponds than in unfertilised ponds. A second experiment with the same objectives initiated in September '81, is under progress and the results would be known when harvested.

Culture experiments in net enclosures were initiated in the lagoon at Pillaimadam and 900 numbers of *Chanos* fingerlings of average size of 139 mm (208) were stocked in the pen in 8/1981. With growth fluctuating from 0.5 mm/day to 2.1 mm/

day during various periods of time, at the end of 234 days from the date of commencement of the experiment, a weight increase from 20 g to 490 g and length increment from 139 mm to 405 mm were noticed. The experiment is under progress.

In order to take up similar culture activities with *Sillago* sp., intensive survey and collection of seed were undertaken. The seeds were abundant in January and less in September. Furthermore, their occurrence was more during day than at night.

A series of experiments was carried out at *Tuticorin* where coastal ponds have been developed in an inter-tidal swampy area with an ecosystem altogether different from areas available elsewhere at Mandapam. Culture of the milk fish, *Chanos* and the mullet *L. macrolepis* were undertaken at this centre in 6 ponds B to G in various combinations. Ponds B & C were respectively stocked with *Chanos* (2000 nos) and crabs (1260 nos.); and *Chanos* (7200 nos.) and *L. macrolepis* (2000 nos). Ponds D & G with purely Chanos and E & F with *L. macrolepis* at different intensities. Supplementary feed of rice bran soaked in ground nut oil was provided at 5% of the body weight. The growth of *Chanos* in Ponds B & C was better with a production rate of 525 kg/ha/yr. In pond C, the survival rate (44%) of mullets was better than that of *Chanos* (8%). The rate of production of the two species together was 865 kg/ha/yr. In the monoculture of *Chanos* in ponds D & G, wide variations in growth, survival and production rates were noticed and differed considerably from those obtained from composite culture. Although the mullets grew well in pond F at the rate of 24 mm/12g/m, the recovery rate (11%) was poor.

Etroplus suratensis with a mean size of 64.8 mm and mean weight of 3.9 g were stocked at a rate of $0.6/m^2$ (6153/ha) in 8/81 at *Calicut*. An artificial feed of powdered meat, fish meal, rice and groundnut oil cake was supplied twice daily. During harvest in 3/82, the production and survival rates were observed at 240 kg/ha and 60.4% respectively. By providing artificial environment with the help of bundles of drumstick wood suspended, 4 new broods (1 in December '81 and 3 in March '82) could be successfully spawned.

Breeding, seed production and culture of grey mullets (FB/CUL/1.1.3)

P.S.B.R.James, L.Krishnan, V.Gandhi, G.Mohanraj, A.Raju and V.S.Rengaswamy.

At *Narakal* the availability of breeders of *Mugil cephalus* was negligible. But breeders of *L. parisa* were available during all months of the year under report. A sample of 33 specimens of *L. parsia* examined, showed that 5 males were in oozing condition, 6 females were in spent condition and the rest had eggs in the III stage of maturity. While breeders of both *M. cephalus* and *V. seheli* were not available at *Mandapam,* mature specimens of *L. macrolepis* were available during the period August–October '81. Apart from obtaining the breeders of *M. cephalus* from the wild at Narakkal, monitoring of the brood-stock maintained since sometime in a 0.1 ha. pond was continued. This resulted in observing for the first time one female (60.5 cm and 2.5 kg) having gonads with well yolked eggs in the II stage of maturity. The collection and maintenance of brood stock of *M. cephalus L. macrolepis* and *V. seheli* at *Mandapam* were not very successful as most of the specimens died. Experiments on induced breeding of both the wild stock and pond reared specimens of *M. cephalus* and *L. parsia* were carried out at Narakkal with partial success. Inducing agents such as carp pituitary gland, L. H. and chorionic gondotrophin were tried at Mandapam on *L. macrolepis* and *M. cephalus.* Encouraging results have not been obtained so far in most of the experiments barring one attempted in September and November when 26 females of *L. macrolepis* were treated with hormones. Of the 4 that responded to the treatment, one was stripped and fertilization achieved with milt from 3 males. The size of a fertilized ovum was 0.76 mm. Hatching took place after 18 hours. The larvae measured 1.43 mm in size and survived for a week. Monoculture of *V. seheli* at different stocking densities was undertaken at *Mandapam.* A production rate of 782.2 kg/ha over a period of 9 months with a survival rate of 81.2% was achieved. New sets of experiments at monoculture of *V. seheli* are under way since September '81.

Breeding, seed production and culture of eels (FB/CUL/1.2)

K. DORAIRAJ AND D. KANDASAMI.

Experimental culture of eels, *Anguilla bicolor bicolor*, were undertaken at *Mandapam* in two ecosystems viz., in outdoor cement tanks and in 12' dia. polycraft pools. Induced breeding experiments were also carried out. In August '81, 208 numbers of eels (9 kg) ranging in sizes from 252 to 346 mm and in weight from 24 to 72 kg. were stocked at a rate of 500g/sq. m. The net weight increase during 7 months was 111.7 g and the survival rate 100%. A total weight of 234.55 kg of artificial feed was supplied during the experimental period and the eels had consumed 210.85 kg. The food conversion worked out to 9 : 1.

Started in April '81, culture experiments in 12' dia. tanks were continued. In February '82, the total weight and average weight had respectively increased from 30 kg. to 37.9 kg and 88.2 g/eel to 126.3 g/eel. Compared with the growth obtained in outdoor tanks, the growth in the pool is low. The survival rate was also low (88%).

In experiments on induced breeding, a total of 720 mg of carp pituitary extracts and 23,000 I.V. of Profassi (HCG) were given to a female eel which reached spawning condition 75 days after the treatment. The specimen, however, died after partial spawning. None of the males responded to the hormonal inducement. It was, furthermore, observed that the length remained constant in the treated eel, whereas the weight by 6.3%, eye-index by 35.8% and pectoral length by 38.9% had increased over those of the initial measurements. The left ovary was longer and heavier than the right. Eggs were spherical, transparent and measured 0.9 mm in diameter. In another experiment, injections were given to 10 females and 24 males at dosages ranging from 15 mg to 200 mg carp pituitary extracts and 500–2000 I.V. of HCG for females and 4 injections of 500 I.V. of Profassic to males. Only 3 females and 4 males reached spawning condition.

At *Tuticorin* biochemical estimations for moisture, protein, fat and ash were made of elvers, spawned and cultured eels.

CRUSTACEAN FISHERIES DIVISION

In the capture fisheries the salient features of the prawn fishery during the year 1981–82 were:

1. Decreasing trend in the overall production of prawns is maintained during the year;

2. The same trend of overall decrease was noticed in the penaeid prawn fishery, mostly brought about by the conspicuous decline in the catches at Neendakara in Kerala State;

3. While the catches at Neendakara (*Parapenaeopsis stylifera*) (Karikkadi) recorded less than one third of the catches of previous year, most of the centres on the east coast in Tamil Nadu and Andhra Pradesh recorded higher catches when compared to previous year;

4. The non-penaeid prawn fishery showed decline at the west coast centres like Veraval and Bombay, while showing increase in the east coast centre at the Kakinada;

5. The juvenile penaeid prawns were less abundant than in previous year in most of the estuarine environments except for *Metapenaeus dobsoni* in Cochin backwaters;

6. The spiny lobster fishery recorded improved catch and catch rates during the year at all the observation centres except Veraval.

Significant developments in the culture fisheries for prawns were the following:

1. Methods of mass culture of prawn seeds were standardised and perfected at the Narakkal Prawn Culture Laboratory and greater survival rate of the larval forms was recorded.

2. Induced maturation of *P. indicus* to develop spawners by unilateral eyestalk ablation has been widely used obviating the dependance on wild spawners from the sea.

3. Continuous third generation of *P. indicus* has been developed and maintained in the growout ponds of NPCL.

4. Work on mass production of *P. monodon* seeds have been initiated at the Kovalam Laboratory in Madras State.

5. Design for the mariculture facility in the newly acquired 93 acre site at Muttukad near Madras has been made and three ponds have been constructed. These ponds have been stocked with prawn seeds developed at Kovalam laboratory.

6. Encouraging results have been obtained in culture of prawns in the polythene lined pools at Calicut.

Assessment of penaeid prawn resources (CF/RE/1.1.1)

M.J.George, P.Vedavyasa Rao, K.N.Rajan, Manmadan Nair, S.Lalitha Devi, D.B.James, Sampson Manickam, M.Rajamani, N.S.Kurup, K.K.Sukumaran, G.Nandakumar, S.Ramamurthy, M.Aravindakshan, G. Sudhakara Rao, M.M.Kunju and K.Y.Telang.

In the penaeid prawn fishery most of the observation centres showed increase in catches compared to 1980–81 except at the centres in Kerala State. The catches at Neendakara which registered a substantial increase in 1980–81 from the earlier year showed a steep fall to less than one third of the catch of the

previous year. In fact this is reflected in the total penaeid prawn landings of the country, showing an overall decrease in 1981–82.

The estimated landings of penaeid prawns along with catch per unit effort, species composition peak season of fishery and price variations at the different centres of observation are given in Table 8. In both centres of Maharashtra State the estimated trawl catch showed marginal increase from that of last year while at Veraval in Gujarat the catch was considerably lower. The three centres covered in Karnataka state recorded higher catches. At the same time all the three centres in Kerala State showed poorer catches, especially Neendakara, the catches recording less than one third of the earlier year and thus affecting the entire prawn fishery of the country. On the east coast all the centres in Tamil Nadu and Andhra Pradesh recorded higher catches when compared to previous year except Madras where the estimated catch was slightly lesser than last year. The respective catch rates also showed similar trend in all the centres.

The percentage composition of species in the different centres is shown in Table 9. The dominant species in the observation centres on the west coast except at Karwar and Calicut is *Parapenaeopsis stylifera*. While at Karwar *Metapenaeus monoceros* dominated, at Calicut the dominant species was *M. dobsoni*. In the indigenous fishery at Karwar also *P. stylifera* was the dominant species. In general it is noticed that *M. dobsoni* which was the dominant species in most of the centres especially along the southern region of the west coast in earlier years is being replaced by *P. stylifera* in these centres. *Penaeus* spp. dominated along Tamil Nadu coast, *P. semisulcatus* in Tuticorin and Mandapam *P. indicus* in Madras. In Andhra Pradesh while *M. dobsoni* was the dominant species in Kakinada, *M. monoceros* dominated at Waltair.

Along the Maharashtra and Gujarat coast September to December period is the most productive for penaeid prawns in the trawl fishery. In the centres of Karnataka coast March–May is the production period. In Kerala state the most abundant season is the south west monsoon months June to August at the important centre of Neendakara while it is the earlier months of

the year which are productive in the northern centres of the state. In Tamil Nadu June to September is the season of abundance. In Andhra Pradesh February to April seem to be the most productive period at Kakinada while at Waltair September-November period has maximum production of penaeid prawns. The size of the different species as well as maturity show the same trend as in previous years.

Table 8. Penaeid prawn fishery at various Centres in 1981—82

	Gujarat	Maharashtra		Karnataka			Kerala		Tamil Nadu				Andhra Pradesh		Orissa
	Veraval	Sasoon Dock	New Ferry Wharf	Karwar	Malpe	Manga-lore	Calicut	Cochin	Neenda-kara	Tuti-corin	Mandapam	Madras	Kaki-nada	Waltair	Puri
Mechanised Fishery															
(a) Catch in tonnes	1,252	4,140	6,049	708	570	856	138	2,550	9,399	1,467	681	199	2,707	625	
(b) Catch/effort (Kg/hours)	2.4	27.6	302.7 (per unit)	5.7	4.6	5.8	5.4	13.4	17.7	6.3	2.3	1.2	6.9	3.2	
(c) Important Species*	j, k, e, c b, l, i	b, j, c, l, m, d	j, l, b, c	c, j, a, b, g, h	j, a, c, b, f, h	j, a, c, b, f, h	a, j, c, f	j, a, f, b, c, h	j, f, a, b, c	i, f	i, b, f	f, c, i, a, h	a, c, f, d,h,j,b	c, m, f, l, a, h, l	
(d) % of prawns			29.1					47.5	22.5				30.2		
(e) Productive Months**	11, 12, 1, 10	10 11, 9, 12	10, 4, 11 1, 9, 3	4, 12, 5, 1	5, 4, 12, 2	3, 12, 2, 5, 4	12, 1, 2	7, 5, 1-4, 12	8, 7, 6	7, 6, 9, 5, 11	7, 8, 6	10' 8, 6, 7, 4	2, 10, 3, 4, 1	11, 2, 8, 1, 9, 10	
Indigenous Fishery															
(a) Catch in tonnes				21.2	15.0	12.0	185						796		119.5
(b) Catch/effort (Kg)				20.0	(Purse seine)	59							1.8 (per hour)		0.4 (gill net)
(c) Important Species*				j, a, g, b, h	a	a	a, f, g, b						a, f, d, c		f, g, b, h
(d) % of prawns													33.8		
(e) Productive Months**				7, 8, 6	9, 1	8, 9	7, 8, 6, 10						2, 1, 3, 10, 5, 4		11, 10
Price Structure (Rs.)															
Large			40—60			40—60		55—75	60—75				50—85		55—70
Medium			20—35			25—40		40—55	35—50				23—50		20—35
Small			10—18			10—16		6—15	8—14				8—15		
Tiny			3—8												

* a. *M. dobsoni*
b. *M. affinis*
c. *M. monoceros*
d. *M. brevicornis*
e. *M. kutchensis*
f. *P. indicus*
g. *P. merguiensis*
h. *P. monodon*
i. *P. semisulcatus*
j. *P. stylifera*
k. *P. hardwickii*
l. *S. crassiocornis*
m. *M. stridulans*

** *Calendar months*

Table 9. Percentage of penaeid prawn species at different centres in trawl fishery. Indigenous gear given in parenthesis

Species	Gujarat	Maharashtra			Karnataka		Kerala		Tamil Nadu			Andhra Pradesh		Orissa
	Veraval	Bombay (Ferry Wharf)	Sassoon Dock	Karwar	Manga-lore	Malpe	Calicut	Cochin	Neenda-kara	Tuti-corin	Manda-pam	Mds.	Kaki-nada	Waltair	Paradip Puri
Solenocera crassicornis	7.2	31.7	8.0										2.7	10.1	
Penaeus indicus				0.1	4.2	2.7	4.0	10.9	9.2	44.4	2.0	27.6	11.6	10.2	(47.8)
Penaeus merguiensis				1.3 (6.1)			(3.0)						2.4		(34.9)
Penaeus monodon				0.3 (3.3)	1.2	1.0		0.2				8.7	8.3	6.9	(2.7)
Penaeus semisulcatus	5.3									55.6	83.3	20.8	1.6	0.9	
Penaeus penicillatus	3.4	4.4	0.5												
Metapenaeus dobsoni				18.8 (32.3)	31.6 (100.0)	24.5	56.0 (94.8)	37.7	3.4			16 8	25.4	8.3	
Metapenaeus affinis	7.3	13.5	41.0	7.2 (5.8)	4.5	5.4	(0.2)	1.1	2.1		8.7		6.1		(14.6)
Metapenaeus monoceros	9.2	9.3	15.0	43.7	13.8	14.8	6.0	0.3	1.4			26.1	13.6	38.4	
M. brevicornis		0.9	4.0										9.5		
M. kutchensis	9.6														
Parapenaeopsis stylifera	40.2	35.5	22.0	28.3 (52.4)	44.8	51.5	34.0 (2.0)	49.2	83.2				6.3		
P. hardwickii	15.6	2.8											4.0		
P. sculptilis													0.9		
Metapenaeopsis stridulans			6.0											21.3	
Other penaeid prawns	2.2	1.9	3.5	0.3				0.1	0.3		6.0		7.6	3.5	

Assessment of non-penaeid prawn resources (CF/RE/1.1.2)

S. RAMAMURTHY, S. LALITHA DEVI, V. D. DESHMUKH AND G. SUDHAKARA RAO.

Compared to 1980-81 the non-penaeid prawn fishery declined at the west coast centres, marginally at Bombay and considerably at Veraval. At Kakinada on the east coast the fishery improved by about 25%. However in the backwaters of Kakinada the yield was less, being only 40% of the previous year. *Acetes indicus* was the dominant species at Veraval and Bombay, forming more than 50% of the catch. At Kakinada also this species was dominant but constituting only 1/3 of the catch. Next in importance was *Nematopalaemon tenuipes* at Bombay and Kakinada and *Hippolysmata ensirostris* at Veraval. The steep decline in the catches during the current year at Veraval was mostly due to the poor catches of *A. indicus*, the species dwindling to little above one third of the catch of the previous year. The mean length of *N. tenuipes* ranged from 44.5 mm to 49.7 mm in the fishery here, with highest number of burried females occurring in September. At Bombay the mean length for this species ranged from 23.9 mm to 50.4 mm, with maximum breeding activity during June to September. Sizes below 40 mm of this species were not found in the marine fishery of Kakinada.

Assessment of prawn resources in the nursery grounds (CF/RE/1.1.3)

C. SUSEELAN, K. N. RAJAN, S. LALITHA DEVI, D. B. JAMES, V. S. KAKATI, K. K. SUKUMARAN AND G. NANDAKUMAR.

The resources and biology of prawns from the estuarine habitats were studied from Karwar, Mangalore, Calicut, Cochin, Madras, Kakinada and Puri. The juvenile penaeid prawns were relatively less abundant than in the previous year in most of the estuarine environments except for *Metapenaeus dobsoni* in Cochin backwaters. In Kadwad backwaters at Karwar active recruitment of postlarval and juvenile penaeid prawns was noticed although the year except during July–October, with *Penaeus indicus*, *M. dobsoni* and *P. merguinensis* as dominant species. Juveniles

Table 10.

Estuarine prawn fishery at selected centres during the year 1981—82

	KARWAR	MANGALORE	CALICUT	COCHIN	MADRAS	KAKINADA	PURI
Estimated catch in tonnes	131.4	3.0	46.4	1786	11.6	600.0	28.7
CPUE in Kg.	2.16	0.1@	7.3	2.39*	—	15.4	0.44+
Fishing gears	Stake nets	Cast net & Seines	Stake nets	Stake nets & Cast nets	Stake nets	Stake nets & Drag nets	Drag nets
Important Species	*M. dobsoni* *M. monoceros*	*M. moyebi* *M. dobsoni* *P. indicus*	*M. dobsoni* *M. monoceros* *P. indicus*	*M. dobsoni* *M. monoceros* *P. indicus* *M. affinis*	*P. indicus* *M. dobsoni* *M. monoceros*	*M. monoceros* *P. indicus* *P. monodon*	*P. indicus* *M. monoceros* *P. monodon* *M. dobsoni*
Peak fishing seasons	November–February	April–June & November	May	February–March	July–December	August, September, November.	May–July

@ For cast nets * For stake nets + Catch/hour

of *M. dobsoni* and *M. monoceros* were exploited commercially from this environment using stake nets during August–March when a total of 131 tonnes were caught at an average catch rate of 2.16 kg/unit (Table 10). At Mangalore, low rate of recruitment of prawns this year resulted in about 20% reduction in the commercial catches in Nethravati estuary along with a severe decline in catch rates from 0.7 to 0.1 kg/cast net unit. Contrary to the earlier years *M. moyebi* dominated the catch as against *M. dobsoni*. In the Korapuzha estuary at Calicut, although marginal improvement in the total harvest of penaeid prawns was recorded, the CPUE remained lower indicating a lesser stock of juveniles than in the previous year. The reduction was well manifested in the principal species *M. dobsoni*, which in Cochin backwaters improved considerably during the last quarter of the year resulting in about 22% increase in the stake net catches over those of the previous year along with a corresponding increase in the catch rates for that gear. In the latter environment the abundance of *P. indicus*, however, was much lower than in the previous year as evidenced by its poor representation in the try-net collections as well as in the cast net fishery. Better recruitment was recorded for *M. monoceros*. The greater abundance of *M. dobsoni* and *M. monoceros* towards the end of the year suggests a better fishery for these species in the inshore waters of this coast during the ensuing months. Preliminary survey carried out in Ashtamudi backwaters revealed preponderance of *P. semisulcatus* and *P. indicus* among the juvenile population of penaeid prawns indicating the possiblity of the existence of good breeding stock in the adjacent marine environment.

Postlarval recruitment for *P. indicus* and *M. dobsoni* was active throughout the year in Ennore estuary at Madras, with peaks in November and March. A total of 11.6 tonnes of juvenile prawns exploited from here was mostly made up of the former species followed by the latter and *M. monoceros*. The backwater centres of Kakinada witnessed further decline in prawn production this year, the estimated landings being 600 tonnes only as against 838 tonnes of the previous year. A slight decrease was also noticed in the catch rates for the stake nets and drag nets. *M. monoceros* formed 62.5% followed by *P. indicus*, *P. monodon*, *M. dobsoni* and *M. brevicornis* in the order of abundance. At

Puri (Arkakuda) although the total prawn landings improved from 20.3 tonnes to 28.7 tonnes, the catch rate declined for the drag nets indicating lesser abundance of juvenile prawns in this part of the Chilka lake. *P. indicus*, *M. monoceors* and *P. monoden* were the major species in the order of abundance.

M. dobsoni was mainly represented by 41–60 mm size group in most of the estuarine environments except in Korapuzha estuary where its mean size ranged from 33.5 to 54.9 mm. Smaller size groups contributed to substantial portion of the fishery during August-September in the estuaries of Karnataka, May-June and January-February in Kerala and December-January at Kakinada. *M. monoceros* was chiefly represented by 45–84 mm size at Kakinada and 56–90 mm at the other centres. The major size group of *P. indicus* was 70–120 mm with fresh recruits entering into the fishery during the summer months. The common size range of *P. monodon* was 106–150 mm at Puri and 135–154 mm at Kakinada.

Evaluation of penaeid prawn fishery with reference to size and effort (CF/RE/1.1.4)

M.J.George, M.M.Thomas and C.Suseelan.

Using the data on catch per unit effort and effort in respect of prawn fishery for about 10 years in 9 important centres along the coasts of India the maximum sustainable yield (MSY) and the corresponding optimum effort have been worked out (Table 11). From the scatter diagrams for catch and effort and the fitted equations relating the two, the results are summarised in table. It appears that for the fisheries around Sassoon Docks, Karwar, Mangalore, Calicut, Cochin, Neendakara, Mandapam and Madras the indications are that increasing the effort beyond the optimum value may not increase the yield. In Kakinada, on the other hand, the slope of the regression line of CPUE on effort was positive indicating that the fishing effort does not have any adverse effect on the yield and the effort in operations can be increased. Similar processing of data of other centres is in progress.

Table 11--

Estimated MSY and the corresponding effort relating to prawns for areas around important centres in India.

Centres	MSY (in tonnes)	Optimum (boat days)	Catch in 1980 (tonnes)
Sassoon Docks (Bombay)	2,890	39,841	3,914
Karwar	538	10,665	557
Mangalore	1,715	30,498	980
Calicut	760	18,672	355
Cochin	4,426	48,690	3,516
Neendakara	53,487	4,65,912	36,568
Mandapam	363	23,756	—
Madras	920	93,979	—
Kakinada	*	*	2,580

**CPUE increased with increase in effort and MSY was not worked out.*

In continuation of the earlier report of overfishing and depletion of prawn resources at Neendakara, an intensive study of the prawn fishery of that centre during the monsoon period was attempted during the year. Large scale capture of undersized prawns of the dominant species *Parapanaeopsis stylifera* (Karikkadi) during the peak season was noticed. The data is being processed.

Assessment of lobster and crab resources (CF/RE/1.3)

P.V.KAGWADE, E.V.RADHAKRISHNAN AND G.SUDHAKARA RAO.

The estimated landings of lobsters during the year 1981–82 showed an improvement over the catch recorded during the previous year in most of the observation centres. At Madras the

catches increased this year from 11.2 tonnes to 18.7 tonnes and Tuticorin recorded a marginal increase to 15.6 tonnes from 13.2 tonnes in last year. In Kanyakumari District the catches were slightly lesser than the previous year. At Bombay the catches went up to 325 tonnes from 290 tonnes in 1980–81. However, at Veraval the landings showed a decline from 70.4 tonnes in 1980–81 to 30.2 tonnes in 1981–82. October–November and April–May appear to be the period of abundance of lobsters in most of the centres. While *Panulirus polyphagus* was the dominant species in the Bombay region, *P. homarus* was the dominant species in the south west coast and south east coast. At Madras *Thenus orientalis* was the predominant species. In Bombay area also this species was landed in fairly good quantities.

The crab yields showed improvement in this year at Mangalore and Madras. However, at Kakinada the most important centre for crab fishery, the catches declined considerably decreasing from 494 tonnes in 1980–81 to 283 tonnes in 1981–82. Among the two constituent species, while *Portunus sanguinolentus* dominated in the fishery at Madras and Mangalore, *P. pelagicus* was dominant at Kakinada. The best catches of *P. sanguinolentus* were in May on the west coast and in October–November on the east coast, when *P. pelagicus* also was abundant there.

Prawn Fishery Atlas (CF/RE/1.4)

E.G.Silas, K.Rengarajan, S.K.Dharmaraja and I. David Raj.

On the basis of the model copy of atlas already prepared, some more maps were drawn and added using the analysed data on prawn fisheries resources from different areas of the coast of India.

Genetic resources of commercially important prawns (CF/RE/1.6)

M.M.Thomas

Morphometric data on cultured specimens of *Penaeus. indicus* collected from culture ponds were analysed along with other morphometric data collected from various other environ-

ments in order to find out whether there are differences between specimens from different environments.

Electrophoretic studies were continued with different tissues from commercially important prawns *P. indicus, M. dobsoni, M. monoceros* and *M. affinis* using polyacrylamide gel. Among the concentrations used, 7% concentration gave best results in clarity of bands. There were distinct differences between the band patterns in different species and based on the nature of the band and their distances from the point of origin, species could be differentiated clearly. The fractions in the bands showed similarities and differences between species.

Assessment of Stomatopod resources (CF/RE/1.7)

M.M.KUNJU, D.B.JAMES, K.K. SUKUMARAN AND K.Y. TELANG.

The estimated total landings of stomatopods by mechanised vessels were higher than the previous year in most of the places and the catches were mostly constituted by the species *Oratosquilla nepa*. One or two other species were recorded in very small quantities, especially from Madras. Only at Cochin the total catch for the year amounting to 181 tonnes was considerably less than the previous year in which the catches were 618 tonnes. At this centre, in the case of *O. nepa* it is interesting to note that in all the months females far exceeded in numbers than males and in a size range of 36 mm to 125 mm the modal sizes ranged from 63 mm to 83 mm.

Intensive Culture of Penaeid Prawns (CF/CUL/1.1.1)

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Observations on pond culture of *Penaeus indicus* at Cochin, Calicut, Tuticorin and Mandapam Camp and of *P. monodon* at Madras were carried out using various stocking densities.

At Cochin: Eight field culture experiments were conducted during the year at the Prawn Culture Laboratory, Narakkal. (Table 12). All the ponds were stocked with *P. indicus* seed reared in the NPCL chiefly from eggs spawned by farm grown adults induced to mature through eyestalk ablation. No artificial pellets were fed to the prawns since the natural productivity of the ponds was high.

The western pond (0.6 ha) was free from *Tilapia* and Exp. 1 and 2 were conducted after netting out the unwanted fish at stocking densities of 36,440 and 23,600 prawns per ha. While Exp. 2 yielded a poor harvest due to escape of prawns from the pond during unusually high tides during December 1981, a good harvest of 370.3 kg/ha, 72 days after stocking was obtained from Exp. 1. The average size of the prawn at harvest was 15.3 gm (129.5 mm).

Pond B (0.1 ha) yielded very poor results because in Exp. 3 the prawns were affected with "softness" and in Exp. 4 the heavy mortality due to 0_2 depletion occurred in March 1982.

In pond C (0.1 ha) Exp. 5 was lost due to total loss of stock through a breach in the bund. However, in Exp. 6 a very good harvest of 598 kg/ha was obtained after only 49 days of stocking the ponds @43,250 prawns/ha. The size of prawns at harvest was 16.8 gm (134.4 mm). The prawns registered a record average growth rate of 2.23 mm/day during the culture period.

Pond D (0.05 ha) also gave an equally good harvest of 602 kg/ha in Exp. 8, 54 days after stocking the ponds with 50,000 prawns/ha. The size at harvest was slightly lower than in pond B, the average weight being 14.5 gm (128.8 mm) Exp. 7 was lost due to high mortality caused by "soft prawn" disease.

Good results were correlated with the absence of *Tilapia* from the ponds and a sandy–mud pond bottom. It is observed that black, soft, muddy bottom leads to poor growth and "softness" of prawns. Tilapia appears to compete with the prawn for food and space and affect the growth of prawns stocked.

Pelletised prawn feeds No. 24 and 25 developed at the NPCL, Narakkal were prepared and supplied to the prawn culture project; 264 kg of pellets to the Calicut Centre of the CMFRI and 52 kg to the NPCL. The ingredients in the feeds were prawn waste, squilla, fishmeal, groundnut oil cake and tapioca.

At Calicut: In the polythene lined ponds on the sandy beach at Calicut the seeds of *P. indicus* reared at the NPCL were stocked and fed @ 10% of body weight on pelletised feed prepared at the NPCL. Two sets of experiments (vide Tables 13 & 14) were conducted using various stocking densities. It is seen that there was an inverse relationship between stocking density and survival rate and the size at harvest was also inversely proportional to the survival rate. Mortality was very high when the stocking density exceeded 10 nos/M^2. The optimum stocking density in these ponds where the sea water is pumped in and the growing conditions are entirely artificial appears to be 7–10 nos/M^2. In many of the experiments the production was about 400 kg/ha. During March, 1982 due to intense solar radiation, a thick mat of filamentous blue-green algae developed in the ponds and led to oxygen depletion early in the morning, resulting in mortality of the prawns and retardation of growth. The conditions in the ponds were essentially stagnant and it was felt that the growth of the prawns could be accelerated if the bottom sediments along with the water could be pumped out periodically and replenished with fresh sea water.

At Madras: 2476 juveniles of *Penaeus monodon* (30.9 mm T.L) reared at the Kovalam Field Centre of the CMFRI, were stocked in the newly constructed 0.5 ha pond No. 2 of the Mariculture Centre of the CMFRI at Muttukad 36 km south of Madras. The stocking was done on 29–12–1981 and the growth of the prawns till the end of March, 1982 is given in the following Table.

No. of days after stocking	Ave. length (mm)	Ave. weight (mm)
At stocking	30.9	0.33
25th day	62.2	1.90
44th day	82.4	4.30
64th day	135.8	19.60
94th day	154.2	27.00

The experiment is continuing.

The seed of *Penaeus monodon* produced at the Kovalam hatchery of the CMFRI were transported in oxygen-filled polythene bags and stocked in a 1 ha private pond owned by Shri P. Gangadharan, situated on the banks of the Vedaranyam canal 7 km south of Nagapattinam. A total number of 3743 seeds of *P. monodon* (average size 36.5 mm) were stocked on 22.9.1981. The water level in the pond was maintained by pumping water from the Vedaranyam Canal once in two days. Since the pond was not productive, the prawns were fed with crushed flesh of trash fish collected from the canal everyday. The salinity in the pond was low throughout the period of culture varying between 2.70–4.64 ppt. Harvesting was done 118 days after stocking on 17.1.1982, when the prawns started becoming soft. The prawn grew from the initial size of 36.5 mm to 136.8 mm in 53 days (1.9 mm/day) and then practically stopped growth. At the time of harvest the average size was only 139.7 mm (20 gm). The harvest yielded 45.72 kg of prawns; 62.2% of the stocked prawns were recovered. Softness was noticed in 2.4% of the harvested prawns. The poor growth and low yield are perhaps due to lack of sufficient food and the low salinity of the water in the pond.

At Mandapam Camp: The attempts at culturing *P. indicus* in the marine ponds at Mandapam Camp were continued but since water supply to the ponds could not be maintained due to sand bar the experiments had to be terminated.

At Tuticorin: Three experiments in pond culture of *P. indicus* were conducted using seed collected from the wild. The

stocking densities were 37,000; 52,150 and 26,000 nos/ha. and the duration of the experiment was 148, 128 and 123 days respectively. In the first two experiments the prawns were fed with groundnut oil cake and trash fish. While in the last experiment the prawns were not provided with supplementary food. Growth was very poor in all the ponds, the average weight of prawns even after four months of growth was only 5–6 gm (100 mm T.L). The harvests from the three ponds were 64 kg/ha (survival 36.8%) 90 kg/ha (survival 32%) and 79.2 kg/ha (survival 57.6%) respectively. The poor growth and yield are perhaps due to the high salinity (29.75 to 54.16 ppt) prevailing in the ponds during the culture period.

The project staff also actively participated in the Lab–to–land demonstration project of the CMFRI at Valappu where a co–operative society of 136 Harijan families was helped to develop a prawn culture farm. The seed of *P. indicus* produced at the NPCL was supplied to the Lab–to–land programme for stocking in the farm and technical advice on the successful culture of prawns in the ponds was given to the Society.

Several entrepreneurs, private individuals and development and banking agencies made use of the technical expertise available in the Institute for counselling on prawn culture during the year. Inspections were undertaken by the scientists to assess the suitability of sites of several farmers for prawn culture operations and detailed reports and advice were provided to them.

Mass production of prawn seed (CF/CUL/1.1.2)

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Further progress has been made during the year in the mass production of prawn seeds, induced maturation and spawning of panaeid prawns in captivity and culture of live feed organisms. As a result of the work carried out at the Narakkal Prawn Culture Laboratory (NPCL) the marine prawn *Penaeus indicus* has been made to complete its life cycle in the farm it-

Table 12. Details of field culture experiments at the Narakkal Prawn Culture Laboratory lab-reared seeds of *P. indicus*.

Exp. No.	1	2	3	4	5	6	7	8
Pond	Western pond	Western pond	Pond B	Pond B	Pond C	Pond C	Pond D	Pond D
Area (ha)	0.6	0.6	0.1	0.1	0.1	0.1	0.05	0.05
Dates	8.3.81 to 19.5.81	14.12.81 to 1.3.82	7.3.81 to 11.6.81	25.2.82 to 31.3.82	7.3.81 to 14.5.81	1.2.82 to 22.3.82	9.3.81 to 14.5.81	1.2.82 to 17.3.82
Duration of Exp. (Days)	72	77	96	34	68	49	94	54
Stocking density nos/ha	36,440	23,600	50,000	30,150	50,000	43,250	50,000	50,000
Average initial size	21.9 mm (0.04 gm)	18.3 mm (0.05 gm)	20.7 mm (0.04 gm)	33.7 mm (0.27 gm)	20.7 mm (0.04 gm)	25.3 mm (0.09 gm)	38.2 mm (0.06 gm)	25.8 mm (0.09 gm)
Average size at harvest	129.5 mm (15.3 gm)	130.2 mm (15.6 gm)	95.9 mm (4.9 gm)	133 mm (10.7 gm)	91.4 mm (4.5 gm)	134.4 mm (16.8 gm)	93.4 mm (5.3 gm)	128.8 mm (14.5 gm)
Growth rate (per day)	1.5 mm (0.2 gm)	1.45 mm (0.2 gm)	0.78 mm (0.05 gm)	2.9 mm (0.3 gm)	1.04 mm (0.07 gm)	2.2 mm (0.34 gm)	0.59 mm (0.06 gm)	1.9 mm (0.27 gm)
Count per Kg. (headon)	65	64	206	95	—	60	—	68
% recovery	65.6	21.3	8.1	25.9	nil	83.0		82.7
Quantity harvested	222.2	47 kg	2 kg	8.2 kg	nil	59.8Kg.	nil	30.1 kg
Production per ha(kg)	370.3	78.3	20	82	—	598	—	602
REMARKS	Prawns very healthy	Prawns escaped from pond due to over flowing	Prawns affected with "softness'	Prawns died due to 0_2 depletion	Breach in the bund led to total loss of stock	Prawns very healthy	Exp. discontinued due to "softness" of prawns	Prawns very healthy

self and three successive generations have been bred and grown at the NPCL farm. It was found that the time taken to complete one generation (from date of birth to date of first spawning) was $4\frac{1}{2}$ to 6 months.

Mass production of P. indicus seed

At the NPCL, 41 sets of larval rearing experiments were conducted during the period under report using wild spawners, spawners induced to maturation under laboratory conditions by adopting unilateral eyestalk ablation technique and by using spawners induced to mature without resorting to eye stalk ablation (Table 15). Of the 41 experiments conducted 13 experiments were infructuous as the larvae could not be reared due

Table 13.

Prawn culture in Polythene lined ponds at Calicut, First Experiment (25-4-1981 to 8-9-1981)

Pond No.	2	5	8	13 (1st set)	13 (2nd set)
Area (M^2)	192	63	123	70	70
Stocking (Nos./M^2)	15.1	38.0	30.5	6.4	7.1
Duration of Crop (days)	133	115	114	67	47
Salinity range (ppt)	1.0-31.7	4.1-28.1	5.8-31.7	5.3-30.6	11.2-30.9
Size at (mm) / stocking (gm)	18.0 / 0.1	18.0 / 0.1	18.0 / 0.1	46.6 / 0.7	84.0 / 3.6
Size at (mm) / harvest (gm)	102.1 / 6.6	124.3 / 13.3	111.8 / 10.1	116.0 / 10.4	110.9 / 6.9
Quantity harvested (Kg)	3.33	2.50	1.23	3.7	3.1
Production per ha (Kg)	166.5	417.5	102.0	529.0	443.0
Survival rate (%)	18.4	7.9	3.6	86.7	89.8
Head on count/kg	160	76	108	100	145

Table 14.

Prawn culture in Polythene lined ponds at Calicut Second Experiment (5-1-1982 — 29-3-1982)

Pond No.	4	6	7	13	10	11	12	8
Area (M^2)	84	78	88	100	246	210	420	135
Stocking (nos/M^2) rate	10	10	7	7	5	5	5	3
Duration of crop (days)	83	79	83	83	83	83	80	83
Salinity range (ppt)	7.3 to 22.6	12.2 to 30.2	7.6 to 18.1	13.3 to 29.2	16.4 to 36.8	10.5 to 34.1	21.3 to 30.2	9.3 to 23.2
Size at (mm) stocking (gm)	15.8 0.03	15.8 0.03	15.8 0.03	15.8 0.03	15.8 0.03	15.8 0.03	15.8 0.03	15.8 0.03
Size at (mm) harvest (gm)	106.2 7.6	114.6 9.6	102.3 7.0	110.9 9.1	90.8 4.4	93.2 4.7	105.6 7.4	119.3 12.3
Quantity harvested (kg)	3.345	3.115	3.795	1.78	3.485	5.315	12.813	0.343
Production per ha (kg)	398.0	399.0	431.0	178.0	141.0	253.0	305.0	25.0
Survival rate (%)	49.5	42.3	57.7	29.1	61.9	99.2	90.7	6.9
Headon count/kg	125	104	142	108	214	205	135	81
Food conversion ratio	5.51	5.76	4.55	10.18	8.12	4.69	3.04	4.59

to various reasons such as electricity failure, poor water quality and blooms of undersired species of phytoplankton and ciliates. The survival rate upto postlarvae in the rearing experiments ranged from 76.0% to 7.8%. The majority of the experiments conducted in the later half of the period were highly successful and yielded over 60% survival on an average. During the monsoon months June to September the hatchery work had to be stopped bcause of non-availability of good sea water for rearing larval forms.

The method of rearing followed was the same as was followed last year with minor adjustments. The larvae were reared upto the post larval stages in 6' dia. plastic pools kept indoors. From Protozoea I to mysis III stage the larvae were fed with a mixed culture of phytoplankton dominated by *Chaetoceros* spp and *Thalassiosira* spp. But from Mysis stage, in addition to the mixed phytoplankton culture, frozen rotifers (*Brachionus plicatilis*) were also given to them. Advanced stage of postlarvae were given frozen cladoceran (*Moina* sp.) as food particularly when they were reared in nursery pools of 40 tonnes capacity kept outside in the laboratory compound.

Preliminary experiments with artificial compounded formula feed in the form of dry powder was also taken up. The experiments are in progress.

1.03 million postlarvae of *P. indicus* were produced at the NPCL during the year. 181,000 juveniles were utilised for stocking in the growout ponds at the NPCL for experimental purposes and rest were given to local small farmers for getting feed back information.

At Kovalam laboratory of the CMFRI 28 spawning experiments were conducted using *P. monodon*. 94 specimens of *P. monodon* were subjected to unilateral eyestalk ablation. Only 18 among these developed into spawners and they were used in 12 larval rearing experiments. 16 experiments were conducted using wild spawners. All these experiments were carried out in plastic lined temporary pools kept indoors. The size of spawners used ranged from 198 mm to 265 mm. As a result of these experiments over 268,000 postlarva I were produced. But the viable seeds that could be utilised for field culture was only 12,373.

Apart from stocking in the departmental ponds at Muttukad a consignment of 3800 seeds were given to a farmer (P. Gangadharan) in Nagapattinam district.

At Tuticorin, experiments were conducted to breed *P. semisulcatus* under controlled conditions in the laboratory. Of

the 8 experiments conducted the first 3 could not produce any viable larvae. In the subsequent experiments it was possible to spawn the species and the larvae obtained were able to be reared upto postlarval stage. As a result of all the 8 experiments total number of 8000 postlarvae of *P. semisulcatus* were produced. In a single experiment with *P. indicus* only 351 postlarvae could be obtained. The maximum survival rate obtained was only 6.6%. Local arrangements are now being readjusted to obtain high rate of survival and better spawning of these species.

Induced breeding of panaeid prawns

The unilateral eyestalk ablation technique which was developed and reported in the previous year was further refined and employed successfully to produce spawners for the NPCL hatchery on a regular basis (Table 16). During the current year 65 farm reared *P. indicus* spawned after eye-stalk ablation; 18 of them rematured and spawned more than once, 13 spawned twice, 4 spawned three times and 1 spawned eight times. By adopting this method it has been possible to induce maturation in the F_1 and F_2 generation prawns reared in the growout ponds of the laboratory.

For the first time 11 farm reared *P. indicus* were induced to mature and spawn viable eggs without eyestalk ablation by manipulating the quality of the water in the maturation pools alone. Realising the importance of pH regulation in successful maturation of prawns in brood stock pools, detailed studies have been initiated. Considerable attention has been given to the matter of selection of spawners from the growout ponds for induced maturation. Since it has been possible to maintain successive generations of *P. indicus* in the growout ponds of the NPCL detailed observations could be made on their characteristics relevant to successful inducement of maturation. Although maturation has been induced by eye-stalk ablation in *P. indicus* specimens as small as 130 mm it has been found that the viability of the eggs spawned by such specimens was poor in spite of the fact that the specimens were fully impregnated. In the culture ponds the species attains the size of 130 mm in 50 days

after stocking under favourable conditions but such specimens do not produce good quality eggs. Better results are always obtained from specimens older than 6 months.

Culture of live feed organisms

Continuous cultures of *Brachionus plicatilis, Moina* sp. and *Artemia salina* were maintained at the NPCL during the year and were utilised in the rearing of prawn larvae, mullet fry and chanos fry. The quantity of the live feed organisms produced during the year and utilised for culture experiments are given below:

Brachionus plicatilis	36285	millions
Moina sp.	1080	"
Artemia adults	0.32	"
Artemia nauplii	0.16	"

Apart from the parthenogenetic Bombay strain of *Artemia salina* which required salinity of 80 ppt for normal reproduction a bisexual strain from California (Great Salt Lake) is also maintained as a continuous culture at the NPCL. The California strain which reproduces even in 34 ppt seawater was cultured from a sample of eggs sent by a commercial firm in California.

By use of 10% glycerine as a cryo protectant the quality of frozen moina and rotifer was increased. This method of preservation prevented breaking of the cell walls and maintained the shape of these minute organisms on thawing. The loss of body fluids is prevented and its nutritional value preserved by this method.

Several improvements in the system of mass culture of rotifer *Brachionus plicatilis* have been effected during this year. It was found that the parthenogenetically reproducing forms normally living in sea water of 30 ppt salinity could be induced to form resting eggs by reduction of salinity. These resting eggs could be dried and stored and transported for starting fresh cultures elsewhere.

Design of low cost hatchery for prawns (CF/CUL/1.1.4)

K.H.MOHAMED, M.S.MUTHU AND K.V.GEORGE.

Design of a low-cost hatchery having capacity for production of 5 million prawn seeds per month is designed and given to the CPWD for making detailed structural drawings. The hatchery consists of 10 nos of 5 ton capacity tanks for rearing and 5 nos of 12 ton capacity tanks for nursery in addition to 3 circular pools meant for brood stock maintenance. An elevated platform is provided for placing phytoplankton culture tanks as also for conducting spawning activity. Service unit consists of two small rooms wherein the machinery such as air compressor, generator, etc. will have to be installed and a sea water filter unit which is being constructed near the sea shore. Structural plans prepared by the CPWD have been approved and the work is in progress at Narakkal. It is expected that this hatchery will become available for use from September 1983.

Artificial propagation of marine crabs (CF/CUL/1.1.3)

R.MARICHAMY.

Seeds of the crab *Scylla seratta* were collected from wild and reared to marketable size in ponds having a total extent of 0.426 ha at Tuticorin. A survival rate of 25% has been recorded in the stocking experiments which lasted for 9 months. An average growth rate of 12-14 mm/31-61 gm per month has been recorded. Significant difference in growth rate has been noticed in different sexes; the males showing higher rate of growth particularly in the advanced period of culture. This experiment also showed that the milk fish *Chanos chanos* could be grown in the same ponds along with crabs with advantage.

Berried female crabs obtained from commercial catches were reared in the hatchery. From a single female crab 2.5 million zoea emerged and attempts to rear this larvae through various stages could proceed only up to the 4th zoea stage. Heavy mortality of the larvae was found to be associated with moulting and metamorphosis.

Table: 15. Penaeus indicus rearing experiments at the NPCL 1981–82

Exp. No.	Dates	Source and number of spawners	Hatched out nauplii x10^8	Postlarvae obtained x10^8	Survival rate	Remarks
1	2	3	4	5	6	7
1/81	9.4.81 18.4.81	Wild—4	693	131	18.9%	
2/81	1.5.81 3.5.81	Maturation induced—1 F_1 generation	72	nil		Died due to poor water quality
3/81	4.5.81 13.5.81	Maturation induced—1 F_1 generation	86	43	50.0%	
4/81	10.5.81 15.5.81	Maturation induced—1 F_1 generation	34	nil		Died due to poor water quality
5/81	16.5.81 26.5.81	Wild—2	141	91	64.5%	
6/81	19.5.81 23.5.81	Maturation induced—2 F_1 generation	49	nil		Died in mysis stage due to poor quality

1	2	3	4	5	6	7
7/81	22.5.81 27.5.81	Maturation induced—1 F_1generation	66	nil		Died in mysis stage due to poor water quality
8/81	27.5.81 1.6.81	Maturation induced—1 not ablated F_1	87	nil		
9/81	7.10.81 17.10.81	Wild—5	321	241	75.1%	
10/81	28.10.81 7.11.81	Maturation induced—1 F_2 generation	105	38	36.2%	
11/81	4.11.81 10.11.81	Maturation induced—1	29	nil		Died in mysis stage due to poor aeration caused by electricity failure
12/81	10.11.81 20.11.81	Maturation induced—1	166	10	6.0%	
13/81	10.11.81 20.11.81	Maturation induced—1	114	11	9.6%	
14/81	10.11.81 13.11.81	Maturation induced—1	50	nil		Died in protozoea stage, larvae weak
15/81	1.12.81 10.12.81	Wild—1	518	130	25.1%	

1	2	3	4	5	6	7
16/81	16.12.81 23.12.81	Maturation induced—1 F_2 generation	97	nil		Died in mysis stage due to poor aeration caused by electricity failure
17/81	21.12.81 31.12.81	Maturation induced—1 F_2 generation	63	22	34.9%	
18/81	21.12.81 1.1.82	Wild—1	61	27	44.3%	
1/82	8.1.82 19.1.82	Wild—2	200	36	18.0%	
2/82	21.1.82 31.1.82	Maturation induced—2	174	88	50.6%	
3/82	2.2.82 12.2.82	Wild—1	310	160	51.6%	
4/82	5.2.82 12.2.82	Wild—1	143	nil		Died in mysis stage due to poor aeration caused by electricity failure
5/82	6.2.82 14.2.82	Wild—2	133	nil	48.6%	
6/82	7.2.82 16.2.82	Wild—1	144	70	48.6%	

1	2	3	4	5	6	7
7/82	11.2.82 20.2.82	Maturation induced—8	231	115	49.8%	
8/82	16.2.82 26.2.82	Rematured—1	117.0	62	53.0%	
9/82	17.2.82 27.2.82	Wild—1	36	15	41.7%	
10/82	18.2.82 27.2.82	Maturation induced—1 Rematured—2	74	35	47.3%	
11/82	19.2.82 27.2.82	Maturation induced—1	137	74	54.0%	
12/82	20.2.82 2.3.82	Maturation induced—2	88	22	25.0%	
13/82	21.1.82 2.3.82	Maturation induced—2	32	4	12.5%	
14/82	3.3.82 13.3.82	Wild—1	234	153	65.4%	
15/82	3.3.82 13.3.82	Maturation induced—1 F_8 generation	45	35	77.8%	
16/82	4.3.82 10.3.82	Maturation induced—3	180	nil		Died in mysis stage due to ciliate bloom

1	2	3	4	5	6	7
17/82	4.3.82 13.3.82	Maturation induced—2	136	86	63.2%	
18/82	5.3.82 9.3.82	Maturation induced—3	141	nil		Died in protozoea stage due to ciliate bloom
19/82	13.3.82 15.3.82	Maturation induced—4	172	nil		Died in nauplius stage due to ciliate bloom
20/82	15.3.82 25.3.82	Maturation induced—2 not ablated	95	26	27.1%	
21/82	21.3.82 30.3.82	Maturation induced—1	12	9	75.0%	
22/82	26.3.82 4.4.82	Maturation induced—5	98	53	54.1%	
23/82	27.3.82 5.4.82	Maturation induced—7	165	86	52.1%	

Table-- 16

Eye-stalk ablation experiments with farm reared P. indicus

Month	No. of female ablated	No. of females that spawned atleast once after ablation	% of success
April 1981	6	6	100%
May 1981	7	5	71.4%
June 1981	–	–	—
July 1981	–	–	—
August 1981	–	–	—
September 1981	–	–	—
October 1981	2	2	100%
November 1981	5	5	100%
December 1981	3	3	100%
January 1982	2	2	100%
February 1982	8	8	100%
March 1982	68	34	50%
TOTAL	101	65	64.4%

Culture of spiny lobster (Panulirus spp.) (CF/CUL/1.5)

T. THOLASILINGAM, K. RENGARAJAN, E.V. RADHAKRISHNAN AND M. VIJAYAKUMAR.

Studying of the reproductive biology of spiny lobsters was continued at the Kovalam field laboratory of the CMFRI. Trials with various types of collectors for lobster larvae were not successful and only 181 puerulii were collected during the period under report. This included 120 puerulii of *P. polyphagus* obtained from commercial gill net operations. The puerulii were stocked in different containers for feeding and growth experiments.

In 4' diameter tanks 20 mm *Panulirus homarus* attained 159 mm size (143 gm) in one year. Specimens of *P. homarus*,

P. polyphagus and *P. oranatus* stocked in 12' diameter pools in the previous year continued to grow and attained sizes of 270 mm, 246 mm and 368 mm respectively in October 1981. The growth rate of these lobsters appeared to increase when better water management measures were adopted.

125,000 phyllosoma larvae were obtained from a berried female of 89.5 mm carapace length in July 1981. The larvae were, however, affected by vorticellid infection which was treated with various concentrations of malachite green. It was observed that the larvae treated with 10% malachite green for 10 minutes were completely relieved of vorticellids in 5 days time. The health of the larvae was not affected and they continued to moult and grow after the treatment. These larvae attained stage III c in 23 days but could not develop further. In February 1982 rearing of another batch of larvae of *P. homarus* was undertaken but this time also the development progressed only up to III b stage after which all the larvae died.

In order to determine the size at which *P. homarus* becomes sexually mature data on a series of morphological characters of 146 females and 212 males were recorded. This data is being processed.

Eyestalk ablation experiments in *Panulirus homarus*

The eyestalk of two groups of 10 lobsters were bilaterally ablated by ligation. Both groups were fed *ad libitum* on clams twice a day. After 165 days the total weight added by the control lobster was 57.1 gm and by the ablated ones 347.5 gm i.e. an average of 2.1 gm/day in ablated animals as against 0.35 gm. day in the controls. This enhanced growth is a cumulative effect of accelerated moulting frequency and weight increment per moult. Eyestalk ablation conducted on prepubertal females interfered in the development of secondary sexual characters like the decalcified zone (window) on the sternal plate and ovigerous setae on pleopods. Normally these characters develop when they attain sexual maturity i.e. at 50 to 55 mm carapace length. In another experiment the eyestalk ablated males and females were dissected after 15 days. The ovaries of all ablated females were in stage IV (ripe) with visible ova, while the ovary was

still in stage I (immature) in control specimens. Whether the moult inhibiting hormone and gonad inhibiting hormone factors are the same and how they act at different physiological states of the animals are to be investigated. In another experiment it was found that a group of nine eyestalk ablated *P. homarus* completed 8 moults in 15 days as against 5 moults in nine control animals. Experiments on effect of eyestalk ablation in spiny lobster are being continued.

Biochemical studies carried out indicated that relative weight of hepatopancreas in *P. homarus* seems to increase as the animal grows older. There was no significant difference in percentage flesh weight in different size groups of the lobster.

Management of ecological parameters for enhancing production of prawn in culture fields (CF/CUL/1.7)

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Among the various factors that control the environment and population of prawns in culture ponds calcium has been identified as one of the important parameters. Detailed study of calcium content of the environment as well as the culture species (*P. indicus*) was undertaken making use of samples obtained from NPCL, Narakkal. Chemical and physical characteristics of the concerned ponds have been meticulously recorded in regular frequencies. The blood and tissue samples were obtained from male *P. indicus* (77–137 mm) and from female (72–150 mm). In most of the months calcium content in the Exo-skeleton of male *P. indicus* was higher than that in the females but such difference was not found in haemolymph. Calcium content in the blood was recorded between 0.022–0.065 gm/100 gm while in muscle it was between 0.122–0.536 gm/100 gm. Variation of calcium content of pond water is seen to have direct relationship to the salinity of the water. Preliminary experiments indicate that there is a positive relationship between the calcium level of haemolymph and the pond water. Calcium level in the pond water and soil was seen varying between 0.507–0.71 gm/100 gm during low salinity period and the same increased

1.08–10 ppt. Thereafter the calcium content stabilised at about 0.4 gm/100 gm. There seems to be no regular pattern in the calcium distribution in the pond bottom soil.

MOLLUSCAN FISHERIES DIVISION

Under the major Project Molluscan Fishery Resources, the Division took up six sub-projects, of which four were new. The Project, Culture of Molluscs had 12 sub-projects including four new ones. Three training programmes were continued. The scientists were also involved in Inter-Divisional and Inter-Institutional Projects. The resources survey programmes included survey of the cephalopods of Exclusive Economic Zone, assessment of inshore squid and cuttlefish resources, and general survey of the chank, oyster, pearl oyster, clam and mussel resources. The Division developed an important faciliity for artificial breeding of bivalves at Tuticorin with seawater purification system, larval rearing tanks and mass culture of micro-algae. One of the significant developments was the breakthrough in breeding of the pearl oyster *Pinctada fucata* and mass production of spat under controlled conditions achieved for the first time in India. Substantial progress was made in breeding of the edible oyster and mussel. Culture of edible oyster, mussel, blood-clam and backwater clam gave encouraging results.

Resources survey of commercially important molluscs (MOL/RE/1.1)

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The survey of the estuaries in Andhra Pradesh was continued during the year from Waltair and Kakinada Research Centres.

Clam beds (*Meretrix* sp.) of about 100m^2 area were located at Bheemunipatnam and Nagamayapalam and another at Dibbapalam. At Balacheruvur clams are landed on large scale. South of Waltair, at Cheepurupalli, a clam bed has been located. At Upputeru estuary a clam bed of about 2,000 sq. m. area has been observed. Beds of edible oysters were also recorded at this place. Beds of *Meretrix casta* and *Crassostrea madrasensis* are present in the Sharada estuary.

Molluscan resources survey of the Godavary estuary was completed from Kakinada Research Centre. In the Mulletimoga Godavary estuary clam bed extends over an area of 75 ha. A total of 269 fishermen collect about 300 tonnes of *M. meretrix* per annum. The clam and shell resources were estimated. In Chilakamma Goyya Godavary estuary, the clam bed extends over an area of 45 ha. A total of 78 fishermen fish about 50 tonnes of *Katelysia opima* and 20 tonnes of *Anadara rhombea* per annum. The total population of *K. opima* was estimated to be about 315 tonnes and *A. rhombea* about 105 tonnes. In Mostippa Goyya, the clam bed spreads over 60 ha in 6 m depth and 190 fishermen are engaged in fishing.

Along the Tamil Nadu coast, the survey was conducted from Madras and Tuticorin Research Centres. The Kovalam backwaters near Madras indicated presence of *Meretrix casta* in small quantities. Stray numbers of *Katelysia opima* were also recorded.

The chank fishery of 1981–82 season commenced on 11–12–1981 at Tuticorin and was held for 70 days upto 9–3–1982. At Tiruchendur it started on 10–3–1982. During 1980–81 a total of 795,463 chanks were landed. In 1981–82, upto March '82, a total of 558,977 chanks were landed. A total of 130,474 wormed chanks were landed in the year 1980–81, and in 1981–82 (up to March '82) a total of 52,837 wormed chanks were caught. Field trips were undertaken to study the edible oyster population found in Pinnakayal estuary. The pearl oyster grounds were monitored.

Vizhinjam and Calicut formed the bases of survey along the Kerala coast. The molluscan resources survey of Ashtamudi

lake was completed. A total of 5–10 ha was identified as edible oyster beds where regular exploitation was carried on by 10–15 fishermen selling the oysters in the local market at Rs. 5–8 per 100. *Meretrix* sp. is being exploited in Kayanad area. *Villorita* sp. was exploited both for lime and edible purpose from different centres of Ashtamudi lake. Mussel (*Perna indica*) landings at Vizhinjam were estimated to be 98.2 tonnes (Table 17) At Muttom and Enayam the brown mussel production amounted to 110 tonnes.

Table -- 17

Brown mussel landings at Vizhinjam in 1981–82 *season*

Months	Units operated (catamarans)	No. of fishermen engaged (in catamarans and by hand picking)	Landing of mussels (kg)
September 1981	—	205	4,500
October	140	806	19,840
November	488	1598	37,875
December	236	922	23,250
January 1982	171	620	11,276
February	105	287	1,540

At Quilon, the chank landings were very poor; hardly 1550 numbers were caught during 1981–82 in trawl nets. From November to January divers from Vizhinjam had gone to Varkala, Edava and Paravur and collected 3,000 numbers of chanks. At Vizhinjam only 500 chanks were landed by gill nets. Longline operation for chank was not observed this year. The chank landings at Enayam, Colachel and Kadiyaptnam were, respectively, 1200, 550 and 1100 during November–December, and the January landings in all three centres were a total of 350 chanks. The total chank landings of the zone during 1981–82 were estimated as 8,250 numbers.

From Calicut, a stretch of about 15 km along the Korapuzha estuary was surveyed. Only one oyster bed and two clam beds of the species *Villorita cyprinoides* were located in the estuary.

The estuaries of Karnataka were surveyed from Mangalore and Karwar Research Centres. The estimated clam production from Gurpur estuary in 1981–82 was 224 tonnes of which *Meretrix casta* var. *ovum* formed 58.5% and *Villorita cyprinoides* 41.5%.

The landings of *M. casta* were 37.3, 37.4, 26.4 and 30.1 tonnes, respectively, in April, May 1981, January and February 1982. For the same months, the landings of *V. cyprinoides* were, respectively, 13.5, 17.9, 31.2 and 30.2 tonnes. There was no fishing during June–December 1981.

The total landings of clams from Mulki estuary amounted to 951 tonnes of which *M. casta* constituted 78.5% and *Paphia malabarica* 21.5%. January–March accounted for 74.5% of the catch of the former species.

Molluscan resources survey of the Kali estuary was initiated during this year. The clam fishery started in the last week of September, 1981 in Kodibag–Sunkeri area, where 35 small dugout canoes were used for the fishing. A total of 178 tonnes of clams were landed in the period September 1981 to March 1982. Though small quantities of clams were sold in the local market, generally they were sent to Goa for marketing.

Survey of Cephalopod Resources in the Exclusive Economic Zone (MOL/RE/1.2.1)

E.G.Silas, K.Alagarswami, K.Satyanarayana Rao, H. Mohamed Kasim, Kuber Vidyasagar, M.M. Meiyappan, K.Prabhakaran Nair, R.Sarvesan and G. Radhakrishnan.

The area-wise and depth-wise distribution of cephalopod in the Exclusive Economic Zone has been studied by analysing the catches of Government of India trawlers based at Bombay, Mangalore, Cochin, Vizhinjam, Madras and Waltair.

Bombay: Cephalopods were obtained in small to moderate quantities in the months April, November and December by Exploratory Fisheries Project (EFP) trawlers from the fishing areas 17–71, 18–72 and 17–72. The catch rates varied from 1.33 kg/hr to 13.75 kg/hr.

Mangalore: Cephalopod catches were caught by EFP trawlers in the months September to December 1981. Only small quantities were obtained in September from major areas 12–74 and 13–74. But during October–December moderately good catches were obtained from fishing areas 12–74, 13–74 and 14–74 at depths of 20 to 60 m with catch rates of 4.5 kg/hr to 22.41 kg/hr. The catches consisted of *Loligo duvaucelii, Sepia aculeata* and *S. pharaonis.*

Cochin: The Integrated Fisheries Project and EFP trawlers based at Cochin conducted trawling almost throughout the year and cephalopods were caught in small to moderate quantities in all the months except June and August, from the major areas 8–76, 8–78, 9–75, 9–76, 10–75, 10–76 and 11–75. About 60% of the total effort put in by all the vessels was spent in the area 9–76. The catch rates varied from 0.28 kg/hr to 4.31 kg/hr. The depth of operations ranged between 10 m and 65 m. Moderately good quantities of cuttlefishes were obtained from subareas 9–76/2A, 3A and 8–78/6C. The cephalopods which fromed from 0.1% to as much as 17.88%, consisted of *Sepia pharaonis, S. aculeata* and *S. elliptica.*

Vizhinjam: The EFP vessel M.V. MATSYA NIREEKSHINI initiated trawling operations in October in the Wadge Bank area and obtained good quantities of cephalopods from major areas 8–76, 8–77, 7–76 and 7–77 at depths 40–200 m. The cephalopods formed 3.4%–40.2% of the trawl catches during the period October 81 to February '82. *Sepia pharaonis* formed 97.2% of the catches and the rest consisted of the squid *Loligo duvaucelii.*

Madras: The EFP vessels which conducted trawling in the months December '81 and January and February '82 in the major areas 11–79, 12–80, 13–80, 14–80 and 15–80 landed cuttlefishes in small or moderately good catches with catch rates of

0.7 to 5.2 kg/hr. The catch was composed of *Sepia aculeata* and *S. pharaonis.*

Waltair: The catch rate of cephalopods obtained by EFP trawlers based at Waltair from the major areas 16–81, 16–82, 17–81, 17–83 and 18–84 was low in April, June and September (0.1 kg/hr to 2.7 kg/hr), but was moderately good (7.0 kg/hr) in May. The catches mainly consisted of *Loligo duvaucelii, Sepia aculeata* and *S. pharaonis.*

Stock assessment of Cephalopod resources of the inshore waters (MOL/RE/1.2.2)

K. ALAGARSWAMI, K. SATYANARAYANA RAO, H. MOHAMED KASIM, KUBER VIDYASAGAR, M. M. MEIYAPPAN, K. PRABHAKARAN NAIR, R. SARVESAN AND G. RADHAKRISHNAN.

The basic data for assessment of cephalopod resources of the inshore waters were collected by monitoring the exploited stocks at different centres and recording relevant biological data. The landings were by the small mechanised boats operating bottom trawl at all centres, and by hook and lines, boat seines and shore seines at Vizhinjam. The production estimates, CPUE, species composition and size range are given in the Table–18.

The percentage increase in production of cephalopods in 1981–82 over 1980–81 was 16.3, 69.2, 13.7, 38.8, 72.8 and 11.6 respectively at Veraval, Bombay, Mangalore, Cochin, Vizhinjam and Madras. Only at Waltair, a decline of 22.5% was noticed. Good seasons for cephalopod landings were December–April at Veraval, October to May at Bombay, December to March at Mangalore, August–September and December–March at Cochin, April–September and November–January for squids and September–March for cuttlefishes at Vizhinjam, May and September–December at Waltair and April–October at Madras. Mature squids and cuttlefishes were common in the landings at all centres and spawning squids were noticed during Apirl-July, December–January and March at Cochin.

Table – 18

Estimated cephalopod landings by trawlers at different centres during 1981–82

Centre	Total cephalopod landings (t)	CPUE (kg)	L. duvaucelii %	L. duvaucelii Size range (mm)	S. aculeata %	S. aculeata Size range (mm)	S. pharaonis %	S. pharaonis Size range (mm)	S. elliptica %	S. elliptica Size range (mm)	S. inermis %	S. inermis Size range (mm)	Others (%)
Veraval	1344.5	28.8	80.7	35-265	17.0	30-145	0.3	—	—	—	2.0	15-85	—
Bombay	1996.4	47.6	54.6	35-274	—	30-204	—	160-329	—	—	—	—	—
Mangalore	52.3	—	36.1	70-210	56.9	90-140	5.5	—	—	—	1.5	—	—
Cochin	101.3	2.5	41.6	40-219	22.6	50-169	13.6	60-229	14.3	40-139	7.9	30-109	—
Madras	154.9	5.6	27.9	—	31.9	—	28.7	—	—	—	—	—	11.5
Waltair	195.4	7.3	32.7	20-159	40.0	40-190	13.1	50-210	—	—	—	—	14.2

At Vizhinjam, the cephalopod catch was 224.6 tonnes and the main gear was hook & lines (88%), followed by boat seines (11%) and shore seines (1%). Cuttlefish *Sepia pharaonis*, in the size range 130–319 mm, formed the dominant catch (84%) and the squids (16%) were respresented by *Loligo duvauceli* (size range 30–189 mm) and *Doryteuthis* sp. (size range 40–219 mm).

Genetic resources of commercially important molluscs (MOL/RE/1.5)

K. ALAGARSWAMI, P. V. SREENIVASAN AND M. M. MEIYAPPAN.

Samples of the backwater clam *Meretrix casta* obtained from two representative centres from east coast (Porto Novo and Waltair) and two from West Coast (Cochin and Mangalore) were measured for several morphometric characters and the data were subjected to statistical analysis. The results did not show any significant differences among the samples. Karyological studies were initiated on *M. casta*. The techniques need refinement for preparation of chromosome plates. Electrophoretic studies were carried out by polyacrylamide disc gel process. The protein constituents did not show much difference.

Assessment of exploited mussel resources (MOL/RE/1.6)

P. S. KURIAKOSE AND K. K. APPUKUTTAN.

The centres selected for the study on the assessment of exploited mussel resources along the North Kanara coast were Tadri, Gokarna, Manjuguni, Gobithwada, Harwada, Kodar, Chendia, Karwar and Majali. At Harwada a thick and continuous mussel bed was noticed over intertidal and fully submerged rocks and there was regular exploitation. It was found that mussel spat set in large numbers on mudflats at Harwada. A survey of Vizhinjam area showed that the potential stock of mussels in the area was about 500–600 tonnes. The potential stock in Quilon backwaters was estimated at 14.4 tonnes.

Experiments in transport of molluscan seeds (MOL/RE/1.7)

S. MAHADEVAN, K. RANGARAJAN, M. E. RAJAPANDIAN, P. MUTHIAH, K. K. APPUKUTTAN AND P. S. KURIAKOSE.

Brown mussel, 40–64 mm in size, were transported from Vizhinjam to Cochin in May with negligible mortality by using wet gunny packing method. Using same method, mussels were transported from Quilon to Vizhinjam and from Tuticorin to Vizhinjam. In September 3,000 pearl oysters were transported

with success from Vizhinjam to Tuticorin. Edible oysters were transported in wet gunny bags with negligible mortality from Tuticorin to Cochin by road and from Tuticorin to Madras by train.

Culture of edible oyster (MOL/CUL/1.1)

K. NAGAPPAN NAYAR, S. MAHADEVAN, D. C. V. EASTERSON, K. RAMADOSS, P. MUTHIAH AND M. E. RAJAPANDIAN.

Studies on seasonal gonadal changes and condition index of the farm oysters, along with hydrology and plankton of the farm, were made. Although maturing and ripe females were observed throughout the year, biannual maxima were recorded during February–March and August. Spent oysters were more common during April and May and less during September, October, December and February. High percentages of males were observed during June and August. The condition index varied from 5.1 to 15.3 and the highest value was obtained in July when 60% of the females were in fully mature condition.

During April–May spawning season, cultches such as lime-coated tiles, rens of oyster shells, coconut shells and asbestos sheets were used and over 200,000 oyster spat were collected from lime-coated tiles. The April–May spat grew to a mean size (height) of 38 mm in 2 months. The oysterlings grew to mean sizes of 56, 64, 67, 71 and 72 mm in 4, 6, 8, 10 and 12 months, respectively. During August–September season, 20,000 spat were collected. About 1,340 numbers of predatory gastropod *Cymatium cingulatum* found in the farm were eradicated.

A total of 26 tonnes of oysters were harvested from the experimental farm.

Development of bye-product of oyster shells (MOL/CUL/1.1.1)

P. MUTHIAH AND M. E. RAJAPANDIAN

As calcium carbonate forms 93% of oyster shells, efforts were made to prepare shell grit from it. Four different grades

of shell grit were prepared and it was found that, of these, two grades could be used as grit for grower birds in poultry. The calcium oxide content of oyster shells, after ignition, is 52.2%. About 25 tonnes of oyster shells were disposed of for the manufacture of calcium carbide.

Culture of mussels (MOL/CUL/1.2)

S. MAHADEVAN, K. RANGARAJAN, K. K. APPUKUTTAN, P. S. KURIAKOSE AND N. RAMACHANDRAN.

Karwar: Dense settlement of seed mussels (*Perna viridis*) was noticed at Harwada. In October 1981 juvenile mussels were collected from the above source and seeded on ropes. Three rafts were floated in Karwar bay and the seeded ropes were suspended from them. The seed ranged between 14 mm and 26 mm in length. Growth of juvenile mussels was rapid, compared to the growth of those in natural bed. Mussels having a mean length of 26 mm (weight 1.1. g) transplanted on 14th October 1981 grew to a size of 69 mm (wt 21.1 g) on 31st March 1982, whereas those in the natural beds grew to a mean size of 55 mm (wt 13.6 g). In the farm young mussels attained maturity within a month after transplantation. Efforts were made to collect mussel spat by using frilled nylon rope, coconut shells and tiles as spat collectors but settlement of spat was not noticed.

Vizhinjam: A total of 225 ropes with seed mussel (*Perna indica*) were suspended from eight rafts in Vizhinjam Bay. There was slipping of mussels from a majority of the ropes. The growth rate of mussels in the bay was poor. The total weight and meat weight showed an increase in June–July which coincided with spawning season. Natural settlement of mussel seed was noticed at Vizhinjam, Mullor, Quilon, Kadiyapatnam, Muttom and Kanyakumari from September onwards.

Madras: For culture of green mussel, *Perna viridis*, three rafts, each measuring 25 sq. m, were anchored off Kovalam and 50 coir ropes with seed collected from Ennore were suspended. Small quantities of spat were collected on suspended tiles from January onwards. The rafts were damaged by a severe storm in the first week of May, 1981 and by strong winds in June, 1981.

A new experiment was initiated to culture the green mussel in the backwater at Muttukadu. Mussel seed collected from Ennore were placed in nylon mesh bags and suspended from horizontal poles. Mussels thrived well in the backwater and further studies are in progress.

Culture of clams and window-pane oysters (MOL/CUL/1.3)

K. A. NARASIMHAM, P. V. SRINIVASAN, K. SATYANARAYANA RAO, G. SYDA RAO, P. S. KURIAKOSE AND N. RAMACHANDRAN

The blood clam *Anadara granosa* was successfully cultured at Kakinada. In April 1981 seed clams 14–21 mm in size were stocked in 0.16 ha with split bamboo enclosure at a density of 300/sq. m and on harvesting by end of October 1981, a production of 6.1 tonnes was obtained. The survival rate was 41.5%. The index of condition ranged between 22.7 and 24.7. Experiments were initiated in March 1982 to culture the species by increasing the farm area to 0.5 ha and without pen enclosure. One million seed clams of size range 17–25 mm were stocked at a density of 22/sq. m.

Of the several areas inspected near Cochin for clam culture, a site at Ramanthuruthu was identified as suitable for culture of *Meretrix casta* and another at Mukkathukkarial for *Villorita cyprinoides*. The growth of *M. casta* was retarded during July–November when salinity was low and there was a growth of 7 mm during December–March when salinity was higher (16.95–28.42°/00).

Culture of *Meretrix casta* var. *ovum* was undertaken from Mangalore in the State Government Fish Farm at Mulki. Seed clams of average size 19.9 mm stocked in January 1981 reached 28.4 mm in June and a production rate of 1385 kg/5 months/0.12 ha was obtained. Seed clams of 18.7 mm stocked in December, 1982 at a density of 400/sq. m had attained an average length of 27.5 mm by March 1982.

Pearl Culture (MOL/CUL/1.4)

K. ALAGARSWAMI, A.C.C. VICTOR, A. CHELLAM, S. DHARMARAJ AND T.S. VELAYUDHAN.

Emphasis was laid on monitoring of the pearl oyster populations in natural beds of Gulf of Mannar, improvement in farm technology, consolidation of biological studies on *Pinctada fucata*, control of biofouling and boring organisms and monitoring of environmental parameters.

Indications of replenishment of pearl oyster populations, after the 1979 November mortality, were seen on a few of the pearl banks. About 87,700 oysters were collected from Nagarai paar for 16 survey trips, yielding an average 5480 oysters per trip. For an observation period of a decade, this proved to be the best collection. The predatory gastropods *Cymatium cingulatum* and *Murex virgineus* were found to cause high mortality of oysters in natural beds. Pearl oysters were reared in cages on the slope of harbour breakwater and also suspended from a raft in harbour basin. *P. fucata* showed a growth from 16.9 mm, 0.7 g to 48.6 mm, 20.5 g in one year. Studies on the reproductive cycle indicated two peak periods of maturity, April–June and September–October. Effective control measures against biofouling and boring were introduced. Hydrology of farm area was studied. Accidental entry of predatory gastropods in the farm caused some mortality which was checked later. Crab predation reduced the pearl oyster stock at Vizhinjam to about half the initial stock of 10,000 oysters. Spatfall at Vizhinjam showed progressive reduction of *P. fucata* and increase of *P. sugillata*. The Vizhinjam stock was transferred to Tuticorin farm.

Development of techniques for large scale collction of pearl oyster spat from natural beds (MOL/CUL/1.4.1)

K. ALAGARSWAMI, A.C.C. VICTOR, A. CHELLAM, S. DHARMARAJ AND T.S. VELAYUDHAN.

Preparatory work was taken up and a reference buoy had been fabricated. Concrete blocks for mooring the buoy were also got made. Materials for spat collection were pro-

cured. The buoy could not be moored and programme started, due to difficulties in procuring the right type of anchor chain.

Economics of a model pearl culture farm (MOL/CUL/1.4.2)

K. ALAGARSWAMI, A. CHELLAM, A.C.C. VICTOR, S. DHARMARAJ AND T.S. VELAYUDHAN.

Adequate stock of pearl oyster for pilot scale farming could be raised only towards the end of the year, particularly during January–March, 1982. The oysters were of the 0–year class and below the minimum size for nucleus implantation. The programme will commence during 1982–83 as oysters of required size become available in the farm. Surgical tools for implantation were fabricated indigenously. Shell bead nuclei had been obtained for the project.

Development of Shell-bead nuclei for pearl culture (MOL/CUL/1.4.3)

K. ALAGARSWAMI AND B.S. RAMACHANDRUDU

A critical technical review of the process developed earlier was made and, on the basis of this, a regular plan of work for the steps of cutting, grinding, finishing and polishing was drafted. An inventory of machines, tools and materials required for the project was prepared and procurement action initiated.

Development of hatchery system for edible oyster seed production (MOL/CUL/1.5)

K. NAGAPPAN NAYAR, K. RAMADOSS AND M.E. RAJAPANDIAN

The work on induced breeding and rearing of early developmental stages of *Crassostrea madrasensis* was continued. Fertilization was effected by stripping of gonads and mixing of gametes and also by making the oysters to spawn keeping them at temperature 20–25°C and then raising the temperature of water. The larvae could be reared only up to straight hinge stage when they were fed with flagellate *Isochrysis galbana*. Efforts were made to rear the larvae further by improving the water quality and providing adequate quantities of food.

Development of hatchery system for mussel seed production (MOL/CUL/1.6)

K. RANGARAJAN AND K. K. APPUKUTTAN

The project made some progress at Kovalam laboratory (Madras). The green mussel, *Perna viridis* was successfully spawned by thermal stimulus and the larvae reared to spat stage. The mussel larvae were fed with *Isochrysis* sp. and they reached early umbone stage on 12th day and late umbone stage on 14th day. In one experiment, spatfall took place on 16th day and the spat showed formation of a few byssal threads. Spatfall was very low and only two juvenile mussels could be obtained. The programme is being intensified.

The brown mussel *Perna indica* was transported from Vizhinjam to Tuticorin where hatchery facilities were available. Spawning in this species was effected by mechanical and thermal stimuli. The larvae were reared upto pre-setting stage at which there was mortality. Further experiments are being carried out to rear the larvae up to setting stage.

Development of hatchery system for pearl oyster seed production (MOL/CUL/1.7)

K. ALAGARSWAMI, A. C. C. VICTOR, A. CHELLAM, D. C. V. EASTERSON, S. DHARMARAJ AND T. S. VELAYUDHAN.

A significant breakthrough was achieved in the development of techniques for larval rearing and production of spat of the Indian pearl oyster *Pinctada fucata* in the shellfish hatchery laboratory of the Institute at Tuticorin. For the first time in India success was achieved in mass production of seed of any economically important mollusc under controlled conditions. The development solves an important problem of raising adequate oyster stock for mother oyster culture in pearl culture operations. The pearl oysters were induced to spawn by biological, chemical and thermal stimulation. After fertilization the eggs were reared in filtered sea water obtained by passing sea water through sedimentation tank and sand filter bed. Corning glass beakers and

fibre glass tanks were used for rearing the larvae. *Isochrysis galbana* was used as standard food of the larvae. The larvae reached the straight hinge stage in 20 hr 40 minutes after fertilisation, umbo stage on day 10, eye spot on day 15, pediveliger stage on day 20, plantigrade on day 22 and settled as spat on day 24. Six experiments were conducted during the year and consistently good results were obtained in four rearings during August 1981–January 1982. The spat were fed on mixed phytoplankton. On reaching suitable size in the laboratory, the spat were transplanted in the pearl oyster farm and were further reared under farm conditions. The technology will be scaled up and streamlined for hatchery production of seed.

Training in pearl culture (CMFRI/TR/2)

K. ALAGARSWAMI, A.C.C. VICTOR, A. CHELLAM, S. DHARMARAJ AND T.S. VELAYUDHAN.

The Training Course is offered based on demand from the States/UTs. During the year, the programme was not organised due to preoccupation of the scientists with the hatchery project.

Training in edible oyster culture (CMFRI/TR/3)

K. NAGAPPAN NAYAR, S. MAHADEVAN, K. RAMADOSS, P. MUTHIAH AND M.E. RAJAPANDIAN.

No training was given during 1981–82. A training programme in edible oyster culture is proposed during 1982–83.

Training in under-water investigations by SCUBA diving (CMFRI/TR/4)

S. MAHADEVAN, K. NAGAPPAN NAYAR AND K. RAMADOSS.

Training was given in under-water investigations by SCUBA diving to some of the scientists of the Molluscan Fisheries Division and it was useful to them in studying the ecological conditions of the sea bed off Tuticorin coast.

FISHERY ENVIRONMENT MANAGEMENT DIVISION

Physical and chemical aspects of the waters of the Exclusive Economic Zone (MBO/ES/1.1)

A.V.S.MURTHY, C.P.RAMAMIRTHAM, K.G.GIRIJAVALLABHAN, S.KRISHNA PILLAI, R.MARICHAMY, PON SIRAIMEETAN, R.PADMINI, S.MUTHUSWAMY AND TECHNICAL STAFF.

The overall intensity of upwelling during the current year was less than during 1980 for the same period. In the region off Cochin, a noticeable type of intermittant upwelling was noticed during August when the usual intensity of upwelling subsided due to the weakening of the SW monsoon temporarily. When the monsoon was again active during the latter part of the month, upwelling developed again and was persistant till late September.

In the offshore regions beyond 10 m depth the monsoon effects were still prevalent during October with much less intensity than the previous month, and by late October the monsoon features viz. low temperature and low oxygen content of the subsurface waters had mostly disappeared. More or less uniform temp. conditions prevailed from surface to bottom during November. Surface cooling was observed during December and thus temp. inversions were quite common during this month. There was a noticeable increase in the salinity and dissolved oxygen values as a whole. The winter conditions prevailed till February and during March the summer temp. increase was associated with a noticeable decrease in dissolved oxygen content in the whole water column.

At Karwar the monsoon features mostly disappeared during October–November and as off Cochin the temp. values increased with a more or less isothermal layer existing from surface to bottom. The salinity and dissolved oxygen values also increased during the post monsoon. The silicate contents showed a drastic decrease than the monsoon, however, the pH values were not much different than the monsoon season, this being mostly in the alkaline range. During December winter cooling was observed at the surface and the nutrients showed a decrease and these features were more well defined during January. Winter cooling was so intense that the surface temp. was as low as 26.2°C during middle of January. The surface productivity values were high and highest values were observed during mid–January period amounting upto about 860 mg C/m/day. During February–March these values were much lower the maximum being only 580 mg C/m/day, during middle of March.

One prominant feature off Mangalore was the existence of very low surface temp. during August during the peak monsoon. Values as low as 20.5°C were observed during late August. The mean surface temp. for July was only 25.8°C probably the lowest along the SW coast of India during the SW monsoon. This very low surface temperature has some significance as far as the upwelling along the west coast is concerned.

The relevant observations at various centres are given below:

Bombay

The observations off Worli showed that the surface temperature was maximum (30.5°C) in April and minimum in February (24.5°C). The salinity values were maximum (35.9‰) in February and minimum (30.7‰) in October. The dissolved oxygen recorded maximum (4.9 ml/l) in April and minimum (1.2 ml/l) in December.

The waters of Bombay harbour recorded maximum temperature (29.2°C) in April and minimum (25.0°C) in February. The salinity of the waters was maximum (36.4‰) in March and minimum (28.9‰) in October. The dissolved oxygen of the

waters was maximum (4.2 ml/l) in February and minimum (2.7 ml/l) in November.

Karwar

The hydrographic parameters observed from the near shore waters off Karwar are presented in the following tabular form.

Month	Depth in m	Temp. °C	Salinity ‰	Oxygen ml/l	Inorganic Phosphate µgatP/l	Nitrite µgat N/l	Silicate µgat Si/l
April 1981	0	30.0	33.45	4.64	1.27	1.19	7.13
	5	29.9	34.95	5.09	1.07	0.78	5.20
	10	29.9	34.92	4.39	1.64	2.14	5.52
May	0	30.5	33.52	3.98	1.63	1.09	2.66
	5	29.8	34.41	4.00	1.61	0.33	1.28
	10	29.7	34.78	3.51	2.32	1.09	2.32
June	0	28.1	24.81	3.99	1.30	0.98	10.68
	5	28.3	30.74	3.44	1.20	1.06	7.96
	10	28.2	32.42	3.29	1.42	1.79	7.76
July	0	26.4	6.56	4.71	2.22	0.76	28.26
	5	26.6	14.72	3.85	2.19	0.70	20.13
	10	27.2	26.65	2.95	2.71	0.96	10.90
August	0	25.7	5.58	5.05	2.00	0.46	43.87
	5	25.0	14.64	4.09	1.63	0.57	19.98
	10	24.6	27.98	2.41	2.21	0.94	13.60
September	0	26.4	22.11	4.31	1.22	0.30	8.09
	5	24.8	32.01	3.23	1.47	0.30	8.37
	10	24.1	33.38	2.70	2.00	0.42	7.95
October	0	27.6	29.23	4.39	1.29	0.29	5.55
	5	26.6	33.05	3.72	1.56	0.24	3.34
	10	25.7	33.93	2.66	2.62	0.94	3.80

1	2	3	4	5	6	7	8
November	0	28.1	32.63	4.12	1.74	0.79	3.65
	5	28.4	33.33	3.94	1.50	1.02	3.46
	10	27.5	33.88	3.76	2.20	1.47	3.55
December	0	27.2	33.77	4.02	1.15	0.33	2.17
	5	27.3	33.99	4.11	1.00	0.38	2.30
	10	27.1	34.38	4.45	1.54	0.55	2.48
January 82	0	26.2	32.62	4.14	1.23	0.42	3.05
	5	27.0	33.33	4.31	0.76	0.25	2.72
	10	27.0	33.26	4.63	1.42	0.41	2.53
February	0	26.9	33.67	4.11	1.00	0.50	2.98
	5	26.9	33.85	4.20	0.70	0.64	3.08
	10	27.0	33.94	3.84	1.23	0.92	3.83
March	0	27.5	33.68	4.36	1.25	0.50	2.50
	5	27.6	34.15	4.78	1.13	0.59	2.48
	10	27.4	34.44	4.60	1.40	1.05	3.03

Mangalore

Premonsoon season data showed increase in temperature and salinity. Sea surface temperature values greater than 31°C were observed in May. Very high values of salinity were also observed. In the first week of May maximum salinity values as high as 36.48‰ were recorded from the four fathom station. But the last week of May, a sudden drop in temperature is observed. Extinction coefficient values showed an increase in May, due to the increase in turbidity as the monsoon winds started blowing and also due to the river run-off.

As the monsoon set in, further drop in sea surface temperature accompanied by decrease in salinity values were noted. Lowest values of salinity were recorded in the second week of

July. Thereafter an increase in the values are observed. A further decrease in temperature followed this. By the second fortnight of August, very low values of temperature and high values of salinity are observed. The same conditions were continued in the first fortnight of September. The lowest temperature recorded is 20.5°C and the highest salinity observed is 35.71‰ during this period. The phosphate values increased upto 3.00 µg/at/l. Nutrient values were more conspicuous in the barmouth region, indicating river run-off. The other nutrient parameters did not show much of sudden change. The second fortnight of August and the first fortnight of September could be termed as intense upwelling period, where cold dense subsurface water which is nutrient rich is found to be present.

There is an increase in temperature and decrease in salinity during post-monsoon season. Oxygen values were comparatively high. This season which includes winter, marks a decrease in temperature in December. But the bottom waters showed an increasing trend. Phosphate values showed a decreasing trend which could be attriubted to the lesser influx of deeper water during November and December. Other nutrient contents (Silicates, Nitrates and Nitrites) which are more dependent on the river run-off showed a decrease in November and an increase in December. The extinction coefficient values showed an increasing trend.

Calicut

The hydrography of the inshore area off Calicut was studied. Temperature varied from 28.0°C to 31.0°C at the surface and bottom respectively of 5m depth. Temperature at 10 m varied from 28.5°C to 31.0°C, 28.2°C to 29.2°C and from 28.4°C to 30.3°C at the surface, mid depth and bottom respectively. Variation in temperature at 10 m depth was comparatively less. Salinity varied from 32.74‰ to 36.27‰ at 5 m. At 10 m depth salinity varied from 32.10‰ to 35.67‰. At both the stations higher salinity was observed from March to May. Dissolved oxygen varied from 4.60 mg/l to 6.65 mg/l at the surface and from 4.91 mg/l to 6.95 mg/l at the bottom of 5 m station. Relatively low oxygen was observed in April-May. At 10 m

the variation in the dissolved oxygen was from 4.70 mg/l to 6.26 mg/l, 5.57 mg/l to 6.45 mg/l and from 5.44 mg/l to 6.82 mg/l. Here also dissolved oxygen was low during April and May.

Phosphates varied from 0.51 ug at/l to 2.17 ug at/l and from 0.38 ug at/l to 2,99 ug at/l at the surface and bottom respectively at 5 m depth. Higher phosphate was observed in November–December. Silicates also showed variation from 9.54 ug at/l to 19.55 ug at/l and from 11.01 ug at/l to 36.11 ug at/l. Lower silicate content was observed in February–March. Nitrite varied from 0.16 ug at/l to 1.07 ug at/l and from 0.54 ug at/l to 1.64 ug at/l at the surface and bottom respectively. Nitrate varied from 1.10 ug at/l to 5.55 ug at/l and from 1.53 ug at/l to 4.69 µg at/l at the surface and bottom respectively. Higher Nitrate content was observed from November to January.

Vizhinjam

The monthly mean values of the inshore hydrographic observations made off Vizhinjam are presented in the following table:

Month	Temperature °C	Dissolved oxygen ml/L	Salinity ‰	Inorganic phosphate µg at/l
April 1981	30.05	5.14	35.48	2.93
May	29.75	5.20	35.57	3.52
June	24.12	4.64	33.62	3.29
July	27.40	5.13	35.01	2.57
August	28.85	5.06	35.00	2.72
September	28.80	5.09	35.17	2.91
October	28.25	4.32	33.54	1.88
November	28.55	4.50	34.21	1.91
December	28.15	4.57	34.30	2.38
January 1982	28.40	4.60	34.62	1.89
February	29.20	4.64	35.20	1.17
March	29.35	4.62	35.30	2.35

Tuticorin

Hydrological observations of the shelf region of Tuticorin coast, covering the important fishing grounds were carried out during 1981–82. Two maxima in surface temperature ie. in April and September 1981 and two minima in July and December '81 were noticed whereas the atmospheric temperature show a single peak in May '81 and a fall in January 1982.

The salinity varied from 33.80 to 29.93 ppt coinciding the summer rise and fall due to monsoon. The dissolved oxygen content of the surface was generally higher than the bottom samples except April and August '81. When there was fall in surface temperature a rise in oxygen content was observed during July–September '81 and during March–May when the temperature was high in the range 30.4–31.6°C a fall in oxygen content was noticed. pH of the surface sample was measured in the range 7.38–7.95. It was low in December '81 and high in July '81. But the estimation of nitrate exhibited a higher values in the bottom samples and it was fairly rich during July–September 1981 and remained in the range 3.0–5.0 ug at/l. It was nil in May '81.

Mandapam Camp

Hydrological studies were continued in the inshore waters of Gulf of Mannar and Palk Bay during the period April 1981 to March 1982. The water samples were collected for the estimation of salinity, dissolved oxygen, hydrogen ion concentration and nutrients. Atmospheric temperature and surface water temperature were also observed and the monthly average values were noted.

The salinity ranged from 30.69‰ (January) to 36.06‰ (August) in Gulf of Mannar while at Palk Bay it ranged from 29.41‰ (December) to 35.98‰ (August).

The dissolved oxygen ranged from 3.72 ml/l (May) to 5.77 ml/l (October) in Gulf of Mannar while in Palk Bay it ranged from 3.07 ml/l (April) to 5.16 ml/l (October).

Surface water temperature varied from 26.48°C (January) to 30.15°C (March) in Gulf of Mannar while at Palk Bay 25.8°C (January) to 29.70°C in April.

The atmospheric temperature ranged from 26.06°C in January to 30.16°C in March in Gulf of Mannar while in Palk Bay it ranged from 25.6°C in January to 29.90°C in May. The pH varied from 8.1 to 8.4 in both the places.

Madras

The temperature of the surface sea water varied from 27.0°C to 30.0°C. The temperature decreased from November 81 onwards to February–March 82. A peak in the temperature was noted during the months of September–October '81.

The salinity values ranged from 27.05‰ to 34.29‰. It showed an increasing trend from January to May—July 81 and a downward trend from October onwards to December 81. The lowering of salinity values may be due to the rainfall and river's discharge.

The dissolved oxygen content of the surface waters has not shown any wide fluctuations. It ranged from 2.53 ml/l to 7.95 ml/l. The dissolved oxygen content showed an increase during April '81. It showed a decrease from May '81 onwards more or less maintaining the minimum trend for a major part of the year ie. upto December '81.

Waltair

During the year under observation, a total number of 46 samples of sea water collected from open sea, beyond surf zone (weekly sample) were analysed with respect to their physico-chemical constituents.

Month	Temp. °C	Salinity ‰	Diss. Oxygen ml/l	Phos-phate µgat/l	Nit-rate µg at/l	Nitrite µg at/l	Silicate µg at/l
April '81	25.10	33.51	5.09	0.14	0.29	0.02	26.3
May	27.60	33.39	4.99	0.49	0.40	0.03	37.4
June	29.30	33.64	4.14	0.73	0.34	0.06	31.0
July	28.10	33.67	3.62	0.58	0.36	0.07	27.7
August	28.25	32.61	4.18	0.52	0.38	0.05	12.5
September	29.84	31.79	3.87	0.35	0.32	0.04	16.3
October	29.90	23.43	4.91	0.93	0.45	0.04	18.5
November	28.00	26.31	4.59	0.45	0.47	0.11	18.7
December	25.78	28.02	4.81	0.38	0.46	0.06	18.5
January '82	25.76	28.07	5.16	0.23	0.34	0.08	16.8
February	25.90	29.53	4.92	0.31	0.38	0.09	17.1
March	27.40	31.80	4.00	0.42	0.63	0.20	22.0

Survey of the ecological and environmental characteristics of the estuarine regions of the Kerala and Karnataka coasts (MBO/ES/1.2)

C.P. RAMAMIRTHAM, R. PADMINI, C.V. MATHEW AND TECHNICAL STAFF.

The hydrographical and planktological investigations in the Vembanad lake at Cochin, the Korapuzha estuary at Calicut, and the Netravathy estuary at Mangalore were continued.

The salinity distribution at the surface and bottom layers was totally different in the two regions namely Cochin–Vaikom and Cochin–Azhikode. In the former region the salinity values in the interior stations away from the barmouth were much lower than in the latter region similarly the dissolved oxygen contents also. This feature was conspicuous during the winter and early summer periods.

In Korapuzha the phosphate, silicate, Nitrite and Nitrate contents were observed in abundance from June to November.

Dissolved oxygen was also higher during this period. Salinity was remarkably low from June to November.

Phytoplankton and primary productivity (MBO/PP/1.1)

K. RADHAKRISHNA, K. G. GIRIJAVALLABHAN, P. V. R. NAIR, C. P. GOPINATHAN, C. V. MATHEW AND TECHNICAL STAFF.

The project was undertaken at Karwar, Calicut, Cochin, Mandapam Camp, Madras and Waltair.

At Karwar production at the surface was higher than near the bottom (6–11 m). Production ($mgCm^3$ /day) at the surface varied from 144.5 (July) to 578.9 (December) and near the bottom 72.04 (November) to 362.4 (October). These values are higher than those of 1980–81.

Phytoplankton standing crop (cells/l) at the surface and near the bottom was high during February–March. Diatoms contributed most to the standing crop. *Chaetoceros* was the most dominant genus.

At Calicut gross production at the surface of 5 m depth station varied from 38 $mgCm^3$ to 835 mgC/m^3. Relatively high production values were obtained from January to March. Low values were obtained in May. The production near the bottom at 5 m varied from 32 mgC/m^3 to 630 mgC/m^3. Highest production was obtained in February at this depth. At the surface of 10 m depth station production varied from 53 mgC/m^3 to 698 mgC/m^3 Maximum was obtained in April. At the mid depth of this station the production varied from 50 mgC/m^3 in May to 790 mgC/m^3 in February. At the bottom the highest value was obtained in February. General high production was observed in February at these two stations.

Light penetration of the environment also varied. Secchi disc measurement varied from 0.4 m to 4.0 m at 5 m station and from 1.5 m to 9.0 m in 10 m station. Maximum light penetration was observed in November.

At Cochin (10 m station) surface productivity (mgC/m^3/day) varied from 55 in December to 677 in September and near the bottom from 36 in December to 268 in October. Rate of production is very low at all the 3 stations in December. The post monsoon months of September–November recorded fairly high production.

Dinoflagellates dominated in the phytoplankton samples in the first quarter and diatoms dominated during the second quarter. No data for the third quarter are presented.

At Mandapam productivity was measured at 3 stations viz. Palk Bay, Gulf of Mannar and Athankarai estuary, by Oxygen method.

In Palk Bay the productivity rangeed from 104.63 to 788.99 mgC/m^3/day, the maximum being in November and the minimum in July. In Gulf of Mannar the productivity ranged from 180.10 to 368.78 mgC/m^3/day, the maximum being in July and the minimum in August, In Athankarai the estuary, it ranged from 411.65 to 917.63 mgC/m^3/day, the maximum being in November and the minimum in February. During this year the Athankarai estuary was more productive. The productivity value of Athankarai estuary was more in all the months, than the other two areas.

At Waltair gross daily primary productivity in 48 experiments through the year varied from 160.8 mgC/m^3(in August' '81) to 1372.67 mgCm^3/ (in April, '81). Gross productivity was generally high in April/May and October and was lowest in June. The average daily productivity was 590.16 mgC/m^3 in April '81. The average daily net productivity was 374.mgC/ m^3. Net productivity was highest in October '81 and lowest in February '81.

The correlation between productivity and nutrients was not positive.

Secondary Production in the Exclusive Economic Zone in relation to fisheries (MBO/PL/1)

T.S.Naomi, C.V.Mathew, K.J.Mathew, K.Rengarajan Rani Mary Jacob, R.Marichamy, Pon Siraimeetan, S. Krishna Pillai, K.G.Girijavallabhan and Technical Staff.

The studies under the project were continued at 8 centres during the year 1981–82. No significant variation was noticed at any of the centres with regard to the total plankton biomass and the various components through the different seasons and the values were comparable with those of the previous year. In general the trend in secondary production was satisfactory along the Indian coasts. No adverse blooms were noticed in any of the observation centres.

Except when some groups like cladocerans, *Creseis* sp. and ostracods made swarms, the copepods formed the major constitutent in the plankton at all the centres. Along the west coast the fish eggs and larvae were abundant during the south-west monsoon period. But along the east coast the period from March to May was found to be good for them.

Fish eggs and larvae studies (MBO/FEL/1.1)

K.C.George, M.Kumaran, K.Rangarajan, I.David Raj Rani Mary Jacob, K.G.Girijavallabhan, S.Krishna Pillai, Pon Siraimeetan and Technical Staff.

Work under this project was carried out at Cochin, Vizhinjma, Tuticorin, Mandapam Camp and Madras.

All the centres except Vizhinjam have now the facility of medium sized mechanised vessels (29'—43.5') for collection of plankton. At Vizhinjam the Catamaran is used for the work.

At all centres except Cochin, single cone net of 0.3–0.4 mm mesh and 50 cm mouth diameter is used for the 10' surface hauls. At Cochin the twin cone small Bongo net (0.5 mm mesh,

20 cm dia mouth) with a digital flow meter is used. This net is towed by the continuous oblique method, covering the entire depth of the water column at the station.

The week/fortnightly collections were normally restricted to the 30 m depth contour.

Cochin

Observations at one nearshore station (15 m) and one offshore station (30 m) showed consistently lower plankton biomass at the nearshore station than the offshore station. The biomass was higher during the July to December period than the other months of the year.

While fish eggs occurred in more numbers at the nearshore station, larvae were found in more numbers at the deeper station. Eggs were observed in good numbers during July, September, to January and March and the larvae in August, December and March. Eggs of *Stolephorus, Saurida* and eel and larvae of several species like *Stolephorus, Sardinella, Exoceotus, Mugil,* mackerel and tuna were recorded from the collections. Larvae identified upto family level included those of Sciaenidae, sillaginidae, Platycephalidae, seranidae etc.

The surface water characteristics showed the offshore station to be relatively warmer and more saline and better aerated.

Vizhinjam

Maximum plankton biomass was observed in April and the minimum in October. More numbers of eggs as well as larvae were caught from the station nearest to the shore.

Fish eggs were present in good numbers in April, September and January while more larvae were collecteed during the December to February period.

Anchovy eggs were recorded in April and June. Carangid eggs were abundant in the October–March period. *Sardinella* larvae were observed in April and January to March period. Mackerel larvae were collected in April, June, November and

February. Carangid larvae were present in good numbers from November to March.

Maximum surface tempeature was observed in April and the minimum in June at the station closest to shore. Salinity maximum was in May and the minimum in June.

Tuticorin

The monthly average plankton volume per 10' haul ranged from 4.7 to 16.0 ml, the minimum volume in a single haul was noticed in July and the maximum in December.

Fish eggs and larvae were present throughout the period. Maximum number of eggs in a single haul was seen in March and minimum in January. Best collection of larvae were in August and least in February.

Madras

Maximum number of fish eggs were observed in September and minimum in April. Eggs of *Stolephorus, Thrissocles, Saurida, Cynoglossus* and *Caranx* sp. were found in the collections.

Fish larvae were met with in the collections only in April, December and March with the best catch in December.

Mandapam

Fish eggs and larvae were present in all the months with peak abundance of eggs in February–March and larvae during July–August period.

Seaweed Resources Investigations (MBO/SW/1.2)

V.S.K. CHENNUBHOTLA, N. KALIAPERUMAL AND TECHNICAL STAFF

Culture of *Gracilaria edulis* was carried out at 4 m depth area in the Gulf of Mannar near CMFRI jetty from January

to March 1982, with a view to work out the economics of the seaweed culture. For this purpose 100 numbers of HDP rope nets with *Gracilaria edulis* seed material (each net with 10 kg seed material) were introduced in January. The growth was found to be good in all nets for about one month. The total quantity of material harvested from 82 nets was 1034.550 kg (wet weight) while in 18 nets there was no crop at all.

In order to find out the possibility of cultivating the seaweeds in lagoon waters, 15 kg of *Gracilaria edulis* seed material in long line coir ropes was introduced at Pillaimadam lagoon. Culture of *Gracilaria edulis* in velon screen bags was started for the first time in December and January in the Gulf of Mannar near CMFRI jetty. Cultivation of *Gracilaria edulis* and *Gelidiella acerosa* in fish farm ponds was started in June '81.

Experiments on settlement of spores, liberated from the cultured seaweed, on artificial substrata was started in July '81. For this purpose, two seaweed culture nets with *Gracilaria edulis* seed materials were introduced at Palk Bay. The experiment was shifted to Gulf of Mannar in October 81 due to rough weather in Palk Bay. The plants from the spores reached a maximum length of 24.5 cm in 5 months.

Studies on diurnal and seasonal spore output were started from March 82 onwards on *Gracilaria arcuata, G. corticata* var. *cylindrica, G. folifera, Gracilariopsis sjoestedtii, Sargassum wightii, Turbinaria decurrens, Stoechospermum marginatum, Padina gymnospora* and *Dictyota dichotoma* that are being collected from Pudumadam, Kilakkarai and Rameswaram.

Intensive study of the seasonal changes in the productivity of the different trophic levels in the regions off Cochin (MBO/EE/1.3)

C.P. RAMAMIRTHAM, V. JOSANTO, A.G. PONNIAH, I. DAVID RAJ AND TECHNICAL STAFF

Under this project, regular hydrographic cruises in the fishing grounds off Cochin were continued. The thermocline was observed to start from a depth of even 1.5–2m in the in-

shore areas (where the depth does not exceed 10–15 m) where there were mostly isothermal waters during the premonsoon period.

Another salient feature observed during monsoon was the occurrence of the red tide phenomenon in the region off Cochin between 10 and 15 m depths at the surface layers during late June. Comparatively strong upwelling was present in the region.

Marine Pollution in relation to protection of living resources (MBO/MP/1.1)

P. V. RAMACHANDRAN NAIR, V. KUNJUKRISHNA PILLAI, A. G. PONNIAH, V. CHANDRIKA, S. MUTHUSWAMY, D. C. V. EASTERSON AND K. K. VALSALA.

The environmdntal monitoring programme at Valappu prawn culture fields was continued. Water samples were collected and analysed from fifteen stations (both surface and bottom) for temperature, pH, salinity, dissolved oxygen and ammonia.

Comparatively high values of pH were recorded during the four months from May to September probably due to the flow of rain water into the culture ponds during the monsoon period. However, coinciding with this phenomena high negative values of ORP (sediment) and low dissolved oxygen contents in the water were recorded in the same period. Out of fourteen months for which data are available during seven months dissolved oxygen values were less than 5 ml/l which is the accepted figure for normal healthy pond water for aquaculture. However, rather high values of dissolved oxygen were recorded in certain periods, which invariably coincided with algal blooms in the ponds. From the above data it appears that, the higher water temperature, higher pH, high reducing conditions and low dissolved oxygen can induce some amount of stress on the culture organisms.

In connection with monitoring of pollution in Cochin backwaters, no significant variation was observed. Mercury

levels in water was found to be low 0.01–0.07 ppb which is comparable to values in unpolluted coastal waters. BOD levels did not indicate any significant organic pollution load.

(Project FED/PR/1.1 A). Investigations on the pesticide residue in the environment and living resources of the estuarine and inshore waters.

The project work was initiated in April 1981. The gas-chromatograph with Electron Capture Detector has been commissioned. Suitable column combinations were tried for performance evaluation. Working standards have been prepared with technical grade DDT and aldrin and injected on the conditioned columns. Action has been taken to procure pure standards from the Environmental Protection Agency, U.S.A.

Investigations on coral reef resources (MBO/CR/1.1)

C.S. GOPINADHA PILLAI

In continuation of an exhaustive survey and listing in 1969 of the coral fauna and their zonation in the Minicoy lagoon a re-survey was carried out. The present survey revealed large scale mortality to the coral fauna coupled with a significant dwindling of the reef associated icthyofauna and the invertebrates. Though the large scale mortality to corals is only part of the global manifestation experienced at present, it can be mainly due to the large scale settlement of sediments in the lagoon, perhaps owing to high degree of coastal (beach) erosion experienced at Minicoy in the recent past.

Ecological studies of mangrove swamps (MBO/MS/1.1)

M.S. RAJAGOPAL, G.S. DANIEL SELVARAJ, A. BASTIAN FERNANDO AND A. KANAGAM.

Cochin: Ecological studies of the mangrove islands near the Cochin bar mouth, northern islands and southern islands in the backwaters were continued. South of Perumbalam one more island was surveyed during the year. Here also the typical

mangrove vegetation such as *Avicennia marina, Excoecaria agallocha, Clerodendron inerme, Aegiceras corniculatum* and *Acanthus ilicifolius* are common. Terrestrial creepers often overgrow on the mangrove vegetation.

At Perumbalam monthly average surface temperature varied from 26.1°C in August to 31.0°C in May. Surface salinity in the creeks ranged from freshwater conditions during June-July to 25.26‰ during March to May. During the same months the salinity varied from 21.5‰ to 29.8‰ in the northern islands. Dissolved oxygen content varied from 1.7 to 6.4 ml/l during different months. Primary productivity ranged from 130 to 525 $mgC/m^3/day$.

Monthly fluctuations in the abundance of juveniles of *Etroplus* spp., *Haplocheilus melastigma, Ambassis* spp., mullets, prawns and caridians were studied.

Kakinada: The survey of the mangrove areas was initiated at Kakinada during this year. Mangrove creeks and canals near Chollangi, Matlapalem, Ramannapalem, B.V.Pallem, Gadimoga and Bairavapalem were regularly studied. Typical mangrove vegetation as prevailing at Cochin occurs in this region also except that the genus *Rhizophora* is not represented.

Qualitative and quantitative analysis of the phyto and zooplankton in the creeks were made. Mysids, copepods, amphipods, Lucifer, fish and prawn post larvae were common in most of the stations. Larvae and juveniles of *Haplocheilus melastigma, Acentrogobius ornatus, Stigmatogobius* and *Periopthalmus* occur throughout the year as also the juveniles of penaeid prawns. Juveniles of *Macrobrachium* also occur in the creeks. Inter tidal regions are occupied by typical mangrove forms of molluscs and crabs including *Scylla serrata.*

Studies on the effect of Alfalfa/Triacontinol in promoting the growth rate of prawns (FED/MC/P 1.1)

D.S.Rao, P.P.Pillai, K.J.Mathew, K.Rengarajan

Experiments conducted at Madras showed that Alfalfa in selective doses induced a higher growth rate in the fingerlings of *P. indicus* until the moulting period.

In the laboratory there was an increase of 0.21 mm growth per day over the control.

In the field culture experiments an increase of 0.11 mm growth per day over the control was noted. The alfalfa used was an imported one with a triacontinol content of 1.7%.

Efforts to isolate triacontinol from Lucerne are under way.

The method involve the hot extraction of lucerne wax from the leaf material with the solvent ether. Wax is then saponified and unsaponifiable fractions separated which is converted into hydrogen phthalate salts and primary alcoholic phthalates precipitated as sodium salts in ether solution, separated by centrifuging the ether water interface emulsion, washed with ether and then decomposed to give triacontinol. This is then crystallised successively from ethyl alcohol, acetone, ethyl acetate and benzene to get pure triacontinol.

Ecological investigations in Upper Kuttanad (FED/MC/P.1.3)

V. KUNJUKRISHNA PILLAI, P.V.R. NAIR, C.P. RAMAMIRTHAM, C.P. GOPINATHAN, K.J. MATHEW AND TECHNICAL STAFF

Vaikom Kari and Kayal lands include seasonal and perennial fields in about nine villages in the Vaikom Taluk of Kottayam District, Kerala State. Although, till a few years back, traditional prawn culture and paddy-cum-prawn culture were practised in the entire area, at present the activity is virtually restricted to two or three villages which have direct connection to the Vembanad Lake. Enquiries revealed that this is the result of certain major ecological changes in the region due to the continuous discharge of fresh water from one of the major hydroelectric project in the upstream.

The project team carried out extensive field surveys covering almost all villages in the study area in April, 1981 and also in March 1982. Water samples were collected from several stations and analysed for parameters like salinity and dissolved oxygen temperature and pH to get some basic information

about the water quality in this region. Subsequently, six stations were fixed for regular monitoring and samples were collected and analysed for temperature, pH, Dissolved Oxygen, Salinity, primary production and benthic biomass.

Fish Behaviour (FED/Misc/2)

C.S. GOPINADHA PILLAI

Samples of reef fishes from the upper reef flat and lagoon of Minicoy were collected. Their percentage composition both in number and mass (weight) based on several experimental fishing from varying habitats were assessed with a view to having basic knowledge on their structure and composition. Each habitat was found to harbour a diversified fauna, the common elements being limited in number of species. The food habitat and their major food items of the dominant reef fishes are being analysed. The aim is to understand the interdependability of feeding habit and food of reef fishes even when they are collected from the same habitat, like a single colony of ramose coral. The herbivore, carnivore and omnivore fishes of the coral reefs are being categorised and their percentage in the fauna is being estimated. To date about 50 species of reef fishes are studied for their food and six species are being subjected to detailed biological studies. Their breeding periodicity and recruitment to the reef are being specially watched.

Application of underwater acoustic technology in fishery research (FEMD/Misc/3)

E.G. SILAS AND S. NATARAJAN

Out of the different types of instruments required for the project work only two are procured namely Hydrophone (Type BK 8103) and conducting amplifier (T. 2650). Instruments were tested and found functioning satisfactorily. Recorded the noise of fishes produced by eel & lobster using a domestic tape recorder. The sound could be heard when played back. However to have the visual observation of the noise variation in frequency and amplitude a level recorder (strip chart recorder) is required. And

also for the proper recording a scientific tape recorder (more precision, sensitive etc.) is required. Necessary steps are being taken for importing these instruments as the locally available ones do not match with the combination equipment. Once these instruments arrive it is proposed to record the noise of different species and of different sizes and analyse the pattern/separative of noise.

Investigations on the distribution and biology of endangered species of marine turtles, lesser cetaceans and the dugong (MBO/MM/1.1)

E.G.SILAS, M.RAJAGOPALAN, A. A. P. MUDALIAR AND A. BASTIAN FERNANDO.

During the year 1981 in April a total of 648 hatchlings of Olive Ridley turtle have been released into the sea at Madras. The released hatchlings were in the size range of Carapace length 33.7 to 39.4 mm, Carapace width 26.1 to 30.5, plastron length 21.8 to 23.2 and Plastron width 21.0 to 24.0 and body weight varied from 15.3 to 18.3 gm.

Monitoring the growth of Olive Ridley turtles in captivity at Kovalam Field Laboratory was continued.

During January and March 1982 a total of 30013 eggs of Olive Ridley turtles have been collected from 234 nests from Madras Coast for the conservation.

Studies were made on the quantity of yolk utilised during different stages of embryonic development; calorific estimation of eggs of Olive Ridley in different stages of development were carried out.

For the first time a female Leather back turtle *Dermochelys coriacea* with a total length 195 cm was recorded from Madras coast in March 1982.

INTER-DIVISIONAL PROJECT

Investigations on fish and shell fish diseases (IDP/2.)

S. MAHADEVAN, K. RANGARAJAN, K. DORAIRAJ, D.C.V. EASTERSON, K.K. APPUKUTTAN AND TECHNICAL STAFF.

Salient features:

Investigations on the common cases of fish and shell fish diseases in culture site were conducted with the available facilities.

1. Vizhinjam

Regular observations on the competitors and on the predators on the farm grown brown mussels and pearl oysters were carried out. The main competition was posed by *Modiolus* and barnacles.

Large-scale predation by *'Rhabdosargus sarba* was noticed as in the previous years. Boring of oyster shells by sponges was occasionally observed. Oyster spat in the raft were crunched by crabs like *Charybdis*. No disease outbreak occurred.

2. Tuticorin

There was no outbreak of disease. The crab *Scylla serrata* caused the destruction of 5% of spat in the spat collection site. Mortality of oyster larvae in the hatchery was investigated and

successfully overcome by the supply of bacteria free filtered sea water which ensured spat settlement.

3. Mandapam

There was no serious disease outbreak among the eels. *Anguilla bicolor bicolor* in culture tanks except for the occasional incidence of red block disease during May–September. While treatment with $KMnO_4$ was of no avail, change in running water cured the eels of this disease. Similarly, change of water cured the elvers of the occasional occurrence of white-spot disease.

During July 1981 twenty four elvers died of gas disease, the cause for which is not clearly known.

4. Madras

The investigations could not proceed as expected due to lack of adequate stock of mussels in the farm.

Nutritional Physiology of Fish and Shell fish (IDP/8)

P. V. R. Nair, M. S. Muthu, M. Rajamani, A. G. Ponniah, M. Vijayakumar, D. C. V. Easterson and C. V. Mathew.

The following investigations were carried out under this project: (1) Feeding experiments on *Penaeus monodon* larvae, (2) Growth of lobsters in captivity, (3) Feed conversion in the turtle *Lepidochelys olivaceae*, and (4) Energy utilisation in the developing egg of the turtle *L. olivacea*

Feeding experiments on Penaeus monodon larvae

Experiments were conducted to evaluate whether laboratory reared post larvae of *P. monodon* can be grown to stockable size exclusively on compounded diet. With clam meat as control, the following compounded feed were tried—feed XVII squilla meat + prawn waste ± groundnut cake + tapioca flour + Vit. & Min. mix.) feed XVII (mussel meat + squilla meat + Acetes

meat+GN oil cake+tapioca flour+Vit. Min. mix.) feed XIX (clam meat+squilla meat+rice bran+GN oil cake+tapioca flour). The results indicate that clam meat gave slightly better growth rate. Comparing the results with the observations made on mass cultures where phytoplankton, rotifiers, moina, clam meat and the compounded feed XVII were given as diet, and where the growth rate was highly variable while the survival rate was better, it is inferred that any of the compounded feed that were tried in the experiments could be used as supplementary feed for *P. monodon* post larvae.

Growth of lobsters in captivity

Growth of the spiny lobster *Panulirus homarus* was significantly increased by hormonal changes caused by bilateral eye stalk ablation. While the percentage weight increases in control lobster was 57.9 in 165 days, the ablated ones recorded an increase of 411.29%. Weight increase per day was 0.35 g for control and 2.1 g for ablated lobsters. The result obtained in this study has a far reaching effect in making lobster culture economically feasible.

Food conversion in the turtle *Lepidochelys olivaceae:*

Baby turtles fed on 100% clam meat, 100% sea grass and 5% body weight of clam meat+sea grass and the food conversion efficiency was estimated using Oxygen bomb calorimeter. It was observed that the food conversion efficiency of the baby turtle to clam meat is almost the same irrespective of the amount of feed, but more than 5% baby weight food is required to get maximum growth rate. They cannot survive on sea grass alone as food.

Energy utilisation in the developing egg of L. olivaceae

The experiment estimating the Caloric values using Gallan Kamp ballistic bomb calorimenter gave the following results:-

Description of egg	% dry weight (in terms of initial wt. of the egg)	K/cal/g	Total K. cal (for 100 g wet weight)
Initial	23.49	5.63	132.25
10th day	22.3	5.79	129.0
20th day	21.89	5.81	127.18
30th day	22.45	5.95	133.58
40th day	20.8	5.6	116.48
44th day (Baby turtle with little yolk outside)	16.85	5.84	98.4

28.27% dry matter and 25.29% of energy are lost during development in the turtle egg.

National Programme of Tagging IDP/16

Although it was proposed to tag oil sardine and mackerel in large scale, the work could not be undertaken during the period for want of suitable vessels at the appropriate season for obtaining live fish.

CENTRE OF ADVANCED STUDIES IN MARICULTURE

The Centre of Advanced Studies (CAS) in Mariculture, established in 1979 with an objective of promoting research and education in mariculture, maintained an alround progress in the research and education programmes as envisaged by the Centre. In the M.Sc. (Mariculture) course, instituted for the first time in the country in 1980, 21 Junior Research Fellows, 9 belonging to the academic session 1980-82 (first batch) and 12 to that of 1981-83 (second batch) were on the roll. The first batch completed two semesters of the course, while the second batch admitted in November, 1981 was undergoing training in the first semester.

In the Ph.D. programme, 13 senior research fellows, 4 admitted in 1980 and 9 in the year under report were working in different priority areas such as reproductive physiology, nutrition, ecology and pathology of cultivable marine organisms. The topics of research assgined to the scholars within these priority areas were:

1. Studies on environmental stress in the prawn *Penaeus indicus* H. Milne Edwards in culture system.

2. Reproductive physiology of Indian species of the genus *Perna* (Family Mytilidae)

3. Culture and growth kinetics of selected nannoplankters.

4. Studies on sporulation and propagation of selected Agarophytes.

5. Pathological investigations in penaeid prawns.

6. Nutritional studies in juvenile *Penaeus indicus* with reference to protein and vitamin requirements.

7. Studies on Ecophysiology of *Penaeus indicus* H. Milne Edwards in the grow-out systems.

8. Studies on endocrine control of growth and reproduction of the tiger prawn *Penaeus monodon* Fabricius.

9. Studies on the ecology and productivity of saline lagoons.

10. Role of certain soil microbes in the recycling of nutrients in the prawn culture fields of Kerala.

11. Studies on Indian cichlids.

12. Studies on larval nutrition in the pearl oyster *Pinctada fucata* (Gould)

13. Studies on histological and biochemical changes during spermatogenesis in *Mugil cephalus* (Linnaeus) and related species.

A series of workshops and seminars on subjects of topical importance were organised to update the quality of research and to exchange technical know-how among the scientists and technicians working in different places. Emphasis was given to organise workshops on research methodologies with practical manuals prescribing the research techniques and methods, planning of investigations, handling of instruments, collection of data and their analysis and interpretation. The most important among these were the National workshop on "Crustacean Biochemistry and Physiology" organised jointly by the CAS in Mariculture and the University of Madras in June, 1981; workshop on "Finfish and Shellfish Nutrition" held in January, 1982; two seminars on Reproductive physiology of finfish with particular reference to Mullets" in April 1981 under the leadership of Dr. Ching Ming Kuo who visited the Centre as an Expert Consultant. The post graduate scholars organised 6 seminars on different subjects as part of their curriculum activities.

Besides the workshops and seminars, special lectures were delivered by Experts like Dr. C. Sommerville, University of Stirling on "Fish Pathology"; Dr. K. Gopalakrishnan, University of Hawaii on "Aquaculture R & D activities in Hawaii"; and Dr. M.H. Ravindranath, University of Madras on "Physiology of the mud crab *Scylla serratta.*"

During the period, two consultants, Dr. Ching Ming Kuo, Senior Scientist, ICLARM, Philippines and an Expert on re-

productive physiology of finfishes and shellfishes and Dr. Akio Kanazawa, Professor, Faculty of Fisheries, Kagoshima University, Japan, an Expert on fish and shellfish nutrition visited the Centre. A series of group discussions, demonstration of techniques, seminars and workshops were held during their consultancy tenure at the Insiitute.

Dr. R.J. Roberts, Director, Institute of Aquaculture, University of Stirling, an authroity on fish diseases visited the centre in March 1982. He discussed the problems relating to fish pathology and gave valuable suggestions for strengthening the research and education programmes in this field.

Under the programmes of training of scientists and Faculty members in overseas Institutes in the identified priority areas Mr. K. Nagappan Nayar and Dr. P. Vedavyasa Rao, Scientists S-3 participated in the World Conference on Aquaculture held at Venice during 21-25 September, 1981. Following this, they visited certain Fisheries Research/Aquaculture Institutes in Italy, France, Spain and U.K. to observe and study the recent advances made in the field of mariculture and to identify the experts and the institutes for exchange of technical know-how under the consultancy and training programmes of the Centre.

Mr. S. Mahadevan, Scientist S-2 underwent a 12-weeks training programme in the field of fish pathology at the Virginia Institute of Marine Science, University of Stirling, U.S.A. and the Department of Fisheries, Scotland, U.K. Reproductive physiology, nutrition, endocrinology, bioenergetics and crustacean genetics were the other fields identified for arranging training during 1982-83.

Under the UNDP input of CAS, one Spectronic 2100, 6 Salinity Refractometers and one Rank Xerox Photo Copier were procured. Besides, several laboratory equipments, such as Bomb Calorimeter and Spectrophotometers were procured through indigenous source.

V. Balakrishnan
K. H. Mohammed
P. Karunakaran Nair
K. V. George
K. Asokakumaraunnithan
P. K. Martin Thompsan
K. N. Rasanchandrakartha
A. N. Mohanan
P. Radhakrishnan

Progress of training during the year :

During the year 12 batches of training were conducted of which 9 batches were of 10 days duration and 3 batches were of 20 days duration. A total of 218 farmers were trained which included 74 farm women and also 134 belonging to Scheduled caste and 2 belonging to scheduled tribe.

Follow up survey :

To get an idea of the post training activities of the trainees a follow up survey was conducted during April–July 1981. An analysis of the data collected has indicated that among trained farmers 12.02% are practising Scientific prawn farming, 16.78% in Semi-scientific prawn farming, 3.40% employed in traditional prawn filtration, 2.94% employed in prawn farms, 10.88% other employment not related to fisheries, 22.00% fishing and 27. 0% were unemployed.

Radio Talk :

Three radio talks were broadcast by All India Radio, Trichur, on the following topics namely:

1. Salient points in scientific prawn cultivation.
2. Prawn varieties for pokkali fields.
3. Role of Krishi Vigyan Kendra, Narakkal.

Publication :

1. "Kadalpayal–Vyavasayika–pradhanyameriya oru prakruthi sampathu" (in Malayalam) by Shri K. Asokakumaran Unnithan in the March issue of 'Vyavasaya Keralam', a government of Kerala publication.

2. "Thengukrishi—koode chemmeenum" (in Malayalam) by Shri K. Asokakumaran Unnithan in 'Malayala Manorama' publication, daily.

3. "Chemmeen.....Chemmeen.....Chemmeen..... (in Malayalam) by Shri K. Asokakumaran Unnithan and Shri P. Radhakrishnan in 'Kerala Karshakan', a government of Kerala publication.

3. Film shows arranged :

A total of 20 film shows were arranged as part of the extension activities of the Kendra of which 9 shows were off campus.

List of Farmers trained under the Krishi Vigyan Kendra at Narakkal during 1981–82

EZHIKKARA PANCHAYAT :
(Ernakulam District)

1.	Shri	N.K.Babu	14.	"	V.S.Joshi
2.	"	M.K.Dinesan	15.	"	V.K.Radhakrishnan
3.	"	P.P.Pardhan	16.	"	N.K.Anirudhan
4.	"	T.M.Radhakrishnan	17.	"	K.M.Dayanandan
5.	"	M.K.Surendran	18.	"	K.M.Prathapan
6.	"	C.P.Thilakan	19.	"	T.B.Remanan
7.	"	M.C.Viswambharan	20.	"	K.M.Thomas
8.	"	N.R.Satheesan	21.	Smt.	M.K.Indira
9.	"	N.K.Jalagopalan	22.	"	P.K.Padmini
10.	"	C.K.Prakasan	23.	"	N.K.Radha
11.	"	E.S.Sathessan	24.	"	C.K.Ushadevi
12.	"	N.K.Gopalakrishnan	25.	"	M.K.Prasanna
13.	"	C.A.Sarasan	26.	"	M.K.Mani

KUZHIPILLI PANCHAYAT :
(Ernakulam District)

1. Shri T.N.Gopalakrishnan
2. " V.C.Narayanan
3. " V.V.Remesan
4. " V.C.Ravi
5. " V.K.Darbi
6. " C.P.Prathapan
7. " K.K.Sathyan
8. " V.K.Kunjan
9. " V.C.Jeevanath
10. " V.T.Pavithran
11. Shri V.K.Prabhan
12. " V.O.Pushkaran
13. " V.C.Remanan
14. " V.K.Sivan
15. " K.R.Udayan
16. " K.R.Uthaman
17. " M.V.Thomas
18. " N.M.Rajan
19. Smt. V.V.Nirmala
20. " V.C.Santha

EDAVANAKAD PANCHAYAT :
(Ernakulam District)

1. Shri R.P.Radhakrishnan
2. " K.P.Suresh
3. " M.K.Mohanan
4. " M.A.Suresh
5. " T.K.Unni
6. " K.B.Devarajan
7. " K.T.Thampi
8. " V.A.Ajayakumar
9. " K.J.Alosh
10. " V.C.Asokan
11. " O.P.Suresh
12. Shri K.O.Vincent
13. " M.K.Rajan
14. " M.K.Sidharthan
15. " P.B.Padmanabhan
16. Smt. T.K.Geetha
17. " O.K.Leena
18. " O.P.Sudha
19. " C.C.Suma
20. " P.K.Baby Sarojam
21. " T.V.Santha
22. " C.P.Visalu

NAYARAMBALAM PANCHAYAT :
(Ernakulam District)

1. Shri P.K.Gokuldas
2. " K.B.Jayaprakash
3. " M.P.Sanalkumar
4. " K.J.Ambrose
5. " M.P.Aravindan
6. " K.K.Vijayan
7. " N.V.Thilakan
8. Shri T.T.Sudheer
9. " K.V.Suresh
10. " T.K.Gangadharan
11. " M.I.Cleitus
12. " K.A.Sajeevan
13. Smt. P.V.Jalaja

NARAKKAL PANCHAYAT :
(Ernakulam District)

1. Shri V.S.Gireesan
2. " K.N.Jithendriyan
3. " K.P.Soman
4. " K.G.Wilson
5. " V.A.Dileepkumar
6. " M.P.Manoharan

NARAKKAL PANCHAYATH:
(Ernakulam District)

7.	"	M.G.Yesudas	37.	Smt.	K.N.Leela
8.	"	P.M.Krishnan	38.	"	I.A.Leela
9.	"	P.N.Radhakrishnan	39.	"	A.I.Mary
10.	"	M.Saju Thomas	40.	"	M.K.Rajamma
11.	"	N.S.Surendran	41.	"	K.K.Remani
12.	"	K.Ambrose	42.	"	K.P.Rosily
13.	"	K.P.Joseph	43.	"	K.K.Thankamani
14.	"	M.B.Sajeev	44.	"	Valso Johni
15.	"	P.R.Venugopal	45.	"	A.K.Baby
16.	"	V.S.Lasy	46.	"	T.M.Laila
17.	"	O.G.Pauly	47.	"	A.B.Mandira
18.	"	T.K.Gopi	48.	"	A.A.Omana
19.	"	T.P.Joseph	49.	"	V.N.Prabhala
20.	"	N.K.Rajan	50.	"	A.A.Reetha
21.	"	K.A.Romey	51.	"	P.R.Sainuba
22.	"	N.K.Uthaman	52.	"	P.P.Savithri
23.	"	P.K.Dinesh	53.	"	T.K. Sobha
24.	"	P.C.Jose	54.	"	P.P.Baby
25.	"	P.K.Prakasan	55.	"	V.P.Kunjamma
26.	"	P.K.Purushothaman	56.	"	K.P.Reetha
27.	"	T.P.Remesh	57.	"	M.X.Salina
28.	"	M.K.Ratheesan	58.	"	M.K.Sobha
29.	"	C.S.Shaji	59.	"	P.L.Thanka
30.	"	V.P.Thampi	60.	"	V.K.Thressia
31.	"	N.C.Pushpan	61.	"	N.K.Usha
32.	"	P.X.Devassy	62.	"	K.P.Chandramathi
33.	"	P.A.Saju	63.	"	N.C.Rajamma
34.	Smt.	Achamma	64.	"	M.K.Sobha
35.	"	K.K.Baby	65.	"	N.K.Vanaja
36.	"	Deepa K. Gopi			

ELAMKUNNAPUZHA PANCHAYAT
(Ernakulam District)

1.	Shri	K.R.Chinmayanandan	6.	"	M.R.Chandra Babu
2.	"	Mahesh Mangatt	7.	"	T.P.Devassy
3.	"	V.K.Thilakan	8.	"	V.P.Paius
4.	"	C.K.Sachidanandan	9.	"	C.K.Pavithran
5.	"	A.R.Sunilkumar	10.	"	C.A.Sathyavan

ELAMKUNNAPUZHA PANCHAYATH:
Ernakulam District)

11.	"	T.M.Sunil	31.	Smt.	K.N.Prabha
12.	"	M.A.Abdul Azeez	32.	"	Radhamani Chellappan
13.	"	C.J.Ambrose	33.	"	K.K.Usha
14.	"	N.K.Remanan	34.	"	Vasanthi Bahuleyan
15.	"	T.K.Saseendran	35.	"	P.K.Geetha
16.	"	V.K.Shoukath Ali	36.	"	P.K.Girija
17.	"	K.X.George	37.	"	Jalajamani Prakasan
18.	"	A.R.Muralidharan	38.	"	K.K.Manjula
19.	"	P.B.Ajayakumar	39.	"	T.G.Pushpavalli
20.	"	K.R.Sajeevan	40.	"	Sathi Sekharan
21.	"	P.K.Surendran	41.	"	P.K.Thankamma
22.	"	V.S.Thulasidharan	42.	"	K.C.Usha
23.	"	K.K.Unnikrishnan	43.	"	P.K.Jaya
24.	"	V.K.Vibhooshan	44.	"	C.V.Mary
25.	"	P.P.Babu	45.	"	K.S.Sobhana
26.	"	V.S.Satheesan	46.	"	T.P.Soya
27.	"	P.N.Asokan	47.	"	P.B.Sulabha
28.	"	N.K.Shaji	48.	"	K.K.Meena
29.	"	A.K.Rony	49.	"	A.R.Seenamma
30.	"	P.N.Sathyan			

KOTTUVALLI PANCHAYAT :
(Ernakulam District)

1.	Shri	K.K.Bhavanandan	4.	Shri	K.K.Prathapan
2.	"	C.K.Abhilash	5.	"	T.B.Sanin
3.	"	K.K.Ashraf			

PALLIPURAM PANCHAYAT :
(Ernakulam District)

1.	Shri	A.S.Dinaraj	7.	Smt.	P.C.Leela
2.	"	T.S.Chellappan	8.	"	C.N.Kairali
3.	"	P.K.Shaji	9.	"	N.K.Ammini
4.	"	P.V.Mohanan	10.	"	K.K.Sarala
5.	Smt.	P.C.Sakunthala	11.	"	E.D.Ambuja
6.	"	N.K.Rethnam			

COCHIN CORPORATION :
(Ernakulam District)

1. Shri K.V.Jayan
2. " T.K.Sabu

MULAVUKAD PANCHAYAT :
(Ernakulam District)

1. Shri P.P.Shanmukhan

CHITTATUKARA PANCHAYAT :
(Ernakulam District)

1. Shri K.K.Purushothaman
2. " P.N.Uthaman

PUTHENCHIRA PANCHAYAT :
(Trichur District)

1. Shri A.S.Madhavan
2. " K.T.Sasidharan

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Shri K.Y. Telang
Shri Kuber Vidyasagar
Shri G. Sudhakara Rao
Dr. P.A. Thomas
Dr. D.B. James
Shri C. Suseelan
Shri V. Kunjukrishna Pillai
Shri C.P. Gopinathan
Dr. M. Devaraj
Shri K.J. Mathew
Dr. M.K. George
Shri K.M.S. Ameer Hamsa
Shri R. Sarvesan
Dr. P. Devadoss
Dr. V. Sriramachandra Murty
Shri G.S. Daniel Selvaraj
Shri K.K. Appukuttan

* Away on deputation or lien

Shri Alexander Kurian
Shri P.V. Sreenivasan
Shri S. Lazarus
Shri M. Kathirvel
Shri K. Rengarajan
Shri K.J. Joseph*
Shri Y. Appanmasastry
Miss R. Padmini
Shri A. Chellam
Shri E.V. Radhakrishanan
Miss Gracy Mathew
Dr. E. Vivekanandan
Shri M. Rajamani
Shri V. Thangaraj Subramanian
Shri C. Muthiah
Shri V.S. Kakati
Shri P. Muthiah
Shri Madan Mohan
Shri G. Mohanraj
Dr. S. Kulasekhara Pandian
Shri G. Gopakumar
Smt. Mary K. Manisseri
Shri G. Syda Rao
Dr. A. Lakshminarayana
Dr. N. Ramachandran
Shri S.K. Chakraborty
Shri Vinay D. Deshmukh
Shri M. Vijayakumaran
Dr. L. Krishnan
Dr. (Smt) S. Lalitha Devi
Shri A.R. Thirunavukkarasu
Dr. H. Mohamed Kasim
Shri K.G. Girijavallabhan
Mrs. Geeta Bharathan
Dr. N. Gopalakrishna Pillai
Dr. A.G. Ponniah
Shri V. Gandhi
Shri A. Raju
Shri K.S. Sundaram
Shri K. Devarajan
Shri K.V. Somasekharan Nair
Shri T.M. Yohannan
Shri A.C.C. Victor
Shri A. Regunathan
Shri P. Livingston
Shri K.K. Sukumaran
Shri S. Shanmugham
Shri P. Nammalwar
Shri K. Prabhakaran Nair
Shri A.A. Jayaprakash
Shri G. Nandakumar
Shri K. Ramadoss
Shri R. Soundararajan
Dr. N. Gopinatha Menon
Shri Pon Sivaimuthan
Shri P.N. Radhakrishnan Nair
Dr. N. Kaliaperumal
Mrs. Rany Mary Jacob
Shri K.R. Manmadan Nair
Shri K. N. Rajan
Shri R. Thiagarajan
Shri S. Krishana Pillai
Shri M. Rajagopalan
Shri M. E. Rajapandian
Smt. V. Chandrika
Shri P. E. Sampson Manikam
Shri S. Dharmaraj
Shri D. Sivalingam
Shri M. M. Meiyappan
Shri P. Natarajan
Shri Mohamed Zafar Khan
Shri T.S. Velayuthan
Shri G. Radhakrishnan
Shri V. S. Rengaswamy
Shri I. David Raj
Shri S. Srinivasarengan
Shri K. Narayana Kurup
Shri M. Srinath
Shri K. Balan
Shri K.K.P. Panikkar
Shri R. Sathiadas
Smt. Krishana Srinath
Shri Syed Ahamadali
Shri S. Muthusamy
Shri D. Kandasami

Scientist 'S'

Shri M. Arivandakshan
Shri P. Dhandapani*
Smt. T.S. Naomi
Shri C.V. Mathew
Shri G.M. Kulkarni
Smt. K. Vijayalakshmi
Shri P. Karuppasamy.

LIST OF TECHNICAL PERSONNEL
(Not a Gradation List)

Field Officer (T-7) (Rs. 1100-1600)
Shri C.R. Shanmughavelu
Shri Syed Basheeruddin
Shri S.S. Dan
Shri J.P. Karbari

Field Officer (T-6) (Rs. 700-1300)
Shri G. Balakrishanan
Shri S. Natarajan
Curator (T-5) (Rs. 650-1200)
Shri A. Bastian Fernando

Senior Technical Assistant (T-4) (Rs. 550-900)

Shri Varughese Philipose
Shri T. Prabhakaran Nair
Shri W. Venugopalan
Shri U.K. Sathyavan
Shri K. Ramachandran Nair
Shri A.C. Sekhar

Shri P.S. Sadasiva Sarma
Shri P.K. Mahadevan Pillai
Shri K. Ramakrishanan Nair
Shri R. Bhaskaran Achari
Shri N. Ratnasami
Shri K.C. Yohannan
Shri K. Nandakumaran
Shri M. Ayyappan Pillai
Shri M. Badruddin
Shri V.K. Balachandran
Shri C.V. Seshagiri Rao
Shri S. Kalimuthu
Shri K.N. Gopalakrishanan
Shri S.B. Chandrangathan
Shri M.V. Somaraju
Shri S. Kandasamy

Technical Assistant (T.II.3) (Rs. 425-700)
Shri R. Gurusamy
Shri M. Babu Philip
Shri M. Mohamed Sultan
Shri Jacob Jerold Joel
Shri S.G. Vincent
Shri P.M. Aboobaker
Shri E.K. Raveendran(on deputation to A & N Admn.)
Shri C.G. Lakshmiah
Shri R. Reghu
Shri P. Karunakaran Nair
Shri A. Agastheesapillai Mudaliar
Shri T. Girijavallabhan
Shri A.A. Thankappan
Shri N.P. Kunhikrishnan
Shri P. Ananda Rao
Shri T.G. Vijaya Warrier
Shri A. Hanumantha Rao
Shri K.K. Balasubramanian
Shri K.V.S. Sesharigi Rao
Shri I.P. Ebenizer
Shri C.K. Krishnan
Smt. K. Kaumudi Menon
Shri K.S. Krishnan
Shri P. Ramadas
Smt. S. Lakshmi
Shri C.T. Rajan
Shri S. Manivasagan
Shri K.K. Kunhikoya
Shri V. Suresh
Shri K. Soman
Shri M. Shriram
Shri S.K. Balakumar
Smt. C. Nalini
Shri R. Vasantha Kumar
Shri P. Ramalingam
Smt. Abha Kant
Smt. Geetha Antony

Technical Assistant (T.I.3.) (Rs. 425-700)
Shri S. Siddalingaiah
Shri A. Ganapathi
Shri C. Kasinathan
Shri B. Narayana Rao
Shri K. Thulasids

Jr. Technical Assistants (T-2) (330-560)
Shri J.R. Ramalingam
Shri M. Najumuddin
Shri K.B. Wagmare
Shri Y.D. Savaria
Shri G. Subramanya Bhat
Shri Joseph Xavier Rodrigo
Shri Ramasomyajulu
Dr. C. Thankappan Pillai
Dr. Joseph Andrews
Dr. K. Chittibabu
Dr. N. Jayabalan
Shri V. Selvaraj
Shri K. Dhanaraju
Shri V.A. Narayanan Kutty
Shri K. Muniyandi
Shri L. Jayasankaran
Shri N. Sundram (now on other duty as Adm. officer, CIGR, Mathura, U.P.
Shri K. Balachandran
Miss. A. Kanagam
Shri D. Sundararajan
Shri D. Vincent

Jr. Technical Assistants (T-2) (Rs. 330-560)
Shri J.L. Oza
Shri K.P. Viswanathan
Shri V. Sivaswami
Shri N. Palaniswami
Shri K. Muthiah
Shri K. Ramadas Gandhi
Shri T. Chandrasekhara Rao
Shri L. Chidambaram
Smt. Alli C. Gupta
Shri O.M.M.J. Habeeb Mohamed
Shri M. Selvaraj
Shri R. Thangavelu
Shri A. Srinivasan
Shri V. Thanapathi
Shri H. Kather Batcha
Shri S. Palanichamy
Smt. Uma S. Bhat
Shri Sapan Kumar Ghosh
Shri S. Subramani
Shri M. Manicharaja
Shri A. Deiwendra Gandhi
Shri M.D. Arputha Raj
Shri Hammed Batcha
Shri T.S. Balasubramanian

Field Assistant (T-1) (Rs. 260-430)
Shri T. Krishnan Kutty
Shri K.K. Chellappan
Smt. K.K. Valsala

Shri K. Chandran
Shri Mathew Joseph
Shri M.N. Kesavan Elayathu
Shri K.K. Surendran
Miss T.A. Omana
Shri K. Narayana Rao
Shri M. Manivasagam
Shri S. Sankaralingam
Shri P. Palani
Shri M. Chandrasekharan
Shri C.S. Sasidharan
Shri V. Achutha Rao
Shri C. Manimaran
Shri N. Vaithinathan
Shri G. Arumugham
Shri S. Kemparaju
Shri S. Rajapackiam
Smt. P. Swarnaltha
Shri G. Srinivasan
Shri R. Somu
Shri M. Radhakrishnan
Shri M. Chellappa
Shri A. Ramakrishnan
Shri T. Dhandapani
Shri M. Bose
Shri Pulin Behari Dey
Smt. V.K. Janaki
Shri V.G. Surendranathan
Shri M.P. Sivadasan
Shri J. Narayana Swami
Shri K.T. Thomas
Shri S. Satya Rao
Shri A.K. Velayudhan
Shri P. Poovannan
Shri P. Venkatakrishna Rao
Shri A. Prosper
Shri C.J. Josekutty
Shri K. Srinivasagan
Shri A. Ahamed Kamal Basha
Shri K. Shahul Hameed
Shri S.S. Sugawekar
Shri H. Ramachandra
Shri C.K. Dinesh
Shri S. Hanumantharaya
Shri B. Sridhara
Shri Padmasekhara
Shri D. Nagaraja
Shri N. Chennappa Gowda
Shri Y. Venkatachalamoorthi
Shri J. Bhavaneswara Varma
Shri C.H. Ellithathayya
Shri R. Dias Johnny
Shri A.Y. Mestry
Shri H.K. Dhokia
Shri B.P. Thumber
Shri P.D. Solanki
Shri S. Chandrasekhar
Shri H.S. Shivanna
Shri O. Thippeswamy
Shri D.G. Jadhav
Shri R.G. Kavitkar
Shri L.R. Khambadkar
Shri V.S. Gopal
Shri M.S. Sumithrudu
Shri A.D. Sawant
Shri P. Thirumilu
Shri S. Mohan
Shri H.S. Mahadevaswamy
Shri R. Subramanian
Shri P. Thillairajan
Shri B.B. Chavan
Shri M. Enose
Shri N. Varatharajan
Shri M.G. Sivadasan
Shri A. Kumar
Shri Maruti S. Sankar Naik
Shri M.B. Vallabh
Shri Sukudev Bar
Shri R.G. Kumulkar
Shri M. Abdul Nizar
Shri A. Nandakumar
Mrs. Lalitha Sekharan

Senior Technical Assistant (T-4) (Computors) (Rs. 550-900)

Shri Varughese Jacob
Shri G. Krishnankutty Nair
Shri P. Sivaraman
Shri V. Rajendran
Smt. V.P. Annam

Computor(T.I.3) (Rs. 425-700)

Shri A. Kanakkan
Shri S. Haja Najeemuddin

Computor (T.2) (Rs. 330-560)

Shri C.J. Prasad
Smt. P.L. Ammini

Punch Card Operator (T-1) (Rs. 260-430)

Shri K.P. George
Shri M.B. Seynudeen
Kum. M.R. Beena
Smt. P.T. Mani
Shri P.P. Pavithran
Shri M. Ramachandran
Shri K. Anandan
Smt. Latha Govindraw Thote

Motor Driver (T-2) (Rs. 330-560)

Shri K. Karuppiah
Shri K.P. Velu
Shri P. Krishnan
Shri O. Muthukaruppan
Shri G. Natarajan
Shri C.D. Davis
Shri V. Varadaiah
Shri K. Dharma Rao

Motor Driver (T-1) (Rs. 260-430)
Shri K. Rathnakumar
Shri M. Gopinathan Nair
Shri P. Pasupathi Rao
Shri K.K. Soman
Shri K.J. Mathew
Shri C.S. Xavier
Shri S. Ramachandran Nair
Shri Govind Nath Chudasama
Shri Xavier Mohandas
Shri S. Yadavayya
Shri K. Alagirisamy
Shri K. Ramakurup
Shri K. Narayanan Nair
Shri M.N. Appukuttan Nair

Sr. Library-Cum-Documention Assistant (T-4) (Rs. 550-900)

Shri K. Kanakasabapathi

Sr. Library Assistant (T.II.3) (Rs. 425-700)
Shri E. Johnson

Jr. Library Assistant (T-2) (Rs. 330-560)
Smt. S. Girijakumari
Shri V. Edvin Joseph

Driver (Boat) (T-2) (Rs. 330-560)
Shri M. Mustaffa
Shri A. Pathrose
Shri S.G. Kalgutkar
Shri M.A. Vincent

Driver (Boat) (T-1) (Rs. 260-430)
Shri M. Mohideen Abdul Kader
Shri K. Anbalagan
Shri D. Padmanabhan
Shri James George

Serang (T-2) (Rs. 330-560)
Shri C.K. Dhandapani
Shri O.M. Jainulabdeen

Serang (T-1) (Rs. 260-430)
Shri H. Vasu

Bosun (T.II.3) (Rs. 425-700)
Shri P. Ferozkhan
Shri T.E. George Augustine
Shri Thomas Teles
Shri Nirmal Mathews

Senior Artist (T.II.3) (Rs. 425-700)
Shri K.L.K. Kesavan

Artist (T.I.3) f(Rs. 425-700)
Shri A. Muniyandi

Artist (T-1) (Rs.250-430)
Shri K.K. Sankaran

Photographer (T-4) (Rs. 550-900)
Shri P. Raghavan

Mechanic (T-1) (Rs. 260-430)
Shri M. Alagar

Painter-Cum-Polisher (T-2) (Rs. 330-560
Shri Rs. Marimuthu

Cook (Boat) (T-1) (Rs. 260-430)
Shri E. Sivanandan
Shri M. Rengan
Shri Vali Mahamed
Shri Yerinindra Rao

Carpenter (T-1) (Rs. 260-430)
Shri T.P. Haridasan

Skin Diver (T-2) (Rs. 330-560)
Shri J. Antony Pitchai
Shri A. Dasman Fernando
Shri F. Soosai V. Rayan

Hindi Translator (T-4) (Rs. 550-900)
Miss A. Rajeswari Menon

Projecter Operator (T-I) (Rs. 260-430)
Shri K. Chacko

Deckhand (T-I) (Rs. 260-430)
Shri M. Ibrahim
Shri M.K. Gopalakrishnan
Shri K.S. Leon
Shri V. Vedanayagam
Shri P. Munisamy
Shri D. Bosco Fernando
Shri D. Anandan
Shri S. Enasteen
Shri R. Arokiaswamy
Shri K. Parasuraman
Shri C. Manibal
Shri S. Kesavan
Shri S. Ganesan
Shri P.MD. Abdul Moheedu
Shri R. Sekar
Shri U. Alagamalai
Shri K.C. Devassy
Shri P.M. Hariharan

Skipper (T-7) (Rs. 1100-1600)
Shri P.R. Leopold

Chief Engineer (T-6) (Rs. 700-1300)
Shri P.J. Joshy Jacob

Mate (T-6) (Rs. 700-1300)
Shri P.K. Velayudhan

Bosun (T-4) (Rs. 550-900)

Shri B. Ramesh

Engine Driver (T.II.3) (Rs. 425-700)
Shri Johnson K. Kuriakose

Deckhand Sr. (T-2) (Rs. 330-560)
Shri P. Bhaskaran
Shri T.K. Sudhakaran
Shri S. Moideen Meerasa
Shri V. Maria Alwaris
Shri K.P. Vijayan

Oilman (T-2) (Rs. 330-560)
Shri T.R. Sreekumaran

Oilman-Cum-Deckhand (T-2) (330-560)
Shri P.D. Childambaran
Shri L. Jobai Fernando

Cook Boat (T-2) (Rs. 330-560)
Shri A.K. Unnikrishnan
Shri K.K. Prabhakaran

Foreman (T-II-3) (Rs. 425-700)
Shri P. Thankappan

Technical Officer (T-7) - CAS (Rs. 1100-1600)
Shri K.V. George

Farm Engineer (T-7) -CAS
Shri B.S. Ramachandrudu

KRISHI VIGAYAN KENDRA, NARAKKAL

Senior Training Assistant (T-6) (Rs. 700-1300)
Shri P. Karunakaran Nair
Shri K. Asokakumaran Unnithan
Dr. P.K. Martin Thompson

Training Assistant (T-4) (Rs. 550-900)
Shri K.N. Rasachandra Kartha
Shri A.N. Mohanan
Shri P. Radhakrishnan

Bosun (T.II.3) (Rs. 525-700)
Shri N.B. Gopalakrishna Menon

Driver (boat) (T-1) (Rs. 260-430)

Shri K.K. Bose

Cook (Boat) (T-1) (Rs. 260-430)

Shri K. Raju

OPERATIONAL RESEARCH PORJECT, KOVALAM.

Junior Technical Assistant (T-2) (Rs' 330-560)
Shri V. Selvaraj

Motor Driver (T-1) (Rs. 260-430)
Shri K. Pandi

ADMINISTRATIVE STAFF AS ON 31.3.1982

Administrative Officer

Shri V.K. Sridhar

Assistant Administrative Officer

Shri R. Doraraj

Assistant Accounts Officer

Shri M.P. Chandrasekharan

Superintendents

Shri S.PL. Sethu
Shri S. Suburamanian
Shri M.P. Lakshmanan
Shri A. Sethubhaskaran
Shri P. Aithappa Naik
Shri M. Subbiah
Shri G.V. Pednekar
Shri A.K. Balakrishna Pillai

P. As to Director

Shri L. Krishnaswamy
Shri K. M. Surendran

Table 3: *Estimated Marine Fish Landings in India during the year* 1981–'82 (*in tonnes*)

Sl. No.	Name of fish	West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Pondicherry	Kerala	Karnataka	Goa	Maharashtra	Gujarat	Andamans	Lakshadweep*	Total
1.	ELASMOBRANCHS													
	(a) Sharks	514	2395	2996	2594	180	3747	3354	362	8359	8676	16	189	33382
	(b) Skates	368	—	140	116	—	347	—	—	229	462	—	—	1662
	(c) Rays	190	824	1090	10167	219	1320	237	61	2244	4423	10	22	20807
2.	EELS	21	32	294	190	12	7	7	6	2807	2760	—	—	6136
3.	CAT FISHES	9921	5091	2587	5487	93	9326	8598	1673	10820	11429	21	—	65046
4.	CLUPEIDS													
	(a) Wolf herring	360	1244	1245	2220	83	1063	154	55	3910	3666	21	—	14021
	(b) Oil sardine	—	—	—	295	—	172230	73327	9399	393	—	—	—	255644
	(c) Other sardine	—	4251	14652	22741	1568	7091	5290	1493	433	—	277	—	57796
	(d) Hilsa shad	2683	2169	32	113	—	11	1	1	685	17	—	—	5712
	(e) Other shads	37	23	1688	3884	103	15	52	12	1277	7855	18	—	14964
	(f) Anchovies	—	—	—	—	—	—	—	—	—	—	—	—	—
	Coilia	177	59	57	277	6	—	—	—	15502	4006	—	—	20084
	Setipinna	439	179	186	285	70	—	2	—	—	—	—	—	1161
	Stolephorus	5	132	11051	7681	264	4674	7430	86	83	—	214	—	31620
	Thrissina	—	—	—	—	—	—	—	—	—	—	—	—	—
	Thryssa	110	338	2421	6249	515	682	207	517	1452	2277	—	—	14768
	(g) Other clupeids	3088	1963	4875	4769	386	951	257	338	3341	3508	—	—	23476
5.	BOMBAY DUCK	810	84	905	—	—	—	1	1	71700	59589	—	—	133090
6.	LIZARD FISHES	—	76	845	1741	241	5648	418	663	1335	523	—	—	11490
7.	HALF BEAKS & FULL BEAKS	1	1	63	823	56	673	120	—	80	—	18	113	1948
8.	FLYING FISHES	—	—	166	2464	614	7	—	—	—	—	3	16	3270
9.	PERCHES	—	—	—	—	—	—	—	—	—	—	—	—	—
	(a) Rock cods	—	178	41	1008	15	269	10	1	107	188	—	—	1817
	(b) Snappers	—	33	261	724	—	350	—	2	143	438	—	—	1951
	(c) Pig-face breams	—	—	—	1158	18	115	1	—	4	—	—	—	1296
	(d) Threadfin breams	—	19	1618	2211	383	6905	278	713	3017	3065	—	—	18209
	(e) Other perches	28	110	3500	3040	492	1533	107	529	180	2457	246	315	12537
10.	GOAT FISHES	—	114	868	1247	135	38	1	—	1116	294	—	25	3838
11.	THREADFINS	323	491	1110	240	1	126	3	14	431	2402	—	—	5141
12.	CROAKERS	224	2100	6891	19994	324	2747	1655	1546	16343	34972	—	—	86796
13.	RIBBON FISHES	202	376	7287	7513	164	7058	286	592	9287	9461	16	—	42242
14.	CARANGIDS													
	(a) Horse mackerel	—	236	411	147	—	235	981	113	120	688	—	—	2931
	(b) Scads	—	47	3302	1320	162	1518	—	—	—	—	—	—	6349
	(c) Leather-jackets	60	33	495	827	10	617	241	5	406	2881	—	—	5575
	(d) Other carangids	—	144	1446	8154	1542	4931	1827	672	860	157	167	105	20005
15.	SILVER BELLIES	—	536	7333	52682	894	3124	1329	1566	203	—	315	—	67982
16.	BIG-JAWED JUMPER	—	44	691	449	43	935	440	902	891	5700	—	—	10095
17.	POMFRETS													
	(a) Black pomfret	54	416	1393	617	102	538	71	96	2095	2838	1	—	8221

Sl. No.	Name of fish	West Bengal	Orrisa	Andhra Pradesh	Tamil Nadu	Pondicherry	Kerala	Karnataka	Goa	Maharashtra	Gujarat	Andamans	Lakshadeep*	Total
	(b) Silver pomfret	3115	2487	1453	449	9	868	172	10	15850	19295	8	—	43716
	(c) Chinese pomfret	544	2	29	4	—	15	8	—	5	1	—	—	608
18.	MACKERELS													
	(a) Indian Mackerel	—	515	3964	4425	271	12788	14359	5570	275	—	139	—	42310
	(b) Other Mackerels	—	—	—	—	4	—	—	—	—	—	—	—	4
19.	SEER FISH													
	(a) *S. commersoni*	1186	579	1269	4438	50	2163	1947	248	1646	—	64	25	13615
	(b) *S. guttatus*	102	2588	3215	543	28	2253	1003	168	1192	3948	68	25	15133
	(c) *S. lineolatus*	—	52	13	35	—	6	188	31	—	—	—	—	325
	(d) *Acanthocybium Sq.*	—	—	—	—	—	—	—	—	—	—	—	—	—
20.	TUNNIES													
	(a) *E. affinis*	—	227	201	2966	10	5235	2324	48	240	627	—	23	11901
	(b) *Auxis Spp.*	—	—	—	126	—	1446	1	—	—	—	—	—	1573
	(c) *K. pelamis*	—	—	—	23	—	1	—	—	7	—	14	1744	1789
	(d) *T. tonggol*	—	—	—	—	—	64	—	—	—	14	—	—	78
	(e) Other Tunnies	—	14	76	470	43	192	—	49	1127	113	20	469	2573
21.	BILL FISHES	—	1	210	178	20	142	3	—	114	—	—	17	685
22.	BARRACUDAS	—	12	246	1190	55	903	14	38	12	454	57	12	2993
23.	MULLETS	1	—	178	373	9	117	1	104	25	1594	72	—	2474
24.	UNICORN C OD	—	—	—	—	—	—	—	—	19	—	—	—	19
25.	FLAT FISHES													
	(a) Halibut	—	1	72	217	11	196	—	—	10	486	—	—	993
	(b) Flounders	—	—	1037	2	—	—	—	—	65	—	—	—	1134
	(c) Soles	2	35	1112	1912	183	4564	743	607	2113	3951	—	—	15222
26.	CRUSTACEANS													
	(a) Penaeid prawns	299	1326	6607	15582	312	21809	5313	2556	21925	12389	26	—	88144
	(b) Non-penaeid prawns	848	55	1577	803	16	142	4	—	43002	4745	—	—	51192
	(c) Lobsters	—	6	5	207	7	59	48	12	583	921	2	—	1850
	(d) Crabs	45	132	1012	11164	223	218	1171	624	203	10286	20	—	25098
	(e) Stomatopods	—	125	210	1287	—	2838	11972	1955	622	3066	—	—	22075
27.	MOLLUSCS													
	(a) Bivalves													
	(b) Gastropods													
	(c) Cephalopods	—	73	588	2463	51	2904	301	56	2074	2569	—	14	11093
28.	MARINE TURTLES													
29.	MARINE MAMMALS													
	(a) Dolphin & porpoise	—	—	—	—	—	28	—	—	1	—	—	—	29
	(b) Seacow													
	(c) Whale													
30.	SEAWEEDS													
31.	MISCELLANEOUS	2359	891	2624	13109	392	7026	16705	1501	5406	6200	86	186	56485
	TOTAL	28116	32859	107638	235423	10389	304808	162962	34995	256369	245391	1919	3300	1424169

*Figures relate to 1981 calendar year.