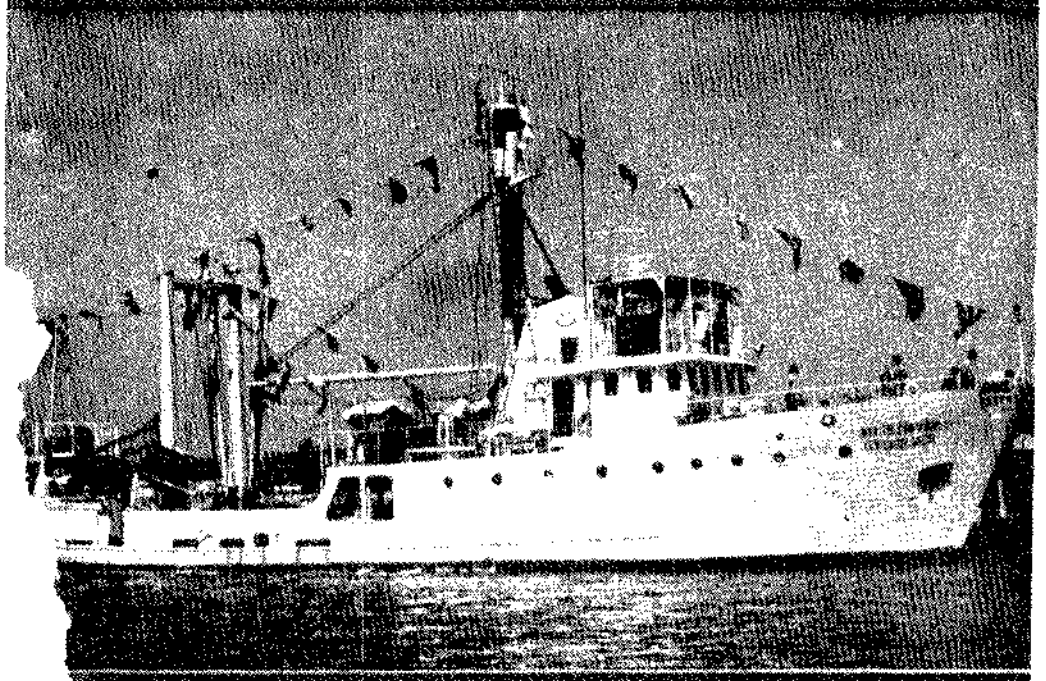
Annual Report

1982-83



CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Annual Report

1982-83

Central Marine Fisheries Research Institute
COCHIN
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Issued by
Dr. E. G. SILAS
Director
Central Marine Fisheries Research Institute
P. B. No. 1912, Cochin-682018

Compilation, Editing and Printing:

Dr. P. V. Ramachandran Nair, *Joint Director*
Shri. M. S. Rajagopalan, *Scientist S.3*
Smt. A. Kanagam, *Technical Assistant*

Cover Photo
R. V. SKIPJACK, the Institute's Research Vessel

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DIRECTOR'S INTRODUCTION

During the year 1982 - 83 substantial progress was made in the development of infrastructure facilities for the research and development programmes of the Institute. These included the taking over of the Research Vessel SKIPJACK for regular exploratory surveys, the acquisition of farms for mariculture programmes and the construction of the laboratory buildings and procurement of equipments. Although the VIth Plan sanction was belated, advance action was taken on developing these infrastructures which involved expenditures in Plan Rs.1,85,07,189 and Non-Plan Rs.1,33,08,785 (Total Rs 3,18,15,974) during 1982-83. From the commencement of the VIth Plan the Institute has utilised about Rs. 3,70,07,192 in the Plan and Rs. 3,50,74,295 in Non-Plan for the R & D programmes, development of infrastructure and establishment. During the year appropriate action was taken by the Administration to process the papers for the Five Yearly Assessment / Re-assessment of Scientists as well as Technical staff. As a result 11 scientists had the benefit of merit promotion or advanced increments. Out of 76 Technical staff 67 have been promoted to next higher grade with effect from 1-7-1982.

Five new Divisions have been established during the VIth Plan namely, (1) Pelagic Fisheries Division, (2) Demersal Fisheries Division, (3) Fisheries Economics and Extension Division (4) Physiology, Nutrition and Pathology Division, (5) Library and Documentation Division. With this reorganisation, the

9 Divisions of the Institute have together undertaken 122 research projects, 8 Inter-Divisional Projects, 4 Inter-Institutional Projects, and several Training Programmes during the year.

The major highlights of 1982-83 were :

1. The Institute has been recognised as the National Marine Living Resources Data Centre (NMLRDC) and as the nodal agency for reconciling and clearing the final figures of marine fish landings by the various maritime States and Union Territories. In order to rapidly disseminate information on landings of major fisheries at the fishing harbours and major landing centres a new publication "Fish Trend" is being issued by the NMLRDC so that the maritime States and the fishing industry would get a monthly picture of the trends of exploited resources by the mechanised sector. The total marine fish production in India during the financial year 1982-83 was estimated at 14.15 lakh tonnes as against 14.21 lakh tonnes during the year 1981-82. Barring West Bengal, Karnataka and Gujarat all other maritime States had recorded higher fish landings. The oil sardine accounted for about 202,000 tonnes forming about 14% of the total all India landings. The landings of other major groups of species in the order of abundance are the penaeid prawns (117,000 tonnes), Bombay duck (90,000 tonnes), Croakers (82,000 tonnes), Anchovies (78,000 tonnes) and Silver bellies (70,000 tonnes).

2. In order to obtain species-wise information and utilise computor facilities which are being developed at the Institute, a Code list of common marine living resources of the Indian seas has been developed for implementation in the survey programme of the Institute from 1983-84.

3. A significant contribution from the Institute has been a comprehensive report on the "Resources of Tunas and Related Species and their Fisheries in the Indian Ocean" (Bulletin No. 32) which highlights the most important

resources of our Exclusive Economic Zone and the contiguous high seas. This report has had a major impact on the industry in supplying valuable resource information for enabling investment decisions in tuna fishing.

4. Similarly a very useful analysis has been brought out on the "Fishery Resources of the Exclusive Economic Zone of the North–West Coast of India" (Bulletin No. 33) based on the one year survey carried out on pelagic and demersal resources by the Polish Vessel M. T. MURENA. This report highlights the extent of productive fishing grounds along the north-west continental shelf and the major resources that are occurring in the area. The area of this survey extended from 15° N to 24°N lying between 55-360 metre depth covering an area of about 30,067 sq. nautical miles.

5. A new approach to the "Analysis of the Marine Fish Landings in India" published as a Special Publication No. 10 of the Institute highlights a new approach to fish stock assessment for rapidly obtaining information for management for developing proper management measures.

6. A number of special studies have been carried out on the impact on various types of fishing operations along the coast particularly with a focus on the small-scale fisheries sector. These have been useful guides to the development departments of the maritime States. Similarly an impact study on natural devastation wrought by cyclone has also been carried out in Gujarat.

7. A remarkable event during the year was the recovery of the white prawn *P. indicus* tagged off Cochin and caught close to Tuticorin in the Gulf of Mannar at a distance of over 380 km. The propensities of the commercially very important species to migrate to long distances has given a new perspective on prawn stock

assessment for developing objective management measures.

8. The Mariculture R & D programmes have made considerable headway during the year resulting in major breakthroughs in:

   a) the standardisation of maturation, breeding and hatchery development of penaeid prawns, particularly *P. indicus* and *P. monodon*;

   b) accelerated growth in the spiny lobsters through a process of eye ablation and feed technique;

   c) in the hatchery techniques of large scale seed production in pearl oyster and edible oyster;

   d) in the successful breeding and rearing of the green crab *Scylla serrata*; and

   e) a better understanding of the nutritional requirements of *P. indicus*.

9. In the area of Post-graduate Education, the M.Sc. Mariculture course was implemented by the staff of the Institute laising closely with the University of Cochin and the semester examinations were held in time. The first batch of 9 students who were admitted to the course in September 1980 completed their course in September 1982. The second semester of the second batch of 12 students is progressing at present. In the third batch 10 students were admitted in December 1982.

   Four Ph. D. Research Scholars belonging to the first batch have completed their course work and they have also passed the qualifying examination conducted by the University of Cochin. The second batch of 9 scholars are currently under-going the second semester of the course work.

Under the expert consultancy assignments, Dr. Akira Machii of National Research Institute of Aquaculture, Japan, Dr. A. L. S. Munro, Marine Laboratory, Department of Agriculture and Fisheries, Aberdeen, U. K. and Dr. V. J. Bye, Marine Laboratory, Lowestoft, U K. visited the Institute. The experts held group discussions with the scientists and research scholars, conducted seminars in the respective fields of specialization and gave valuable suggestions on future programmes and organisation of laboratories. These experts also helped in bringing out Manuals in research methodology on approaches to finfish and shellfish pathology investigations and application of genetics aquaculture.

During the year, 5 scientists of the Institute received advanced training abroad in identified areas where there is little expertise in the country and to exchange the technical knowhow with a view to obtaining professional competency in their fields of specialisation.

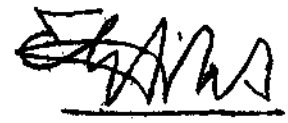
Under the auspices of the CAS in Mariculture, two national workshops were organised during 1982. These are (i) on "Fish and Shell Fish Nutrition" at Cochin from 11-16 January 1982 and (ii) on "Marine Invertebrate Reproduction" at Madras from 25th October to 10th November 1982. The Manuals on Research Methodology brought out of these workshops are now widely used by research workers in various Universities and Research Institutions in the country.

The second Sukumar Bosu Memorial Award has been won by a team of 5 Scientists (K. H. Mohamed, M. S. Muthu, N. N. Pillai, S. K. Pandian and A. Lakshminarayana) working at the Narakkal Prawn Culture Laboratory of the Institute, for their outstanding contributions in the field of prawn culture The awards was presented by the Vice President of India at IARI Convocation held at New Delhi on 6-2-1982. The award is for developing scientific methods for artificial

breeding of prawns leading to mass production of prawn seed and also for fully domesticating important species of marine prawns.

It was gratifying that the President of India, Giani Zail Singh took time during his visit to Cochin to see the activities of the Institute on 13th September 1982.

On the whole this has been a satisfying year and this report embodies details of the project programmes, educational, training and extension activities and transfer of technology undertaken by the Institute during the year under review.



(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 head quarters 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 brackishwater 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 :

With the new Divisions coming into being during 1982-83, the research projects / problems undertaken during the year were implemented by the following 9 Divisions :

1. Fishery Resources Assessment Division
2. Fishery Economic & Extension Division
3. Pelagic Fisheries Division
4. Demersal Fisheries Division
5. Crustacean Fisheries Division
6. Molluscan Fisheries Division
7. Fishery Environment Management Division
8. Physiology, Nutrition and Pathology Division
9. Library & Documentation Division.

Facilites added during the year

1. Taking over of R. V. SKIPJACK from the shipbuilders for regular exploratory surveys and research programmes.
2. Acquisition of farms for mariculture, construction of Laboratory buildings, hatcheries, procurement of equipments indigenously and from abroad.
3. Starting of National Marine Living Resources Data Centre (NMLRDC).
4. Starting of a new publication entitled *"Fish Trend"*.
5. Establishment of a National Centre for Mariculture at Muttukad, 36 Km south of Madras.

Finance :

The actual expenditure incurred by the Institute both under plan and Non - Plan during the financial years 1980-81 to 1982-83 are as follows :

Year	Non-Plan	Plan
1980-81	1,02,65,008	68,64,072
1981-82	1,15,00,502	1,16,35,935
1982-83	1,33,08,785	1,85,07,185

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.

CMFRI STAFF SERVING IN DIFFERENT COMMITTEE 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	1) Member in State Level Committee 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 / FAD-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 & Esturine 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. Accts. Officer	Member in Management Committee S. B. I., Coimbatore.
11.	Shri S. Kalimuthu Tech. Asst.	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	- 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. Murthy 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.	-do-
		v) CMFRI Staff Recreation Club	President

3.	Dr. K. Alagaraswami 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-1	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 Scientist S-3	i)	Transfer Committee	Member
	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.	
	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-3	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	Member
	ii)	Committee on Construction of Mobile Laboratory	do

17.	Shri V. N. Bende 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 Language 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	do
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. Kanaka-sabhapathy 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. Krishna-moorthi Scientist S-3	i)	Management Committee ORP of CMFRI	Member
29.	Shri N. S. Radha-krishnan Scientist S-1	i)	Institute Joint Council	Member
30.	Shri G. Soundara-rajulu Lab Attendant	i)	Institute Joint Council of CMFRI	Member
		ii)	Grievance Cell	do
31.	Shri S. Kalimuthu Tech. Asst. (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. Asst.	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)	Language Implement-ation Committee	Member
37.	Shri Varughese Jacob Tech. Asst.	i)	Institute Joint Council	Member

Official meetings attended:

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

1. The Co-ordination Meeting of ICAR Fisheries Institutes called by Deputy Director-General, ICAR at New Delhi, 12-14 April.

2. International Convention on Deep Sea Fishing organised by the Association of Indian Fisheries Industries at New Delhi, 23-25 June.

3. ICAR Directors' Conference at New Delhi, 7 & 8 October.

4. CAS Advisory Committee Meeting at New Delhi, 1 November

5. Indo-Pacific Fisheries Council and Indian Ocean Fisheries Commission Meeting of the FAO (IPFC/IOFC) at Bali, Indonesia as member of Indian delegation 10 to 18 November.

6. Meeting in connection with the taking over of R. V. Skipjack at Calcutta, 1 December.

7. Plenary session and valedictory meeting of Training Programme by FAO/National Institute of Oceanography at Bombay, 9 December.

8. Seventieth Session of the Indian Science Congress at Tirupati.

9. Meeting of the ICAR Regional Committee No. 8 at Bangalore.

10. The State Level Committee for Development Plan on Marine National Park at Madras.

11. The Annual General Body Meeting at ICAR Headquarters, New Delhi.

12. The Quinquennial Review Team meeting at Madras.

Meetings attended by other Scientists:

1. Shri K. Nagappan Nayar, Scientist S - 3 attended the Second All India Workshop on Lab-to-Land Programme at Jabalpur.

2. Shri V. Kunjukrishna Pillai attended the following meetings:

   Seminar on Fisheries Education and Research Organised by Kerala Agricultural University Fisheries Faculty Members Association at Panangad, 13 November. Seminar on Status and impact of heavy metal pollution in India at the Centre for Environmental Studies, College of Engineering, Anna University, Madras, 1-3 December.

3. Shri G. Sudhakara Rao, Scientist S-1 attended the meeting of Second Consultative Group of Porbandar Base of Exploratory Fisheries Project, Porbandar, 11 March.

Participation in Education / Training Programme:

1. Smt. V. Chandrika, Scientist S-1 participated in the summer institute on Organic matter recycling for fuel feed and fertilizer at Department of Microbiology, Haryana Agricultural University, Hissar.

2. Dr. P Vedavyasa Rao, Scientist S-3 and Shri M. S. Muthu, Scientist S-2 were appointed Guest Lecturers for M. Sc. Marine Biology IV Semester at the University of Cochin.

3. Dr. L. Krishnan, Scientist S-1 at Narakkal and Mr. V. D. Deshmukh, Scientist S-1 at Bombay Research Centre of CMFRI attended the C Class 'C' training programme on Marine resources management and Conservation in the Indian Ocean Basin and Adjacent Seas' organised by the International Ocean Institute-Malta at Goa from October, 10, December to 1982.

4. Dr. M. M. Thomas, Officer - in - Charge and Shri. P. Karunakaran Nair Senior Training Assistant of KVK attended the Rural Programme Committee Meeting of the All India Radio held at CIFT, Cochin, 23, November.

5. Shri N. Surendranatha Kurup and Shri K. Y. Telang, Scientists S-1 at Mangalore attended the Tenth Orientation Course on Agricultural Research Management at Hyderabad from 3 November - 2 December.

6. Shri K. G. Girijavallabhan, Shri G.P. Kumaraswami Achari and Shri Kuber Vidyasagar also attended the Tenth Orientation Course.

7. Shri S. Suseelan, Dr. P A. Thomas, Shri D. B. James, V. K. Pillai and C. P. Gopinathan attended the Eleventh Orientation Course at the above Institute.

8. Shri V. K Sridhar, Administrative Officer attended the training programme for the administrative officers of ICAR Institutes conducted by the National Academy of Agricultural Research Management, Hyderabad for a period of ten days from 19 January.

9. Shri K. N. Rasachandra Kartha, Senior Training Assistant (T-6) Shri K. V. George, Field Officer and Shri B.S. Ramachandrudu, Farm Engineer participated in Aquaculture Engineering Training (Fishpond Construction) at the IIT, Kharagpur.

10. The Seventieth Session of the Indian Science Congress with the theme 'Man and The Ocean, Resources and Development' was held at Tirupati from 3-8 January Dr. E. G. Silas, Director, Shri T. Jacob, and Dr. K. Alagaraja, Scientists of FRAD Division participated and presented papers.

Symposia, Seminars, Workshops, Exhibition etc.

11. A National workshop on Acquisition and Dissemination of Data on Marine Living Resources of the Indian Seas was held at CMFRI, Cochin from 21-23 October, '82. Fiftytwo delegates representing Ministry of Agriculture, fisheries organisations, central research institutes, India Meteorology Department, NPOL, NIO, Naval Hydrographic Office, State departments, dealing with marine fisheries statistics, agricultural universities, State fisheries corporations and private industries took part in the deliberations.

2. The Central Institute of Fisheries Technology organised a Symposium on Harvest and post harvest technology of fish from 24-27 November 1982 at CIFT, Cochin. Dr. E. G. Silas, Director and a number of Scientists from CMFRI actively participated in the Symposium.

3. The Marine Products Export Development Authority held a National Symposium on Shrimp Seed Production and Hatchery Management in association with the CMFRI CIFRI and CIFT during 21-22 January, 1983. CMFRI presented 3 lead papers and held six poster sessions.

4. Dr. A. L. S. Munro, FAO / UNDP Expert Consultant gave a seminar on 'The recent growth of Salmon and Trout farming in Scotland' on 15-1-1983.

5. He gave a seminar on 'Pathology of Bacterial Diseases in Fishes' on 31-1-1983.

6. He gave a seminar on 'Recent developments in the study of furunculosis, a bacterial disease of fishes' on 3-2-1983.

7. He gave a seminar on 'Infectious pancreative Necrosis, a viral disease affecting cultured salmonids in Scotland' on 5-2-1983.

8. He also gave a seminar on 'United Kingdom experience of fish disease legislation on the introduction of non-indigenous fishes, on 16-2-1983.

9. Dr. Akira Machii of National Research Institute of Aquaculture, Japan gave seminars on 'Invertebrate tissue Culture on 17 and 18-1-1983.

10. Dr. V. J. Bye, FAO / UNDP Expert Consultant gave a Seminar on Applications of genetics to aquaculture' on 17-2-1983.

11. He gave a seminar on ,Control of sex and its application in Aquaculture on 26-2-1983.

12. He also gave a seminar on 'Environmental control of reproduction' on 3-3-1983.

13. Prof. H. J. Ceccaldi, Director De Laboratoire A L'ecole pratique des hautes etudes, FAO / UNDP Expert consultant gave a seminar on 'Crustacean Physiology, on 17 and 18-6-83.

14. A Two-days Science camp for students of vocational stream was organised by the KVK, Narakkal on 24- 25 May '82.

15. A 'Open House' was organised by the Institute on 23-12-82 when the Institute's research vessel 'R. V. SKIPJACK' first arrived at Cochin after taking over at Calcutta.

16. The Madras Research Centre participated in the First All India Wildlife Exhibition organised by the Tamil Nadu Forest Department at Gindy.

17. Vizhinjam and Tuticorin Research Centres participated in the exhibition organised by Bharat Karshak Samaj in connection with National Convention held at Trivandrum from 26 - 27 Dec. '82.

18. The Minicoy Research Centre participated in the Island Vikas Mela conducted by the Lakshadweep administration from 3, 13 February 1983. The Centre also organised an exhibition highlighting various aspects of marine fisheries research.

PARTICULARS OF SCIENTISTS DEPUTED ABROAD DURING 1982-83

Sl. No.	Name and Designation	Purpose	Duration
1.	Dr.K. Alagarswamy, Scientist S-3	Deputed abroad to under go fellowship training under FAO / UNDP Programme in the field of 'Reproductive Physiology of Fishes and Shell-fishes at the University of California, USA for one month and at the Institute National de-la-Research Agromonique (INRA) France for two months from 1st June 1982.	3 months from 1-6-82

Sl. No.	Name and Designation	Purpose	Duration
2.	Dr. M. K. George, Scientist S-1	Deputed abroad to under go fellowship training under UNDP/FAO Programme in the field of 'Endocrinology of Fishes and Shell - fishes at the Marine Laboratory, Aberdeen, Scotland.	3 months from 28-5-82
3.	Shri D. Kandasamy, Scientist S-1	Deputed abroad to under go fellowship training under FAO/UNDP Programme in the field of fish and shell-fish Nutrition' at the Kagoshima University, Japan	3 months from 27-5-82
4.	Shri D. C. V. Easterson, Scientist S-2	Deputed to undergo fellow ship training under FAO/ UNDP programme in the field of 'Bio - Energetics' at the Bodega Marine Laboratory, California, USA.	3 months from 14-6-82
5.	Shri K.M. S. Ameer Hamsa, Scientist S-1	Deputed abroad to under go fellowship training under FAO/UNDP Programme in the field of 'Pen and Cage Culture' at SEAFDEC, Philippines	2 months from 2-10-82
6.	Dr. E. G. Silas, Director	Participated in the 7th Session of the IOFC and 20th Session of the IPFC at Bali, Indonasia.	From Nov. 11th to 18th 1982.
7.	Shri N. Neelakanta Pillai, Scientist S-1	Deputed to undergo fellowship training under FAO/ UNDP Programme in the field of Machrobrachium Culture and Crustacean Genetics' at Honolulu.	3 months from 14th March to 13th June, 1983.

List of distinguished visitors to the Institute during 1982 - 83

1. The President of India, H. E. Giani Zail Singh took time during his visit to Cochin to see the activities of the Institute on 13-9-'82.

2. Hon'ble Union Minister of State for Agriculture and Rural Development Shri R. V. Swaminathan accompanied by Chief Engineer, Fisheries Harbour Projects, Kerala with his senior officials and the Director of Fisheries, Kerala visited Vizhinjam Research Centre of CMFRI on 13 May. After seeing the various research activities Hon'ble Minister visited the mussel and oyster culture sites.

3. Mr. Makato Yamasaki, Fisheries and Marketing Specialist, Fisheries and Aquaculture International Co. Ltd., Tokyo visited Vizhinjam Research Centre.

4. Dr. Jean yvzs Le gall, French Expert in tuna fisheries visited CMFRI and gave a talk on French experience in tuna fisheries.

5. Dr. Leonard J. V. Campagno, Tiburon Centre for Environmental studies, San Fransisco State University, Tiburon, California, a world specialist in elasmobranchs visited CMFRI and gave two lectures on sharks, their biology and utility and 'megamouth', a new finding.

6. FAO Anchoviella Study Team with the following members visited Mangalore Research Centre to investigate the possibilities of diversifying Indian anchoviella into products suitable for export to other South East Asian Countries where the species is in great demand.

7. Mrs. Se l - Poh Chen, Fishery Industry Officer (Processing) FAO, Dr. G. Jegatheesan, Fisheries College, Tuticorin.

8. Mr. Galicano L. siton, Lorenzana Food Col. Manila, Philippines.

9. Mrs. Lourdes M. Arafiles, Department of Fish Processing Technology, College of Fisheries, Quezon City Philippines.

10. Mrs. Sharifah Nor Hidayath, Head, Training and Extension Branch, MARDI, Serdang Selangor, Malaysia.

11 Mr. Haji Hassan Abdulla, Fish Sauce Industry, Terengganu, Malaysia.

12. Mr. Marceliano B. Neito, College of Fisheries, Quezon City, Philippines.

13. Dr. K. J. Jauncey, Institute of Aquaculture, University of Stirling a specialist in fish nutrition gave a talk on Techniques of fish nutrition and their application to crustacea and other invertebrates on 18 November.

14. UNESCO/FAO/UNDP Technical Advisory Mission comprising Dr. A. W. El - Moursi, Agricultural Education Officer, F. A. O. Mr. T. R. Worku, Programme Specialist, UNESCO, Mr. D. R. Malhotra, Senior Programme Officer and Shri V. Kumar, Project Administrative Officer, UNDP visited CMFRI and reviewed the progress and the general activities of CAS, 15-19 October.

15. Participants of the Training Programme on Marine Resources Management and Conservation in Indian Ocean Basin and Adjacent Seas Organised by National Institute of Oceanography, Goa and co-sponsored by Ministry of External Affairs and Department of Ocean Development. Government of India, SIDA, UNEP, FAO, Common Wealth Secretariate and other agencies visited CMFRI on 25 November. Dr. E. G. Silas, Director, CMFRI gave a special lecture on tuna and bill fish resources of Indian Ocean region, 25 November.

16. Dr. R. M. Acharya, Deputy Director - General (Animal Sciences), ICAR visited Kakinada Research Centre, 7 September.

17. Dr. C. W. Powell Fuakure, Soil and Plant Research Station, Hamilton, New Zealand visited CAS and gave a talk on Fisheries in New Zealand, 24 January.

18. Professor P. Kochukuttan Menon, Retired Professor of Zoology, Presidency College, Madras visited the Institute on January and gave a talk on Life in mariculture, 6 January.

19. Dr. M. A. Ali, Professor, University of Montreal, Canada visited and gave a special lecture on Vision in fish, 24 January.

20. Professor R. Nagabhushanam, Head of the Department of Zoology, Marathwada University, Aruangabad and U. G C. National Lecturer visited and gave a series of special lectures on Invertebrate endocrinology. 30-31 March.

21. Dr. M. M. Hanumante, Research Student, Tulane University, New Orleans, visited and gave a lecture on Neuroendocrinology.

22. Shri K. P. Padmanabhan, Deputy Director of Fisheries, Pondicherry.

23. Shri M. D. Sahidulla, Deputy Director, Marine Fisheries, Chittagong, Bangladesh.

24. Professor M. M. Taqui Khan, Director, Central Salt and Marine Chemicals Research Institute, Bhavnagar.

25. Shri R. Vijayakumar, IAS, Subcollector, Tuticorin.

26. Shri S. Srinivasan, IAS, Secretary, Ministry of Forests and Fisheries, Tamil Nadu.

27. Shri Sankarasubbiah, IAS, Director of Fisheries, Tamil Nadu.

28. Dr. O. P. Makhija, Scientist, Post graduate Agricultural Education and Research, ICAR, New Delhi and Shri V. Kumar, Administrative Officer, UNDP Cell.

29. Dr. J. G. Rumea, FAO Representative in India and Dr. A. C. Mandiratta, Personnel Officer, UNDP.

30. Dr. P. S. B. R. James, Assistant Director-General (Fisheries) ICAR.

31. Dr. S. N. Dwivedi, Director, CIFE, Bombay.

32. Dr. H. R. Kalia, Vice Chancellor, Himachal Pradesh Krishi Vishwa Vidyalaya.

33. Shri S. C. Hota, Director of Fisheries, Orissa.

34. Dr. N. K. Jaiswal, Director (Transfer of Technology), National Institute of Rural Development, Hyderabad.

35. Dr. A. N. Bose, Professor, Aquaculture Engineering, Indian Institute of Technology, Kharagpur.

36. Dr. M. Rameseshaiah, Lecturer, Department of Marine Living Resources, Andhra University.

37. Professor P. N. Ganapathi, Emeritus Scientist, Andhra University and Chairman, CMFRI Achievement Audit Committee.

38. Mrs. Trutee, 37, Ellawarra Road, Hemington Melbourne Australia.

39. Dr P. M. Rao, Principal Somayya College, Bombay.

40. Thirty students trainees of the CIFNET, Madras along with two staff members visited KVK, Narakkal.

41. Professor S. R. Bawar, Head of Zoology Department, G. M. Khalsa College Bombay.

42. Professor K. N. P. Kurup, Department of Zoology, N S.S. College, Ottapalam.

43. Professor A. G. Karnik, Department of Zoology, M. J. College, Jalagaon.

44. Dr K. R. Ramanathan and M. S. Mathew, Central Pollution Control Board, New Delhi.

45. Professor A. B. Dandakar, Department of Zoology, Modern College, Pune.

46. Study Group 2 of the Parliament Estimates Committee consisting of 19 Members visited CMFRI during 10-13 January.

47. The Second Sub Committee for the Language Implementation Cell visited Minicoy Research Centre.

48. Shri C. Ramakrishna, Deputy Director, MPEDA, Cochin.

49. Shri M. R. Nair, Director-in-Charge, CIFT, Cochin.

50. Dr. K. Gopakumar, Head of Processing Division, CIFT, Cochin.

51. Shri H. P. C. Shetty, Director of Instruction (Fisheries) UAS, College of Fisheries, Mangalore.

52. Shri P. K. Salian, Professor of Fishery Engineering, UAS, College of Fisheries, Mangalore.

53. Shri K. C. Jayaraman, Joint Director, Zoological Survey of India, Calcutta.

54. Zay Hta Aung, FAO Fellow, Peoples Pearls and Fisheries Corporation, Burma.

55. Admiral R. K. S. Gandhi, Vice Chairman, Shipping Corporation of India, Bombay.

56. Professor S. V. Jacob, (Retd.) Co-ordinator and Head of School of Biological Sciences, Madurai Kamaraj University, Madurai.

57 Shri R. G. Dandekar, Deputy General Manager, National Bank for Agriculture and Rural Development, Bombay.

58. Shri V. Chidambaram, Chief Manager, M/s SPIC, Tuticorin.

59. Mr. Reymond Brede from SIMROD, Norway gave a talk on Recent developments in acoustic instrumentation in fisheries.

Radio programme:

1. A talk on 'Fisheries in India' was broadcast in English by Shri J. P. Karbhari, Technical officer over All India Radio, Bombay on 5-9-83, in the Science Magazine programme.

2. A talk on 'NILI KRANTI' (Blue Revolution) was broadcast in Marathi by Shri J. P. Karbhari, Technical officer over All India Radio, Bombay on 20-12-1983, in the Industrial Workers programme (Kamgar Sabha).

PROGRESS REPORT OF
THE DIVISIONS AND PROJECTS

FISHERY RESOURCES ASSESSMENT DIVISION

Sample Survey for estimation of marine fish production and the effort expended (FSS/FRA/1-1) *

The total marine fish production in India during the financial year 1982-83 [1] was estimated at 14.16 lakh tonnes as compared to 14.21 lakh tonnes recorded during the previous year 1981-82, showing a marginal decline of about 6,000 tonnes. Barring the states of West Bengal, Karnataka and Gujarat where there was a marked decline, the total marine fish production increased in all other maritime states of India. (Table 1). While the landings increased significantly in the states of Andhra Pradesh, Pondicherry, Kerala and Andamans there was only a marginal increase in Orissa, Tamil-Nadu, Goa and Maharashtra.

Table. 1 Statewise total marine fish production in India during the years 1982-83 and 1981-82. (In tonnes)

Sl.No.	State	1982-83	1981-82
1.	West Bengal	22,444	28,116
2.	Orissa	33,490	32,859
3.	Andhra Pradesh	126,004	107,786
4.	Tamil Nadu	235,953	235,423
5.	Pondicherry[2]	12,985	10,449
6.	Kerala	348,443	304,808
7.	Karnataka	127,968	162,962
8.	Goa[3]	35,874	34,995
9	Maharashtra	267,527	256,369
10.	Gujarat	196,437	241,640
11.	Andamans	4,284	1,919
12.	Lakshadweep	3,810	3,907
	Total	14,16,219	14,21,233

* Prepared by Fishery Resources Assessment Division.

1. From 1982 onwards the marine fish production in India is furnished on a financial year basis instead of calendar year and accordingly the figures for the period from April 1982 to March 1983 are furnished. This has been given effect to meet the requirements of the various central and state Governments and other end users.

2. Excluding Mahe and Yenam which are included in Kerala and Andhra Pradesh respectively.

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

N. B:- For Andamans and Lakshadweep the figures were obtained from the Governments of the respective Union Territories.

Pelagic and demersal group of fishes

In Table 2, the specieswise composition of total marine fish landings in India is shown. The species were grouped into pelagic and demersal. The pelagic group of species comprises wolf herring, oil sardine, other sardine, hilsa shad, other shads, anchovies, other clupeoids, Bombay duck, half beaks, full beaks, flying fishes, ribbon fishes, carangids, mackerel, seer fishes, tunnies, bill fishes, baracudas, mullets and unicorn cod. Elasmobranchs, eels, catfishes, lizard fishes, perches, goat fishes, threadfins, croakers, silver bellies, big jawed jumper, pomfrets, flatfishes, prawns, lobsters, crabs, stomatopods and cephalopods from the demersal group. The statewise break-up of pelagic and demersal group of fishes is shown in Table 3.

Table-3 State-wise break up of the landings of pelagic and demersal group of species during 1982-83 (in tonnes)

Sl. No.	State	Pelagic	Demersal	Total
1.	West Bengal	9,301	13,143	22,444
2.	Orissa	14,639	18,851	33.490
3.	Andhra Pradesh	63,529	62,475	126,004
4.	Tamil Nadu	92,259	143,694	235,953
5.	Pondicherry	7,294	5,691	12,985
6	Kerala	240,734	107,709	348,443
7.	Karnataka	77,264	50,704	127,968
8.	Goa	12,938	22,936	35,874
9.	Maharashtra	94,898	172,629	267,527
10.	Gujarat	78,931	117,506	196,437
11	Andamans	2,617	1,667	4,284
12.	Lakshadweep	517	3,293	3,810
	Total	694,921	720,298	14,15,219

From Table 3, it is seen that Kerala accounted for the highest catch of pelagic group of species during 1982-83, followed by Maharashtra, Tamil Nadu, Gujarat, Karnataka and Andhra Pradesh in the order of abundance. As regards demersal group of fishes, Maharashtra accounted for the maximum, followed by Tamil Nadu, Gujarat, Kerala, Andhra Pradesh and Karnataka. Figs. 1 and 2 shows the comparative landings of oil sardine, Bombay duck, anchovies, other sardines, ribbon fishes and mackerel belonging to the pelagic group and penaeid prawns, croakers, silverbellies, elasmobranchs, catfishes and non-penaeid prawns of demersal group of fishes during 1982-83 and 1981-82.

Statewise marine fish production

West Bengal

During 1982-83, the total marine fish landings in West Bengal were estimated at about 22,400 tonnes in comparison to about 28,000 tonnes recorded in 1981-82, showing

a decline of about 5,600 tonnes. This was due to reduced landings of cat fishes, hilsa shad, other clupeiods and seer fishes by about 6,200, 1,600, 1,200 and 200 tonnes respectively. The landings of croakers, pomfrets, wolf herring and Bombay duck, however, showed an increase of 960, 950, 700 and 690 tonnes respectively.

Orissa

The total catch in Orissa during 1982-83 increased marginally to about 33,500 tonnes from 32,900 tonnes recorded in 1981-82. The landings of croakers, perches, anchovies, penaeid prawns and other sardines increased by about 1,900, 1,300, 1,200, 700 and 280 tonnes respectively. Cat fishes, elasmobranchs, other clupeiods and pomfrets, however, recorded lower landings by 1,900, 1,700, 260 and 230 tonnes respectively.

Andhra Pradesh

During 1982-83, the total marine fish landings in Andhra Pradesh was about 126,000 tonnes as compared to about 108,000 tonnes recorded in 1981-82, showing an increase of about 18,000 tonnes (17%). This was due to higher landings of elasmobranchs, non-penaeid prawns, seer fishes, perches, penaeid prawns, croakers and ribbon fishes whose landings increased by about 3,600, 3,300, 2,500, 2,200, 2,000, 1,700 and 1600 tonnes respectively The landings of anchovies, other sardines and silver bellies, however, declined by about 5,000, 1,500 and 500 tonnes respectively.

Tamil Nadu

The total landings in Tamil Nadu during 1982-83 did not show much variation as compared to 1981-82, the respective figures being about 236,000 and 235,400 tonnes. Perches, other sardines and elasmobranchs recorded higher landings, the increase being 5,500, 2,500 and 2,300 tonnes

respectively. The landings of silver bellies, croakers, penaeid prawns and carangids, however, showed decline, the reduction in their landings being 7,000, 3,400, 2,500 and 1700 tonnes respectively.

Pondicherry

An increase of about 2,500 tonnes (24%) in the total landings was noticed in Pondicherry during 1982-83 as compared to 1981-82. Higher landings of crabs, perches, carangids mackerel and other sardines were observed the increase being about 760, 580, 560, 460 and 230 tonnes respectively. The catch of anchovies, however, declined by about 60 tonnes.

Kerala

During 1982-83, the total marine fish landings increased to about 348,000 tonnes from about 305,000 tonnes recorded in 1981-82, the quantum of increase being about 43,000 tonnes (14%). The landings of penaeid prawns, anchovies, flat fishes, carangids, silver bellies and ribbon fishes showed an increase of about 10,500, 9,700, 7,500, 6,500, 6,000 and 4,000 tonnes respectively. The catch of oil sardines and mackerel however showed a decline of about 12,700 and 3,500 tonnes respectively.

Karnataka

The total landings in Karnataka during 1982-83 showed a substantial fall of about 35,000 tonnes (21%) as compared to 1981-82. This was due to significant reduction in the catch of oil sardine and mackerel, the decrease in their landings being about 38,000 and 9,000 tonnes respectively. Consequent to the failure of oil sardine and mackerel fisheries, reduction in the number of purse seine operations at Mangalore, Malpe, Ganguli and Bhatkal was observed. The landings of anchovies, seer fishes, penaied

prawns, cat fishes and threadfin breams however showed an increase of about 4,400, 3,000, 2,400, 1,600 and 1,500 tonnes respectively.

Goa

During 1982-83, the total catch in Goa showed a marginal increase of about 900 tonnes as compared to 1981-82. The salient feature of the fisheries of this state was that while mackerel and oil sardine recorded substantially lower catches, the reduction in their landings being about 5,500 and 4,200 tonnes respectively, penaeid prawns, anchovies, croakers and catfishes recorded higher landings, the increase in their catch being about 3,400, 2,000, 1,000 and 600 tonnes respectively.

Maharashtra

The total landing in Maharashtra during 1982-83 increased to about 268,000 tonnes from about 256,000 tonnes recorded in 1981-82. The landings of penaeid prawns, threadfin breams, ribbon fishes, non-penaeid prawns, croakers and catfishes showed an increase of about 12,900, 2,400, 1,900, 1,800, 700 and 500 tonnes respectively. Bombay duck and pomfrets, however recorded lower landings, the reduction in their landings being about 22,700 and 2,300 tonnes respectively.

Gujarat

In Gujarat, the total landings during 1982-83 declined sharply by about 45,000 tonnes (19%) as compared to 1981-82. This is mainly due to a significant fall in the landings of Bombay duck, the reduction in the catch being about 21,000 tonnes. Croakers, pomfrets, perches and ribbon fishes also recorded lesser landings by about 9,900, 9,300, 3,400 and 2,300 tonnes respectively. The landings of penaeid prawns, elasmobranchs, catfishes and non-penaeid prawns, however, showed an increase of about 1,100, 1,000, 800 and 600 tonnes respectively.

Andamans

A significant increase of about 2, 400 tonnes in the total catch was noticed in Andamans during 1982-83 as compared to 1981-82. This was due to higher landings of other sardines, silver bellies, perches and mackerel, the increase in their catch being about 1,000, 600, 260 and 210 tonnes respectively.

Lakshadweep

The total landings in Lakshadweep marginally declined by about 100 tonnes during 1982-83 as compared to 1981-82. While the catch of tunnies and perches declined by about 300 and 30 tonnes respectively, the landings of carangids showed an increase of about 100 tonnes.

Major groups of fishes

From Table 2. it is seen that oil sardine landings accounted for about 2.02 lakh tonnes forming about 14.2% of the total all India landings during 1982-83. The landings of other major groups of species in the order of abundance of their catch are penaeid prawns (117,000 t-8.3%), Bombay duck (90,000 t-6.4%), Croakers (82,000 t-5.8%), anchovies, (78,000 t-5.5%), silver bellies (70,000 t–5.0%), elasmobranchs (65,000 t-4.6%), catfishes (61,000 t 4.3%), other sardines (59,000 t-4.2%), non-penaeid prawns (56,000 t-4.0%), perches (50,000 t-3.5%), pomfrets (49,000 t-3.5%), ribbon fishes (48,000 t-3.4%) and mackerel (25,000 t-1.8%).

Pelagic group

1. Oil sardine

During 1982-83, the landings of oil sardine declined by about 54,000 tonnes (21%), the respective figures for 1982-83 and 1981-82 being 2,02,000 and 2,56,000 tonnes. This was due to reduced landings in the states of Karnataka,

Kerala and Goa, the decrease in the catch of oil sardine in the above states being about 37,800, 12,700 and 4,200 tonnes respectively. This was reflected in the poor catches of oil sardine in purse seiners in these states.

2. Bombay duck

A decline to the tune of about 42,000 tonnes (32%) in the landings of Bombay duck was noticed during 1982-83 as compared to 1981-82 the respective yields being about 90,000 and 1,33,000 tonnes. Both Maharashtra and Gujarat accounted for lower landings, the decrease in the landings in these states being about 23,000 and 21,000 tonnes respectively.

3. Anchovies

An increase of about 11,000 tonnes (16%) was noticed in the catch of anchovies during 1982-83 as compared to 1981-82, the respective catch figures being about 78,000 and 67,000 tonnes. An increase in the landings in the states of Kerala (9,700t), Karnataka (4,400t) and Goa (2100 t) contributed to the total all India higher landings. In Andhra Pradesh, however, the yield of anchovies showed a substantial fall of about 5000 t.

4. Other Sardines

The landings of other sardines showed a marginal increase of about 1,600 tonnes during 1982-83 as compared to 1981-82, the respective yields being about 59100 and 57000 tonnes. While the catch increased in the states of Tamil Nadu (2,500 t), Orissa (300 t) and Pondicherry (200 t), Andhra Pradesh recorded a lower catch, the decline being about 1,500 tonnes.

5. Ribbon fishes

There was an increase in the landings of ribbon fishes to the tune of about 5,400 tonnes during 1982-83 as compared

to that of 1981–82 the respective landings being 47,000 and 42,200 tonnes. While an increase in the landings was observed in the states of Kerala (4000 t), Maharashtra (1,900 t) and Andhra Pradesh (1600 t), a decline in the catches to the tune of about 2,300 tonnes was noticed in Gujarat.

6. Mackerel

The landings of mackerel (25,000 t) during the year was the lowest ever recorded in the last one decade, the reduction in the catches during 1982–83 as compared to 1981–82, being 17,300 tonnes. Decline was observed in the states of Karnataka, Goa and Kerala wherein mackerel forms a major fishery, the reduction in the catch in these states being about 9,100 t, 5,500 and 3,500 tonnes respectively.

DEMERSAL GROUP

Penaeid prawns

The landings of penaeid prawns during 1982-83 increased significantly by about 30,000 tonnes (35%) as compared to 1981-82, the landings during the two years being about 117,000 and 87,000 tonnes respectively. Higher landings were recorded in all the maritime states except West Bengal, Tamil Nadu and Pondicherry. A substantial increase in the catch was particularly noticed in the states of Maharashtra (13,000t), Kerala (10,500t), Goa (3,400 t), Karnataka (2,400 t), Andhra Pradesh (2,000 t) and Gujarat (1100 t). In Tamil Nadu, however, there was a reduction in the landings to the tune of about 2,500 tonnes.

Croakers

The landings of croakers declined to 82,200 tonnes during 1982-83 from 86,700 tonnes recorded during 1981 - 82, showing a marginal decline of about 4,500 tonnes (5%). This was due to a decrease in the landings in the states

of Gujarat (9,900 t), and Tamil Nadu (3,400 t). The yield, however, showed an increase in the states of Orissa (1,900 t), Andhra Pradesh (1,700 t), Goa (960 t) and Maharashtra (710 t).

Silver bellies

An increase of about 2,100 tonnes in the catch of silver bellies was observed during 1982-83 as compared to 1981-82, the yield for the two years being about 70,100 and 68,000 tonnes respectively. While there was an increase in the catch in Kerala (6,000 t) and in Andamans (600 t) there was a decrease in the landings in Tamil Nadu (7,000 t) and Andhra Pradesh (500 t)

Elasmobranchs

The landings of elasmobranchs showed an increase of about 9,400 tonnes (17%) during 1982-83 in comparison to 1981-82, the yield for the two years being about 65,100 and 55,700 tonnes respectively. This was due to an increase in the catch in the states of Andhra Pradesh (3,600 t), Tamil Nadu (2,300 t) and Gujarat (1,000 t). In Orissa, however, the yield showed a decrease of about 1,700 tonnes.

Cat fishes

A fall of about 4,100 tonnes (6%) in the yield of cat fishes was noticed during 1982-83 as compared to 1981-82, the respective catch figures being about 60,800 and 64,900 tonnes. A substantial reduction in the catch was noticed in the states of West Bengal (6,200 t) and Orissa (1,900 t) However, Karnataka (1,600 t), Gujarat (800 t), Kerala (600 t), Goa (600 t) and Maharashtra (500 t), showed an increase in the yield.

Non-penaeid prawns

An increase of about 5,100 tonnes in the landings of non-penaeid prawns was noticed during 1982-83 in comparison

to 1981-82. This was due to enhanced landings in the states of Andhra Pradesh (3,300 t), Maharashtra (1,800 t) and Gujarat (550 t).

Perches

A significant increase to the tune of about 14,000 t (40%) was observed in the landings of perches during 1982-83 as compared to 1981-82, the respective figures being about 50,000 and 36,000 tonnes. The states that mainly contributed to this increase were Tamil Nadu (5500 t), Maharashtra (4100 t), Andhra Pradesh (2,200 t), Karnataka (1,800 t), Kerala (1,600 t) and Orissa (1,300 t), However a a decline of the order of 3,400 t was observed in Gujarat.

Pomfrets

There was an over all decline of about 3600 tonnes in the landings of pomfrets during the period under review, when compared to that of 1981-82, the respective figures being 48,900 and 52,500 tonnes. While in the states of Gujarat and Maharashtra a decline in the landings of the order of 9,300 and 2,300 tonnes respectively was observed, an increase to the extent of about 3000 tonnes catch was noted in the states of Kerala and Karnataka.

Frame Survey (FSS/FRA/FS-1.2)

Data on village schedules were analysed and tehsilwise census data were tabulated. Reports on the same for various maritime states of India are under preparation.

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

Code lists in respect of landing centres, fishing crafts and gears and common fish and shell fishes were sent to the field staff for entering the same in the revised proformae and the coded data were retrieved for processing. A significant achievement during the year was the holding of a National Workshop on "Acquisition and dissemination of

data on marine living resources of Indian Seas" at the Institute. A number of useful recommendations were made by the Workshop. Proformae developed by C.M.F R.I. for the collection of catch data from non - mechanised boat, small mechanised boats and larger vessels were reviewed and finalised.

Data relating to marine fish catch statistics were furnished to the end users.

Standardisation of fishing craft (FSS/FRA/1.4)

Using a multiplicative model for catch per unit effort, standardised effort was obtained in respect of three types of boats viz. pablo, pomfret (Royya) and sorrah operating from Kakinada Fisheries Harbour. Pomfret (Royya) type of boat was considered as the standard. The analysis revealed that the catch per unit effort based on adjusted effort remained more or less the same over the years.

Survey of estuarine fisheries (FSS/FRA 1.5)

Investigations were carried out in Vembanad lake and the design for pilot survey has been improved. Different sampling designs are planned for chinese dip nets, stake nets and free nets. For Chinese dip nets, the design suggested is two stage sampling with centre-day as psu and cluster of nets as ssu. For stake nets, a three stage design with centre day as psu, row of nets as ssu and a cluster of nets within row as tsu is suggested. For free nets, however, the design followed to estimate marine fish landings may be adopted.

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

Estimates of statewise and specieswise marine fish landings along with fishing effort from mechanised and non-mechanised boats and of catch and effort at important fisheries

harbours/mechanised landing centres for the year 1981 were finalised and published in M. F. I. S. No. 41.

Districtwise, quarterwise, gearwise and specieswise estimates for different maritime states for 1981 are under preparation.

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

Using a constant model with the smoothing value as 0.25 the forecast for 1982 was found to be 1.39 million tonnes. Assuming 1.39 million tonnes as the estimated total marine fish landings in India, the forecast for 1983 is found to be 1.25 million tonnes.

Determination of sample size for length frequency studies (FSS/FRA/1.15)

Data were generated for certain ranges of lengths of oil sardine. The relationship of the variance on range has been studied. On its basis minimum sample size required in respect of certain ranges for a desired precision have been worked out.:

Stock assessment of commercially important fishes of the exploited zone (IDP/15)

Catch and effort data on prawns exploited in Cochin area for the years 1981 and 1982 were compiled and the biological data on *P. stylifera* for the years 1977, '78 & '79 and *M. dobsoni* for 1977 were analysed.

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

Regular classes for CAS (Mariculoure) students of M. Sc. and Ph. D. were taken up on fishery statistics including population dynamics

Personnel associated with various research projects in the Fisheries Resources Assessment Division

HEADQUARTERS

G. Venkataraman; T. Jacob; K. Alagaraja; S. K. Dharma Raja; K. N. Kurup; K. Balan; M. Srinath; C. R. Shunmughavelu; G. Balakrishnan; U. K. Sathyavan; K Vijayalekshmi; Varughese Philipose; K. C. Yohannan; P. K. Mahadevan Pillai; Varughese Jacob; G. Krishnankutty Nair; P. Sivaraman; R. Rajendran; V. P. Annam; Abha Kant; A. Kanakkan; S. Haja Najeemudeen; C. J. Prasad; P. L. Ammini; N. Jayabalan; Joseph Andrews; S. S. Sugawekar; M. B. Seynudeen; K. P. George; P. P. Pavithran; M. Ramachandran; A. Anandan; P. T. Mani; Lata Thote; and M. R. Beena.

OUT STATIONS

Pulin Behari Dey; Sapan Kumar Ghosh; Sukdev Bar; K. Dhanaraju; K. Ramasomayajulu; V. Achutha Rao; M. Radhakrishnan; S. Sathya Rao; C. V. Seshagiri Rao; K. V. S. Seshagiri Rao; P. Ananda Rao; T. Chandrasekhara Rao; G. C. Lakshmaiah; M. Chandrasekhar; K. Chittibabu; A. Agastheesa Pillai Mudaliar; M. Mohamed Sultan; M. Bose; S. Manivasagam; L. Chidambaram; A. Sreenivasan; L. Jeyasankaran; R. Somu; A. Ganapathy; P. Palani; A. Kumar; Hameed Batcha; K. S. Krishnan; S. Sankaralingam; R. Subramanian; R. Gurusamy, N. Retnaswamy, I. P. Ebenezar; K. Ramakrishnan Nair; S. R. C. Samuel; N. Varatharajan; M. Manivasagam; V. Thanapathi; C. Kasinathan; S. Subramani; O. M. M. J. Habeeb Mohamed; H. Kather Batcha; V. Sivasamy; K. Muniyandi; Jacob Jerald Joel; R. Bhaskaran Achari; T. G. VijayaWarrier; M. Babu Philip; V. S. Gopal; C. K. Krishnan; T. Girijavallabhan; K. Soman; T. Krishnankutty; S. B. Chandrangathan; P. Karunakaran Nair; K. Thulasidas; N. Palaniswamy; A. A. Thankappan; S. Siddalingaiah; H. S. Mahadevaswamy; Devidas Y. Naik; K. Chandran;

B. Sreedhara; M. Padmasekhara; Maruthy Sankar Naik; Ahamed Kamal Basha; T. S. Balasubramanian; A. Prosper; R. G. Kamulkar; Ramados Gandhi; D. G. Jadhav; M. Shriram; J. L. Oza; S. D. Kamble; R. Dias Johny; C. J. Josekutty; K. B. Waghmare; M. Chellappa; Y. D. Savaria; B. V. Makadia; Y. V. Venkatachala Moorthy; P. M. Dalwadi; and H. A. Mahida.

FISHERY ECONOMICS AND EXTENSION DIVISION

The Division came into existence in April 1982. During the year 9 research projects were operated. The salient features pertaining to the projects are given below.

Studies of small-scale fisheries at selected centres for an integrated development of coastal rural sector (E & FE/1)

R. Sathiadhas and K. K. P. Panikkar.

(i) Pair trawling operations at Palk Bay: A study on the economics of pair trawling, a newly introduced fishing technique in the Palk Bay, Tamil Nadu was conducted in 1982 and a report was prepared and published. The study indicated that the introduction of pair trawling resulted in heavy landings of pomfret in February - April 1983 which were estimated at 346 tonnes. The pomfret catch per unit per day of operation worked out to 324 Kgs. On an average the gross income per trip worked out to Rs. 2,800 against the operational cost of Rs. 1,200. However, the unprecedented heavy catch posed problems in disposal resulting in a glut in the market. The infrastructure facilities need to be strengthened to cope up with such short - term spurts in landings. The details have been published in MFIS V. No 39.

(ii) Motorisation of catamarans in Kanyakumari and Tirunelveli Districts in Tamil Nadu: An impact study on the mechanisation of indigenous crafts with outboard motors in two districts of Tamil Nadu has been conducted and the

results published. The study indicated that due to motorisation of catamarans employment opportunities doubled and gross returns increased to Rs. 500 per trip which is about 6 times that of non - motorised catamarans. Details of the findings are given in MFIS V. No. 38.

A study on the impact of purse-seine operation on the socio-economic conditions of the traditional fishermen at selected centres (E & FE/2)

T. Jacob, S. K. Dharma Raja and K. K. P. Panikkar.

A study on the impact of purse-seine operation on socio-economic conditions of traditional fishermen in Kerala coast with special reference to oil sardine fishery was conducted. Manifestation of the purse seining impact, though noticed, was not on a large scale in 1980. The dwindled availability or decrease in the stock might have effected the catches of the artisanal gears operating in the nearshore waters. The diminished interest shown by artisanal fishermen due to reduced returns also might have brought about a reduction in the landings in 1980. However, in 1981 the oil sardine fishery improved remarkably consequent on better availability and increased effort. The effect of purse seining, at the present level of exploitation and availability, was not tangibly felt on the indigenous fishery off Kerala coast. Details are given in MFIS V. No. 40.

Price spread at selected fish markets (E & FE/3)

K. K. P. Panikkar, R. Sathiadhas and Syed Basheeruddin.

Fishermen's share in consumer's one rupee was estimated for some of the commercially important species marketed at Sakthikulangara landing centre in Kerala state. Components of marketing margins of these species were also studied in detail bringing out the margins of intermediaries and marketing expenditure. The study revealed that the fishermen's share in consumer's one rupee for quality fish like seer fish

was about 65 paise and for other varieties like lizard and flat fish which were comparatively cheaper, it was in the range of 30 to 40 paise. Marketing expenses worked out to about 7 paise for all species.

Economics of mechanised fishing units (E & FE/4)

K. K. P. Panikkar and R. Sathiadhas.

Input-output relationship in trawl fishing has been studied utilising data on 50 trawlers which operated in Calicut area of Kerala State and a report was prepared. The study indicated that 'days fished' was the most important variable that influenced the gross returns and the fishing surplus. The frequent increase in oil price during the previous decade has been more than compensated by the rise in prawn prices. The production elasticities of 'days fished' worked out to 1.10 and fuel expenditure 0.71. A detailed report has been prepared for publication.

Economic evaluation of paddy-cum-prawn culture (E&FE/5)

R. Sathiadhas, K. K. P. Panikkar, T. Jacob and U. K. Satyavan.

Data from 70 holdings covering about 160 hectares in Vypeen-Parur area of Kerala state were analysed. The average yield of paddy was estimated as 23 quintals valued at Rs. 3,600 as against the operational expenditure of Rs. 3,100. Prawn production per hectare worked out to 515 Kgs and fish production 100 kgs, the total value being Rs. 5,800. The average expenditure for prawn filtration came about Rs. 5,100 per hectare.

Role of women in small-scale fisheries (E & FE/6)

Krishna Srinath

The data collection for all the eleven marine fishing villages in the Vypeen island in Kerala state was completed. The study showed that women were found engaged themselves

in fish trading, curing, prawn peeling, net making and fishing in the canals on leisure time basis. Their occupation to some extent, was governed by the caste. They did play a role in decision making in the family matters. Most of them were literates and were susceptible to change. Details of the findings are being consolidated for publication.

Study on the introduction of outboard engine and its impact on the socio-economic conditions of the fisherfolk in Kerala coast (E & FE/7)

K. Balan, K. K. P. Panikkar, T. Jacob and Joseph Andrews.

After a preliminary survey of entire Kerala coast part of the data pertaining to daily cost and revenue of 112 selected boats from 8 centres between Munambam and Sakthikulangara have been collected. The analysis of data indicated that the gross income per day per boat after deducting fuel charges ranged from Rs. 129 at Munambam to Rs. 374 at Kattoor. It was observed that the plank built boat operating hooks and lines was the most efficient craft-gear combination registering a higher level of fishing surplus.

Energy utilisation of different types of mechanised boats (E & FE/8)

T. Jacob, K. K. P. Panikkar, S. S. Dan and U. K. Satyavan.

The study showed that a total 185 million litres of diesel oil was consumed per annum for operation of mechanised boats in the Indian coast. Tamil Nadu accounted for 22% of diesel consumption followed by Kerala (19%), Maharashtra and Gujarat (10% each). The total value of the fuel worked out to about Rs. 680 million.

Study on income, consumption employment pattern and credit facilities available to fishermen in North West coast (E & FE/9)

D. B. S. Sehara, R. Sathiadhas and J. P. Karbhari.

Two schedules have been formulated to collect the information, one for village level data and the other for household data. After a preliminary investigation in Maharashtra and Gujarat coasts village level data have been collected for 32 villages. Out of these, 7 villages have been selected for intensive study. The household enumeration work has been completed for 3 villages in Maharashtra and 4 villages in Gujarat. The field work continued.

PELAGIC FISHERIES DIVISION

The major programmes of research activities, in the Pelagic Fisheries Division, were mainly on capture fisheries carried out under 12 projects. The investigations carried out during 1982-83 were concerned with monitoring and evaluation of resource characteristics and stock assessment of the oil sardine, mackerel, Bombay duck, lesser sardines whitebait, tunas and billfishes, pomfrets, carangids and other major exploited pelagic fisheries. The scientists of the Division were also involved in Inter-Divisional and Inter-Institutional projects; besides being actively associated with the Teaching programme at postgraduate level under the Centre for Advanced Studies in Mariculture. The studies on the unit stocks of pelagic species were concluded and the results were given in a detailed report. Good progress has been achieved under various projects during the year.

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The yield from the pomfret, whitebait, lesser sardine, Bombay duck and carangid fisheries was comparatively better during the year than previous year. In others it was lower. Two peak periods of abundance during Feb.-May

and Oct.-Dec. were observed for the most of the pelagic fisheries. By increasing fishing pressure during the above periods, increased catches from these fisheries could be realized.

In most species two peak periods of spawning and recruitment were evident. Small meshed bagnets employed by the artisanal sector, purse seines and trawls by the mechanised sector took heavy toll of juvenile mackerel, oil sardine, Bombay duck and pomfrets from the inshore nursery grounds. This is so, for oil sardine and mackerel during May-July at the southern centres and during August-October at the northern Centres. For Bombay duck and pomfret heavy landings of juveniles were reported during February-April and Sept.-Oct. by dol net and shrimp trawl along the Saurashtra & Northern Maharashtra coast. Fishing the juveniles, before their full growth, is a wasteful utilisation of the resource and calls for appropriate conservatory measures.

The electrophoretic studies in resolving the unit stocks of Bombay duck, mackerel and oil sardine were concluded. The results indicate the absence of intraspecies polymorphism in Bombay duck samples tested from different Centres from Bombay region, suggesting that they are not suitable for delineation of Unit stocks, unless otherwise proved by samples drawn from distant regions. Though electrophoretic patterns of lactate dehydrogenase, esterase, superoxide dismutase and general proteins resolved and detected in a few specimens of mackerel and oil sardine are encouraging, their potential application for unit stock studies is yet to be determined.

Resources of tunas and billfishes (FB/PR/3·1)

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

Research activities under the project were mainly centred around the collection of information of the resources, present

trend of exploitation and biology of tunas and billfishes taken by various gears from the inshore waters of the mainland and from Minicoy Island.

All India tuna landings in 1982 have provisionally been estimated as 22,372 tonnes which indicate an increase of about 6,100 tonnes from the landings in 1981. Analysis of the state-wise landings of tunas indicate that except in Tamilnadu, Goa, Gujarat and Andaman and Nicobar Islands in all the other states tuna landing showed an increasing trend. About 34% of the total all India tuna landings was from Kerala and Tamilnadu accounted for about 17% of the total catch. Maharashtra, U. T. of Lakshadweep and Gujarat accounted for 15%, 10% and 7% of the total all Indian tuna catch respectively.

Among tuna and billfish landings at different centres, tunas constituted more than 90% of the total catch. At Minicoy, tuna fishery was supported by *K. pelamis* and *T. albacares* followed by *E. affinis*. Off the mainland of India the species which supported tuna fishery were *E. affinis A. thazard, A. rochei, S. orientalis, T. tonggol, T. albacares* and *K. pelamis* in the order of abundance. Among the billfishes, *I. platypterus* and *M. indica* made up the major share.

Gear-wise estimated annual total effort, catch and CPUE for tunas and billfishes at the observation centres are given in Table 1. In all the centres except in Minicoy and Mangalore, a declining trend in the fishing effort and in the CPUE (gear-wise) during 1982-83 was observed when compared to those in 1981-82. This is, however, in contrast with the increased trend in the State-wise and all India tuna production. Drift gillnet landings indicated a distinct declining trend at all the observation centres (Table 1). Purse seine landings also

evinced declining trend at Mangalore when compared to the landings in 1981–82. The set back in tuna fishery in 1982-83 observed at Tuticorin was due to social problems developed in the operation of the non-mechanised and mechanised crafts at the major tuna landing centres at Veerapandiapatinam.

Month-wise and gear-wise estimated CPUE of tunas at different centres is given in Table 2. Productive period for tuna fishery at different centres during 1982-83 is summarised below :

Minicoy	: Jan - May	Vizhinjam	:	March	- May
Goa	: Oct - Nov			Sept	- Oct
Mangalore	: Sept - Nov	Tuticorin	:	July	- August
Calicut	: April - June	Madras	:	Feb	- April
Cochin	: April - July	Waltair	:	Aug	- Nov

A variety of gears were used to exploit tunas and bill-fishes at the centres where monitoring of the landings were carried out (Table 3). At Minicoy, pole and line fishery was responsible for the landing of 98% of tunas. In all the centres except in Mangalore and Waltair, drift gillnet was responsible for more than 75% of the tuna landings. At Mangalore, purse seines landed 78% of total tunas and at Waltair Hooks and lines landed 97.5% of tuna catches.

Both mechanised and non-mechanised crafts were employed in the tuna fishery at the above centres. At Calangute and Vasco-Baina centres in Goa, country crafts fitted with Kirloskar inboard Diesel engines (7.5 - 10 Hp) and Yamaha outboard Kerosene engines (8 Hp) were used widely in the drift gillnet fishery.

Annual percentage composition of different species of tunas landed by different gears during 1982 - '83 is detailed in Table 3. *K. pelamis*

Table. 1. Estimated Total Report, Catch and CPUE (Gear-Wise) for Tunas and Bill Fishes at Different Centres (1982 - 1983)

Centre	Gear	Catch (tonnes)		Effort		CPUE (Kg)	
		(82-83)	(81-82)	(82-83)	(81-82)	(82-83)	(81-82)
Minicoy	PL	372.0	310.0	1112	1,201	335.0	259.0
	TRL	9.0	10.0	134	131	64.0	79.0
Goa	DGN	18.0	43.0	5176	4,642	3.5	9.3
	PS	2.2	—	3	—	748.7	—
Mangalore	PS	430.0	1,766.5	16,175	1,03,905	26.6	17.0
	DGN	119.2	140.9	27,527	35,136	4.3	4.0
Calicut	DGN	15.6	123.0	4,034	4,248	3.8	29.2
Cochin	DGN	750.0	1,275.0	19,347	21,566	38.8	59.1
	PS	14.0	124.2	7,940	10,001	1.8	12.4
Vizhinjam	DGN	181.0	353.8	15,719	19,638	11.5	18.0
	H & L	64.2	61.3	63,193	77,123	1.1	1.7
Tuticorin	DGN	128.2	1,226.8	4,823	6,944	26.6	176.7
	TRL	1.9	1.1	1,755	2,649	1.1	0.4
Madras	DGN	14.3	39.2	12,092	13,012	1.19	—
Waltair	SS	0.2	0.3	972	1,144	0.2	0.3
	DGN	1.2	0.2	7,792	7,228	0.2	0.03
	H &L	50.9	36.1	34,425	36,718	1.5	0.90

DGN = Drift gill net, PL = Pole & line, TRL = Surface trol lines, PS = Purse seine
H & L = Hooks & line, SS = Shore seine.

constituted 89.8% of the tuna landed at Minicoy. At Mangalore, Calicut, Vizhinjam, Tuticorin, Madras and Waltair *E. affinis* constituted more than 70% of the tunas landed. At Goa, *T. tonggol* contributed to 75.8% and at Cochin *A. thazard* constituted 55% of the total tuna catch.

Observed ranges in size (cm) of different species and the dominant modes are presented in Table 4. Small sized specimens of major species of coastal tunas were present in the fishery at selected centres as follows:

	Minicoy	Mangalore	Cochin	Tuticorin
K. pelamis	28 (Jan)	—	—	—
T. albacares	25 (Jan)	—	—	—
E. affinis		24 (Oct)	18 (March)	20 (July)
A. thazard		22 (Oct)	22 (Feb)	22 (July)
S. orientalis		24 (Oct)	—	—
T. tonggol		30 (Oct)	24 (March)	—

Observed male:female ratio and maturity stages of different species (annual) percentage composition) at Minicoy and Mangalore where investigations on these lines were carried out are presented in Table 5. The occurrence of ripe and spent specimens of *E. affinis*, *A. thazard* and *A. rochei* in good numbers indicate that these species spawn in the coastal waters of Mangalore during the period of their abundance.

The main tuna live-bait fishes used in the pole and line fishery during 1982-83 were *Caesio* & *Chromis* spp., *Apogon* spp. and Sprats.

Table 2. Month-Wise CPUE for Tunas and Bill Fishes at Different Centres (April 1982 to March 1983)

	Minicoy		Goa		Mangalore			Calicut	Cochin	
	PL	STR	DGN	PS	DGN (NM)	DGN (M)	PS	DGN	DGN	PS
Apr.	523.25	—	—	—	—	—	19.71	22.0	78.29	1.21
May	324.81	—	1.55	—	—	—	7.32	6.24	31.83	10.10
June	26.67	58.88	—	—	—	—	—	12.50	62.40	—
July	—	48.58	—	—	—	—	—	—	85.01	—
Aug.	—	7.16	—	—	—	—	—	—	25.37	—
Sept.	475.00	20.33	—	—	6.86	11.19	6.27	4.03	33.53	0.32
Oct.	296.78	327.19	8.70	770.0	9.61	15.87	3.30	0.81	3.27	—
Nov.	158.79	43.80	8.63	—	4.22	4.78	—	0.16	0.55	—
Dec.	186.57	100.73	4.25	—	0.15	0.41	—	0.62	0.09	—
Jan.	402.50	169.93	—	—	—	0.05	—	—	2.99	—
Feb.	294.74	50.00	—	—	0.14	0.06	—	—	9.96	—
Mar.	294.67	41.43	—	—	0.14	0.05	3.09	0.65	6.65	1.85

	Vizhinjam					Tuticorin		Madras		Waltair	
	DGN (NM)	DGN (M)	H&L (NM)	H&L (M)	SS	DGN	STR	DGN	DGN	SS	H&L
Apr.	8.99	24.47	1.55	—	—	6.7	0.02	1.88	—	—	0.16
May	18.69	42.72	2.47	—	—	0.6	0.06	1.0	0.09	—	0.56
June	1.0	19.92	0.43	—	—	9.3	0.05	1.14	0.17	—	1.07
July	—	—	—	—	—	66.3	—	1.24	0.48	—	0.52
Aug.	—	—	—	—	—	10.0	0.01	0.65	—	—	1.75
Sept.	27.1	37.41	0.14	—	—	4.0	1.7	0 24	0.63	—	0.50
Oct.	9.52	32.01	—	—	—	—	—	0.18	—	—	1.41
Nov.	9.43	—	1.39	—	—	0.5	0.5	—	—	—	2.11
Dec.	4.54	—	1.17	—	—	—	5.4	—	—	22.71	1.53
Jan.	1.92	—	0.15	13.66	—	0.3	—	0.4	—	—	0.33
Feb.	7.5	—	1.10	4.46	—	3.4	—	2.07	—	—	0.40
Mar.	2.39	—	1.69	47.55	—	0.1	—	1.05	—	—	0.32

PL = Pole & line, STR = Surface trol line, H&L = Hooks & line, SS = Shore seine, PS = Purse seine, DGN = Drift gill net.

Table 3. Estimated Total Catch, Gear - Wise Catch (%) and Species - Wise Percentage Composition of Tunas and Bill Fishes at Different Centres (April 1982 to March 1983)

Gear	Gear	Catch (Kg)	% Gear-wise	K. pelamis	T. albacares	E. affinis	A. thazard	T. tonggol	A. rochei	S. orientalis	Bill fishes
Minicoy	PL	3,72,397	98·0	89·8	9·8	0·02	0·1	—	—	—	0·3
	STR	8,603	2·0								
Goa	DGN	18,266	89·0	—	—	24·2	—	75·8	—	—	—
	PS	2,240	11·0								
Mangalore	DGN	1,19,196	22·0	—	—	73·5	12·3	4·7	6·9	0·02	2·6
	PS	4,30,125	78·0								
Calicut	DGN	15,627	100·0	—	—	92·8	7·2	—	—	—	—
Cochin	DGN	7,50,021	98·0								
	PS	14,015	2·0	0·01	0·2	42·7	54·8	0·5	0·4	0·8	0·7
Vizhinjam	DGN	1,80,600	74·0								
	H&L	64,233	26·0	0·3	2·9	72·1	15·1	1·4	6·6	1·6	—
Tuticorin	DGN	1,28,288	98·5								
	TL	1,931	1·5	0·06	1·6	77·7	11·8	0·04	—	7·6	0·2
Madras	DGN	14,377	100·0	5·8	0·5	88·6	5·1	—	—	—	—
	DGN	1,156	2·2								
Waltair	H&L	50,861	97·5	2·1	12 8	51·7	—	0·3	—	—	33·1
	SS	159	0·3								

DGN = Drift gill net, PL = Pole & line, STR = Surface trol lines, PS = Purse seine
H & L = Hooks and line, SS = Shore seines.

Table 4. Observed Range in Size (Cm) and Major Modes of Tuna Species at Different Centres (1982 - 83)

Centre	*K. pelamis*	*T. albacares*	*E. affinis*	*A. thazard*	*A. rochei*	*T. tonggol*	*S. orientalis*
Minicoy	28-68 (48-50)	25-111 (43-46)	—	—	—	—	—
Goa	27-90	—	27-90	—	—	31-71	—
Mangalore	—	—	24-69 (50-58)	20-49 (29)	22-48 (24)	28-82 (40-50)	21-48 (25)
Calicut	—	—	50-64 (60)	—	—	—	—
Cochin	—	—	18-70 (58)	22-48 (38)	—	24-68 (46)	40-58 (46-48)
Tuticorin	—	—	30-70 (52)	22-44 (38)	—	—	36-54 (44)
Vizhinjam	—	—	28-72 (32-60)	26-42 (28-34)	20-30 (24)	—	22-28 (22)

Figure in paranthesis are major modes observed during the period.

Table 5. Sex Ratio and Maturity of Tuna Species at Minicoy and Mangalore (1982 - 1983)

Centre	MINICOY		MANGALORE		
	K. pelamis	*T. albacares*	*T. tonggol*	*E. affinis*	*A. rochei*
M: F ratio	48 : 52	68 : 32	61 : 39	64 : 36	48 : 52
Maturity Stages					
II :	3%	31%	91%	—	—
III & IV :	43%	69%	9%	35%	61%
V & VI :	53%	—	—	64%	29%
Spent :	1%	—	—	1%	10%

This year also *Lepidozygus tapeinosoma* did not enter the Minicoy lagoon.

Induced breeding experiments were conducted on *Chromis caeruleus* and it was observed that only males responded to hormone injections. Further studies on these lines are in progress.

Resource Characteristics of Pomfrets (FB/PR/5.4)

M. H. DHULKHED, M. KUMARAN, V. M. DESHMUKH, M. ZAFAR KHAN, K. N. RAJAN, A. A. JAYAPRAKASH AND P. DEVADOS.

Investigations on the resource characteristics of pomfrets were continued during 1982-83 season at the observation centres.

Silver pomfret formed the exclusive fishery at Veraval, Bombay and Puri whereas at Calicut and Cochin *Parastromateus niger* were also landed. At Karwar and Mangalore all the three species, viz., silver, grey and black constituted the catches.

At Veraval, the fishery for silver pomfret was very poor due to the damage caused to a number of crafts by a severe cyclone in November 1982. At this centre, the estimated catch was 162 t only recording a decline of about 223 t over the previous year. The share of gill net and trawl net being 38% and 62% respectively. The highest cpue for gill net was 9.5 kg during the second quarter whereas for trawl net it was 3.30 kg. in the Jan - March period. At Rajpura, the *dol net* catch of silver pomfret amounted to 217 t. October-December period was more productive accounting 67% of the total annual catch. At Bombay the total catch was 755 t showing a marginal decrease of 15 t over the last season. The April-June period accounted for 40% of the total catch and the cpue being 376 kg.

Karwar witnessed bumper catches of black pomfret by the purse seines in October. The total catch amounted to 586 t as against mere 49 t in 1981-82. The silver, grey and black pomfrets contributed to 9.2%, 4.1% and 86.7% of the total pomfret landings respectively. The October-December period accounted for about 82% of the total catch and the cpue was 186 kg, however, for the year it was 79 kg. only. The annual catch at Mangalore was 131t, up on the catches of previous year by 28%. Silver, grey and black pomfrets amounted to 37 t, 0.3 t and 94 t respectively. The cpue of drift net was about 7 kg. whereas for the trawl it was 4.4 kg. At Kaup, a subsidiary centre of Mangalore where exclusively drift nets operate, the annual catch computed was 105 t showing an increase of 134% over the last year. The cpue was 12.4 Kg. At Calicut, silver and black pomfrets totalled 142 t; the percentage of the former and latter being 58% and 41.6% respectively. The catch of silver pomfret increased by about 50 t over the previous year whereas there was a decline of 53.7% in the case of black species. *Odam* vala and drift net accounted for 58.4% and 41.6% respectively of the total catch of black pomfret. The most productive period for black pomfrets was April-June when 55.7% of the total catch of this species was landed whereas for the silver pomfret it was October-December which accounted for 52.6% of the catch. The fishery for pomfret, during the period under report, at Cochin Fisheries Harbour landed an estimated catch of 149 t which showed a decline of 17% compared to last year. Drift net contributed to the bulk (69%) of the landings. Purse seine and trawler shared 26% and 5% of the landings. The fishery was supported by *P. niger* (72.7%) and *S. argenteus* (27.3%). The most productive period for the fishery was in May and September-October.

Silver pomfret measuring more than 150 mm supported the fishery. Young ones of this species (40 mm onwards) occurred in *dol* net catches at Veraval, during October,

February and March and in trawl nets at Veraval, Karwar, Mangalore and Cochin in the latter months. At Puri, these occurred from June to September. Black pomfret ranging more than 145 mm constituted the catches at Karwar, Calicut and Cochin. Young ones of this species occurred in February and March. At Karwar, the grey pomfret measuring more than 130 mm constituted the catches.

At Puri and Calicut, the silver pomfret were observed to be in advanced stages of maturity during the April-June period. At Calicut, the black pomfret were in gravid condition during May, June and March. Spent fish were encountered from April to June and again in March. Females of silver pomfret were dominant during April, August and from October to March at Puri whereas the males were preponderating during April-June at Calicut.

The food of *P. argenteus* at Puri consisted of hydromedusae. Other organisms found in small numbers were amphipods, copepods, *Acetes* and prawn larvae.

Unit stocks of oil sardine, mackerel and Bombay duck (FB/PR/6.1) (Final Report)

M. K. GEORGE, ALEXANDER KURIAN AND S.MUTHUSWAMY

The results of the investigations carried out on the unit stocks of oil sardine, mackerel and Bombay duck are presented in this final report. These results are described under four headings, namely: 1. Standardization of methods, 2. Results, 3. Conclusions and 4. Suggestions.

Standardization of methods

In the unit stock studies of any species using genetic/protein tags/markers revealed by electrophoresis, formulation or standardization of the electrophoretic procedures such as buffer systems, gel compositions, selection of suitable

tissues/body fluids, their extraction etc. is an essential primary requirement. In view of this, a few buffer systems, gel compositions and different tissues taken from the species under investigation were tested to resolve and detect electrophoretic pattern of a few soluble protein/isozymes. The details of the procedures employed are given below.

A. Gen. buffer systems (Tris-citric)

a)	1.	Tris (hydroxyl) Methylamine	0.030	M
	2.	Citric acid	0.005	M
b)	1.	Tris ...	0.072	M
	2.	Citric ...	0.023	M
c)	1.	Tris ...	0.050	M
	2.	Citric ...	0.008	M
d)	1.	Tris ...	0.260	M
	2.	Citric ...	0.086	M

B. Electrode buffer system (Lithium-Boric)

a)	1.	Lithium hydroxide	0.060	M
	2.	Boric acid	0.300	M
b)	1.	Lithium ...	0.030	M
	2.	Boric ...	0.191	M
c)	1.	Lithium ...	0.044	M
	2.	Boric ...	0.100	M
d)	1.	Tris ...	0.260	M
	2.	Citric ...	0.086	M

C. Gen. composition and preparation

Starch gel was prepared using chosen gel buffer system and taking 12 to 15% hydrolysed starch and 5 to 10%

sucrose per 100 ml. of buffer. Cooked starch was cast into a gel plate and allowed to cool for about 2 hrs. at room temp.

D. Extraction of samples

To study and select most suitable tissue (s) for electrophoresis, various tissues were tested extracting water soluble proteins/isozymes. Extraction of tissues was accomplished by homogenising the tissue in equal volume of distilled water with the help of a mechanical homogenizer or pestle and mortar. For preliminary experimental purposes, the homogenized tissue could be used without centrifugation or the clear supernatant obtained after centrifugation. Different tissues from one individual were extracted to study the tissue specific nature and one particular tissue from different individuals for individual variation.

E. Application of samples

To apply the sample for electrophoresis, chromatography paper No.3 NM cut into small square bits were saturated with the extracted samples and placed adjacently in a slit cut across the gel at a distance of 3.5 cms from one end of the gel.

F. Electrophoresis

The gel with the samples is placed across the electrode chambers containing the chosen electrode buffer. The gel-electrode buffer connection is established using suitable absorbent like surgical lint or filter or chromatography paper. A chosen rate of voltage is introduced across the gel and maintained it through out the experiment. The paper bits with the sample are removed after 30-45 minutes and the electrophoresis continued for about 5 to 15 hrs. depending on the experimental conditions selected.

G. **Detection of electrophoretic pattern of protein/ isozymes**

The gel, after electrophoresis, was removed and sliced into two horizontal halves. Each gel half was then stained for specific protein/isozyme using a specific staining method. The patterns developed on the gel after staining for 30 minutes to several hours (depending on the type of staining) were studied individually as well as comparatively.

Results

A. Bombay Duck (**Harpodon nehereus**)

Different tissues of Bombay duck were subjected to electrophoresis to resolve and detect isozymes like lactate dehydrogenase, superoxide dismutase, esterase and general protein like myogens. All the buffer systems described above were found to be suitable in this connection. Details of the results are given below:

Tissues like muscle, liver, heart, stomach, intestine, gill filaments, brain, ovary, kidney, eyevitreous were tested for *Lactate dehydrogenase* (LDH) activity and pattern. All the tissues had, atleast, one band strongly stained with additional one or more faintly stained bands. In general, all tissues tested appear to possess a tissue specific LDH pattern in comparative terms of number of bands or staining intensity or rate of electrophoretic mobility of different bands. Though muscle and liver had two bands of almost similar mobility, fast band of muscle was more strongly stained than that of liver and the nature of slow band was in reverse order. Moreover, in certain individuals muscle did not show the faint band. Whether this apparent variation is an artifact or sex, maturity and size dependent phenomenon is yet to be investigated. Tissues like muscle, liver, heart, stomach seem to be suitable for LDH investigation in Bombay duck (Fig. 1). Preliminary comparison of LDH pattern of a particular

tissue sample like muscle or liver from a single area or areas like Sasson dock, Versova, New Ferry Wharf, Bassen (Bombay) and Nawabunder (Gujarat) showed lack of variations indicating absence of intraspecies polymorphism at LDH locus.

Different tissues like muscle, liver, heart, eyevitreous, stomach, brain were tested for alpha naphthyl esterase activity. Only liver tissue showed clearly detectable level of this isozyme though eyevitreous, stomach and brain also indicated feeble activity of the same. The electrophoretic pattern of this enzyme in liver consisted of a clear, major slow moving band and two additional fast moving bands in most of the specimens tested. The absence of either the major slow band or minor fast bands or both in certain cases are interesting and deserve further investigation, (see suggestion). At esterase locus also, intraspecies polymorphism was not noticed in the specimens tested (Fig.2).

Among different tissues tested only liver indicated visible activity of the enzyme *Superoxide dismutase* (tetrazolium). The area of enzyme activity appears as an achromatic zone on the gel. This enzyme is also detectable and visible along with the LDH enzyme of liver as its activity revealed by oxidation of tetrazolium contained in the LDH staining solution. Its electrophoretic mobility is much faster than the fast band of LDH. The electrophoretic pattern of this enzyme in specimens tested was monomorphic. Its weak activity in maturing ovary is to be confirmed (Fig. 3).

Amidoblack or coomassie BB staining of muscle tissue for general proteins produced a single banded pattern in few specimens tested. More specimens are to be tested for more information (Fig.4).

B. Mackerel (Rastrelliger kanagurta)

Mackerel tested here were specimens occasionally available from landing centres at Bombay.

Various tissues like white and red muscles, liver, eyevitreous, eyelens, heart, brain and testis were tested for LDH activity. Though all the tissues appear to have atleast one band with apparent common electrophoretic mobility, the number of additional bands or staining intensity and rate of electrophoretic mobility etc. indicate tissue specific nature of this enzyme. White and red muscle LDH pattern differed as the latter had more intensively stained broad band, indicating probably quantitative and qualitative difference. Eyevitreous LDH with four band may be more tissue specific than all other tissues. Eyelens was devoid of LDH activity (Fig 5). Intraspecies variation of LDH is yet to be tested.

Among many tissues tested as above, red muscle and liver showed quite visible activity of the enzyme *Superoxide dismutase* (Tetrazolium Oxidase) in the form of achromatic zone moving ahead of slow LDH band. Possible intraspecies polymorphism at this locus will be known only after a detailed study of large number of specimens.

Liver, muscle and eye were tested *Esterase*. Liver showed two banded alpha naphthyl esterase activity whereas its feeble activity in eyevitreous is to be confirmed after repeated tests. Detailed study of the enzyme is desirable (Fig. 6).

General protein staining of different tissues using coomassie BB produced stained bands for white and red muscle. Red muscle appears to possess two clearly stained bands whereas white muscle had one clearly stained band and 4 weakly stained bands. Eyelens showed about 8 weakly stained faint bands four of which migrating towards cathode. All other tissues also appear to show some Weakly stained faint bands. . A detailed study of muscle and eyelens is desirable.

C. Oil sardine (Sardinella longiceps)

The few specimens tested here were collected from fish market and worli landing centre, Bombay.

Only muscle, liver, heart and eyevitreous were tested for LDH. Muscle and heart looked similar with two bands whereas eyevitreous had 3 bands with an additional band of medium mobility. Liver showed only one band. Detailed tests are necessary for more information (Fig.7)

Only eyevitreous and muscle were tested *Esterase*. The initial observation of four banded muscle esterase and three banded eye esterase patterns are to be confirmed after repeated and detailed tests (Fig. 6).

Muscle and liver were tested for the activity of Superoxide dismutase *(Tetrazolium oxidase)*. Only liver showed clear activity with single achromatic zone moving slower than LDH band of liver. Detailed study of large number of specimens is desirable to find our possible individual variation of this enzyme.

Coomassie BB staining of eyelens and muscle, for general proteins, showed five banded and three banded patterns respectively. A few bands of eyelens migrated cathodally. A detailed study of these proteins is desirable.

D. Species specificity of isozymes

Occasional inclusion of one or more similar tissues taken from the above three species, Bombay duck, Mackerel and Oil sardin in a single test has clearly showed species specificity of the isozymes described above, particularly in terms of electrophoretic mobility. Besides, other commercially important fish species available at Bombay, (*Nemipterus*, Pomfrets, Ribbon fishes, catfish etc) were also tested in order to evaluate the general efficiency of the electrophoretic method being followed. The method was found to be suitable to resolve and detect the isozymes described above in all these species.

Conclusions

Preliminary starch-gel electrophoresis using seven standardized buffer systems had satisfactorily resolved and separated different soluble proteins / isozymes (lactate dehydrogenase, Superoxide dismutase, esterase and general proteins) extracted from various tissues of Bombay duck *(Harpodon nehereus)* mackerel *(Rastrelliger kanagurta)* and oil sardine *(Sardinella longiceps)*.

Lactate dehydrogenase isozyme was found actively present in about eight different tissues of Bombay duck and in a few tissues of mackerel and oil sardine tested for this purpose. Though esterase and superoxide dismutase were found present only in liver tissue of Bombay duck, the latter enzyme was also found active in the red muscle of mackerel. Though esterase activity was absent in the muscle tissue of both Bombay duck and mackerel it was present in the same tissue of oil sardine. The electrophoretic patterns of lactate dehydrogenase in different tissues and that of esterase and superoxide dismutase in particular tissues of Bombay duck, mackerel and oil sardine were tissue specific (on close comparison) and strinkingly species specific in terms of electrophoretic mobility, number of bands and staining intensity of different bands. These apparent observed comparative difference may be due to varied physiological orientation at intra-and inter-species levels.

The absence of intraspecies polymorphism (a natural phenomenon required for testing the hypothesis of unit stocks) at lactate dehydrogenase locus of muscle and liver and superoxide dismutase locus of liver of Bombay duck tested from different centres suggests that these may not be suitable for delineation of units stocks, unless otherwise proved by testing large number of specimens from distant regions. As esterase enzyme in liver and general proteins in muscle

were not tested in sufficient number of specimens, it is too early to arrive at any conclusion regarding their suitability for stock differentiation.

Though electrophoretic patterns of lactate dehydrogenase, esterase, superoxide dismutase and general proteins resolved and detected in few specimens of mackerel and oilsardine are encouraging, their potential application for unit stock studies is yet to be determined by detailed examination.

Suggestions

Based on the preliminary experimental results described above, the following suggestions are made as possible guidelines for future investigation.

1) Necessary modifications and improvement of certain aspects of electrophoretic procedures described here may produce optimum conditions for studing a particular protein/ isozyme of a selected tissue of a species under investigation.

2) A comparative study of electrophoretic pattern of lactate dehydrogenase of either muscle or liver and that of esterase and superoxide dismutase of liver and that of general proteins of muscle of large number of specimens of Bomby duck particularly samples taken from east and west coast is desirable.

3) A detailed study of liver esterase of Bombay duck is necessary to find out whether its observed lack of visible activity in certain cases is due to a possible null allele in the population or its dependance on age, sex and maturity variability.

4) Any other isozymes like alpha glycerophosphatase, superoxide dismutase, esterase etc. were found at detectable level in one or more tissue of mackerel and oil sardine, their intraspecies nature was not tested here. Hence, large samples of both species are to be tested for possible intraspecies polymorphism at these protein loci.

Studies on the distribution and abundance of spawners and of Young fish (FB/PR/7.1)

P. T. MEENAKSHISUNDARAM, R. SOUNDERARAJAN, S. REUBEN, G. GOPAKUMAR, A. A. JAYAPRAKASH M. KUMARAN, P. DEVADOSS AND MOHAMMED-ZAFFAR KHAN

Studies on the distribution and abundance of spawners and young fishes, during the year 1992-83, were continued at Waltair, Madras, Vizhinjam, Cochin, Mangalore, Calicut and Veraval.

Studies on the distribution and abundance of spawners and young ones of Pelagic fish at Waltair have indicated that an estimated 55 million mature fish of pelagic species were landed during 1982-83 seasons by the indigenous units and shrimp trawls. The bulk of this catch (78.6% by numbers) was landed by shrimp trawl. Shore-seine accounted for 18.3% and boat seine for 3.1% of the total mature fish landed. Species-wise the White bait (*Stolephorus*), dominated by *S. bataviensis* and *S. devisi*, contributed to the bulk (86.7% by numbers) of the mature fish landings. Next in importance were the species of rainbow sardines (6.3% scads (3.9%), *Carangoides malabaricus* (1.4%), long jaw anchovies (0.65%) and *Sardinella gibbosa* (0.3%).

Good catch rate for young fish was obtained by shore seine in April (28.36 kg/unit) and November (15.97 kg/hr.) Boat seine at the Outer Harbour Jetty landed good catches young fish in October (11.21 kg/unit), November (12.70 kg unit). Boat seine at the Lawson's Bay (2.23 kg/unit) and shrimp trawl (3.58 kg/hr) at the Fishing Harbour Jetty returned moderate catch rates of young fish *Stolephorus devisi* (76.5%) formed the bulk of the young fish in the catches of shore seine at the Lawson's Bay followed by *Sardinella gibbosa* (8.9%) and *S. indicus* (12·0%). *S. bataviensis* (39.1%) and *S. gibbosa* (35.3%) were important

in the catches of boat seine. *Magalaspis cordyla* (40.3%) and *Carangoides malabaricus* (28.9%) were important young fish encountered in the catches of shrimp trawl net *S. gibbosa* (74.5%) constituted the bulk of the young fish catch followed by *R. kanagurta* (8.4%).

Data on the occurrence and abundance of young fishes and spawners of pelagic fishes have been collected from Madras from boat seine and shore seine catches. A total of 1044 units of boat seines and 256 units of shore seines were operated during the year. In the boat seine catches, out of a total 3202 kg of young ones, pelagic species formed 325 kg with an estimated number of 4,28,758 (catch per unit effort:-0.38 kg and 411 numbers). In shore seine catches out of a total of 1115 kg. of young ones of pelagic species formed 368 kg with an estimated number of 87,468 (CPUE : 1.44 kg and 342 numbers). In boat seines juveniles of about 27 species occurred and juveniles of *Stolephorus* spp. dominated among them. In general, juveniles of pelagic species were comparatively abundant during June to August, November and February-March.

Regarding spawners, *Stolephorus* spp, *Thryssa* spp., *Sardinella gibbosa*, *Rastrelliger kanagurta*, *Decapterus* sp., *Seleroides leptolepis* and *Cypsilurus* sp. were observed. In *Stolephorus devisi* gravid females (Stages V & VI) occurred during August (80%) and in *S. bataviensis* during August (56.5%). In *T. mystax* spawners formed 12.1% in April and 2.2% in June. In *T. dussumierli* they formed 12.3% in April and 10·8% in June· In *Sardinella gibbosa* mature fish occurred in May, June, September and February (2·1%, 12·1%, 15·6% and 1% respectively)· In *Rastrelliger kanagurta* spawners occurred during February-March period (40% in February and 15% in March)· In other species spawners were not observed·

During the period about 3321 kg of young fish were landed at Vizhinjam. About 53·3% of the catch was landed

by boat seine with an average CPUE of 0·05 kg. and the rest (46·7%) by shore seine with an average CPUE of 1·8 kg. In the total young fish landings, pelagic species constituted about 74·9%. Among the pelagic groups, *Decapterus dayi* constituted about 44·3%, *Trichiurus lepturus* 27.3%, *Sardinella* sp. 20.8%, *Caranx* sp. 2.8%, *Stolephorus devisi* 2.5%, *Sphyraena* sp. 1·5% *Sillago* sp. 1·4% and *Chorinemus* sp. 0·3%. The total young fish landings at Vizhinjam during 1982·83 has decreased slightly from that of the previous year.

In the case of mackerel, mature fish were observed in the samples during April-May and September-November. Mature fish on *Stolephorus devisi* were obtained during April-October. *S. bataviensis* during April-September and November and *S. buccaneeri* during May-August and October.

At Cochin young fish (53·8 t) were landed mainly by purse seine (84·4%) and shrimp trawl. Predominant species were oil sardine (61·4%), mackerel (3·9%), whitebait (0·3%) and pomfret (1·2%). Fairly good abundance of mature fish of oil sardine and mackerel were recorded during the South west monsoon months.

The total landings of spawners of *Sardinella longiceps, Rastrelliger kanagurta, Formio niger* and *P. argenteus* together formed about 751 tonnes at Calicut during the year The highest landings of spawners observed was in oil sardine, *Sardinella longiceps* viz,, 697 tonnes with a catch per unit effort of 216.6 kg by pattenkolli vala and 7.6 kg by mathichala vala. Spawners were observed mainly from July to September. About 2.6 tonnes of spawners of *Rastrelliger kanagurta* with a catch per unit effort of 39.2 kg were landed by Ayilachala vala at Calicut. Spawners were caught mainly during March, May, June and August. An estimated catch of about 2.6 tonnes of spawners of *Formio niger* were landed during May. Spawners of *P. argenteus* were landed, in stray catches, during May and June.

Young oil sardines (*S. longiceps*) amounting to 251 tonnes were landed by Pattenkolli, mathichala vala and nethal vala, the C/E being 76·3, 105.2 and 25·3 kg respectively for the three gears. Juveniles were abundant in the landings during September to November. Young mackerel occurred in the landings only in October. Young pomfrets were caught during April, June and November. Juveniles of *S. longiceps* ranging from 65 to 100 mm were dominant during October in Pattenkolli vala whereas in nethal vala juveniles ranging from 40 to 70 mm dominated during September. Young mackerel were found only during September and October.

At Mangalore mature and young oil sardines were abundant only during September to November although adults were also caught till the end of March. Maximum numbers 54,046 mature fish per gear during September were caught followed by 20,730 numbers during October. The lowest numbers were during January with 879 fish. The incidence of the number of mature fish per gear, got reduced from September onwards to January, then it increased during February and March. Juvenile oilsardines appeared in the catches from October onwards. In October alone the number of Juveniles per gear was estimated to be 148,396 and in December it was just 36 only.

At Veraval an estimated catch of 204·5 tonnes of young ones of *Harpodon nehereus* were landed at the catch rate of 1·15 kg numbering 1595 fish per haul; while 10574 tonnes of spawners were landed at the catch rate of 59·46 kg numbering only 655 fish per haul. The young ones were abundant during November and January when the catch per haul in number was 4648 and 4564 respectively. During other months it varied between 354 and 961 fish per haul. An estimated catch of 62.5 tonnes of young ones of *P. argenteus* ranging in size from 10 to 99 mm were landed at the catch rate of 0.35 kg numbering 37 fish per haul. The catch rate of young ones was high during January and May. Only stray spawners were observed.

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

V. BALAN, P. VIJAYARAGHAVAN, M. KUMARAN, P. DEVADOSS, G. G. ANNIGERI AND P. N. RADHAKRISHNAN NAIR

The oil sardine fishery during the year under report showed marked decrease (51·9%) compared to the previous year. During the current season, as in the previous two years, the oil sardine landings (18282 t) in the Mangalore region surpassed remarkedly those of the Cochin, Calicut, Karwar and Goa regions. However, compared to the previous year, the purse seine landings at Cochin, Mangalore and Karwar regions, indicated a striking decrease to about 50%. At Goa also, the purse seine catches declined markedly. The indigenous catches at Calicut though recorded a marginal decrease, those at Vizhinjam indicated some improvements (Table 1). At Mangalore and Karwar regions also, the catches of the indigenous gears declined compared to the preceding year.

The bulk of the mackerel catch was landed by purse seine at Goa (100%). Karwar (99·6%), Mangalore (99·6%) and Cochin (100%); by Pattenkolli at Calicut (80%) and by gill net (Chala vala) at Vizhinjam (90%). The peak abundance of oil sardine at the southern centres was observed during September & March and at the northern centres during November. The highest annual purse seine cpue was recorded at Mangalore (1093 kg) followed by the Cochin region (763 kg). It is remarkable that there was no oil sardine landing by Rampani at Karwar during the year.

The widest range of total-length of the species was observed in Yendi (50-210 mm) at Karwar and in purse seine (45-205 mm) at Goa. Of the different length modes, the predominant ones observed at the majority of the centres were 45, 80 to 85, 100 to 105, 120 to 130 and 145-165, 180 and 185 mm. The recruitment of the juveniles to the fishery

Table 1. Oil sardine landings (in tonnes) at the observation Centres during the fishing season 1981-82 & 1982-83

Centre	Fishing season (1981-82)	Fishing season (1982-83)	% divergence of 1982-83 landings over 1981-82 season
Goa	952	644	— 32.4
Karwar	3,929	1,831	— 53.4
Mangalore	40,675	18,282	— 55.0
Calicut	3,639	3,550	— 2.4
Cochin	14,617	6,285	— 57.0
Vizhinjam	26	91	+ 250.0
Total	63,838	30,683	— 51 9

Table 2. Age composition of oil sardine (No/gear) in the non-selective gear at different centres during the fishing seasons 1981-82 & 1982-83.

Centre	Gear	Fishing season (1981-82) Age class			Fishing season (1982-83) Age class		
		00-year	11-year	22-year(+)	0-year	1-year	2-year +
Goa	Purse seine	11308	2526	1568	12979	2165	617
Karwar	Purse seine	54852	1153	123	12037	4181	798
	Rampani	20414	416	502	0	0	0
	Yendi	66	117	23	19	39	17
Mangalore	Purse seine	117875	15801	3087	53104	11912	2463
Calicut	Pattenkolli (8.5)	8619	2031	877	15784	9471	2411
	Nethal vala	44337	3130	477	87925	138	0
Cochin	Purse seine	55438	13214	894	10119	10967	2836
Total		312909	38388	7551	191967	38873	9142
% composition		87.2	10.7	2.1	80.0	16.2	3.8

Age : 0—year (< 149 mm), 1—year (150—179 mm) & 2—year+ (> 180 mm)

at most of the centres was mainly during September-October months.

As in the preceding year, the 0-year class had the highest abundance at Goa (82.3%), Mangalore (78.5%) and Karwar (70.7%) in the purse seine catches. However, at Cochin it was 1-year class which was numerically abundant in the purse seine catches. On the whole, the 0-year class was 38.6% less abundant numerically in the landings of the current year as compared with the previous year. The relative numerical proportions of different age-classes in the landings of 1981-82 and 1982-83 are given in the table. 2.

Sex-ratio and maturation of the species was investigated at the observation centres. Except at Vizhinjam and Karwar, females were generally predominant in the landings. Adult oil sardine in mature and spawning condition were predominant in the catches during April-June in the southern centres and during August-September at the northern centres like Karwar & Goa.

A meeting of the scientists working in the project on the oil sardine fishery, was held during October 1982 to evaluate the past data on the oil sardine resource. The data is being processed to evaluate its potential and yield.

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

P. SAM BENNET, G. G. ANNIGERI, P. DEVADOSS, P. N. RADHAKRISHNAN NAIR, R. THIAGARAJAN AND S. SRINIVASA RANGAN.

Fairly good fishery for lesser sardines was reported from all the centres during the year, although some marginal decrease in the landings was observed compared to previous year at most of the centres. At Madras, Mandapam, Tuticorin and Vizhinjam indigenous gear such as gill net, boat seine

and shore seine were employed in the fishery. Whereas, at Mangalore, Karwar and Goa major portion of the lesser sardines were caught by purse seine.

Bulk of the lesser sardine fishery was supported by *Sardinella gibbosa*. The species occurred in all the centres of observation and also in fairly quantities. A noteworthy feature of the year's lesser sardine fishery was the increasing emphasis of gill net fishery at Palk Bay centres in the Mandapam area. About 150 gill net units did intensified fishing off Mandapam during April to July.

At Madras an estimated 135 tonnes of lesser sardines were landed by gill nets during the year. The fishery commenced in August and good catches were obtained from October to April. *Sardinella gibbosa* formed 84% of the catch. At Mandapam lesser sardines were landed at Palk Bay centres by gill nets and shore seines. Gill net landings came to 1798 tonnes and 24 tonnes were landed by shore seine. June was observed to be the good month for lesser sardines. *Surdinella albella* and *S. gibbosa* were reported in the fishery with *S. albella* forming the major portion. Lesser sardines were available during all the months at Tuticorin. Only gill nets were employed in the fishery. Total commercial landings came to 3019 tonnes. Good lesser sardine landings were recorded during November to February with the highest monthly landings of 406 tonnes in February. *Sardinella gibbosa* formed 54.7% of the lesser sardine landings.

The lesser sardine fishery at Vizhinjam during 1982-83 landed an estimated 260 tonnes compared to 261 tonnes of previous year. The fishery was extended over several months with peak abundance in May, October and in March. 'Chala vala' landed the bulk (90.1%) of the lesser sardine catch. The share of the shore seine and boat seine was 2.3% and 4.9% Peak landings by 'chala vala' were in May. The catch rate by the above principal gears was

in the order of 12 4 kg, 6.7 kg and 0 3 kg respectively. Predominant species were *Sardinella gibbosa* and *S. sirm;* the later being more dominant during November to March. At Mangalore 74 tonnes of lesser sardines were landed during the year by purse seine. No regular season was reported for lesser sardine. The current year's lesser sardine landings at Karwar were 1160 tonnes compared to 670 tonnes of previous year, thus registering an increase of about 73.1% in the current year. The principal gear was purse seine which accounted for 99.9% of the lesser sardine land ngs. The fishery was sustained mainly by *Sar dinella dayi* (29.8%), *S. fimbriata* (27.8%) and *S. gibbosa* (37.5%). The catch rate by the purse seine for the above species was in the order of 58.3 kg, 54.5 kg and 73.4 kg. in the purse seine landings, *S. gibbosa* during 1982-83 season and *S. dayi* during 1981-82 season dominated. At Goa commercial fishery for lesser sardines was conducted by purse seine only. Total landings came to 567 tonnes. There was 24.7% decrease in the number of purse seine operations during the year as compared with that of the previous year. Second quarter reported good landings. *Sardinella gibbosa*, *S. dayi* and *S. albella* formed the lesser sardine fishery at Goa.

Biological studies were made on *Sardinella gibbosa* at Madras, Mandapam, Tuticorin, Vizhinjam and Karwar. Fish from 7.5 cm to 18.0 cm were recorded in the fishery. Commercial fishery was supported by the 11.0 cm to 14.5 cm size groups. At Madras fish from 9.0 cm to 16.0 cm size groups were reported in the fishery with 14.0 cm size group forming the dominant mode. The size range of fish at Mandapam was from 7.5 cm. to 13.0 cm. Gill net catch from Tuticorin reported fish from 10.0 cm. to 18.0 cm. The dominant size group during the year was at 13.5 cm. The fishery was mostly supported by fish in the 12.5 cm. to 14.5 cm. size groups. Vizhinjam fishery for *Sardinella gibbosa* was supported by fish from 13·5 cm to 16.5 cm, with the mode at 15.0 cm. Size range of the fish at Karwar

was from 11.0 cm to 18.0 cm. Fish in the 15.0 cm. size group dominated the catches.

Females predominated in the catches at all centres except at Karwar where males dominated. Fish in all stages of sexual maturity were noticed in the commercial fishery. Major portion of the catch composed of indeterminates and fish in the developing stages of gonad maturity. Mature fish were noticed in good numbers at Madras during September, February and March and at Mandapam during April to July. Gravid fish were found in the Tuticorin fishery during June to August. Spent fish were seen during March to September. Mature fish were found off Karwar and Goa during September to December.

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

G. LUTHER, R. SOUNDERA RAJAN, G. GOPAKUMAR, M. V. PAI AND G. SYDA RAO

Stolepherus (White bait) fishery at Mangalore this year (1982-83) with the catch at 5691 t showed a tremendous improvement over the past three years with the landings ranging between 760 t and 4600 t, that of last year being 2814 t. Bulk (90%) of this was landed by purse seine and the rest by bottom trawl. White bait formed 15.7% of the purse seine landings and 6% of the trawl landings with the catch rates (C/E) at 391kg. and 13kg. respectively. These catch rates, compared with the past were also higher this year. Purse seines landed 80% of their annual catch in October with the C/E at 1999 kg. whereas trawl net landed bulk (67%) of the catch in November with the C/E at 68.5 kg.

As usual *S. Devisi* was the dominant species of white bait in purse seine and *S. bataviensis* in trawl net. Adult fish (>60 mm for *S. devisi* and >80 mm for *S. bataviensis*) formed bulk of the landings over the year for both the

species. However, juvenile fish was dominant for both the species just prior to the south west monsoon. Fish in advanced stages of maturity (V-VII) were available during April, May and October to December for *S. devisi*; and during April, November, January and March for *S. bataviensis*' Sexes were equally distributed for *S. devisi* but males dominated in the case of *S. bataviensis*.

At Cochin too, white bait landings in the current year registered a spurt over those of previous year. The landings stood at 543 t against 189 t of last year. The bulk (70.6%) of this year's catch was accounted for by trawl nets and the rest by purse seines. In the preceding year, purse seines brought in a major part (55.4%) of the white bait catch followed by trawl nets. The current year's catch rates (C/E) of purse seines and trawl nets were also higher (20.1 kg and 8 kg as compared to 10.4 kg and 2 kg of last year). The bulk (81.9%) of the purse seine catch (160 t) of white bait was landed in the second half of the year, the highest (73 t) being in the fourth quarter A major part (55.6%) of the trawl catch (384 t) of white bait was brought in during the first half of the year, particularly in the first quarter (208 t). Overall, the annual catch rate of both gears (pooled data) stood at 9.7 kg. The months October, January and February were highly productive for white bait in the purse seine fishery. The months May, October and November were best yielding for white bait in the trawl fishery. While *S. devisi* (70.1%) followed by *S. bataviensis* (29.3%), *S. buccaneeri* and *S. commersonii* supported the purse seine fishery, *S. bataviensis* (61%) followed by *S. devisi* (36.2%) *S. commersonii* (2.7%), *S. heterolobus*, *S. buccaneeri* and *S macrops* comprised the trawl fishery.

The overall size-range of *S. devisi* was 45-104 mm and the dominant sizes were between 70 and 85 mm in purse seine and 70 and 90 mm in trawl catches. The size-range of *S. bataviensis* was 45-104 mm and the dominant sizes

were between 70 and 85 mm in purse seine and 75 and 90 mm in trawl net catches. The size-range of *S. commersonii* was 75-124 mm and the dominant sizes were at 100 and 115 mm in purse seine and between 85 and 95 mm in trawl catches. The size-range of *S bucceneeri* was 60-99 mm and the dominant sizes were between 70 and 85 mm in purse seine landings.

While *S. devisi* in maturity stage VI were met with throughout the year, those in spent condition occurred in September, November and January. For *S. bataviensis*, stage VI occurred in all but three months of the year-June, January and March, and spent condition was met with in September, November and February. For *S. commersonii*, stage VI occurred in April, May and November, and spent condition in September and January. For *S. buccaneeri*, stage VI was met with in September, and spent condition in September and January. Males of *S. devisi*, *S. bataviensis* and *S, buccaneer*i predominated, and marginal preponderance of females of S. *commersonii* occurred during the year.

Thryssa landings of the current year aggregated 20 t as against 42 t of last year. Trawl nets acounted for this year's catch unlike the case last year when both purse seines and trawl nets accounted for the catches to the extent of 29.9% and 70.1% respectively. This year's catch was almost equally distributed between the two halves. The first and fourth quarters registered most of the catch. The annual trawl C/E stood at 0.4 kg as compared to 0.7 kg of last year (C/E for pooled data of both gears-0.4 kg against 0.8 kg of previous year).

Vizhinjam area also witnessed unusually good landings of white bait this year by the indigenous gear with the annual catch at 754 t forming 13.3% of the total fish landings, as against the average annual catch of 275 t forming 7.3% of the total fish landings. Bulk (76%) of the catch was landed during July-August by boat seine.

Boat seine landed 83.7% of the annual catch with C/E at 15 kg, followed by Netholivala (gill net) 15.7% with C/E at 26.7 kg.

S. bataviensis with its relative composition at 52.3% was the dominant species of white bait in boat seine followed by *S. devisi* (31.6%), *S. buccaneeri* (14.7%). whereas *S. devisi* formed 72.9% of the catch by gill net followed by S. *bataviensis* (25.6%) and S. *buccaneeri* (1.5%). Size range of S. *bataviensis* was 45-109 with the dominant sizes between 60 and 85 mm in boat seine and 80 and 90 mm in gill net; that of S *devisi* was 40-99 mm with the dominant sizes between 60 and 80 mm in boat seine, and between 70 and 90 mm in gill net; and that of *S. buccaneeri* was 55-99 mm with the dominant sizes between 60 and 80 mm in boat seine, and between 70 and 80 mm in gill net. Fish with gonads in partially spent, and full spent condition was available during April-October for S. *devisi*; during April-July for S. *bataviensis* and during May-August and October for *S. buccaneeri*. Sex ratio was generally equal for the first two species, but males were dominant for *S. buccaneeri* caught in boat seine.

Thryssa landings amounted to about 4 t compared with 6 t of last year. About 45% of the annual catch was landed in December in shore seine at C/E of 1.82 kg per net. *T. setirostris* was the only species met with in the catches. Fish ranged in length between 70 and 140 mm, those between 100 and 120 mm being common. Gravid, partially spent and fully spent fish were met with during November-January.

During the year white bait landings at Madras amounted to 13 t compared to 49 t of previous year. Boat seine with the catch rate (C/E) at 8.4 kg at Nochikuppam were the main indigenous gear for white bait.

Dominant species met with were *S. bataviensis* and *S. commersonii* in trawl net, *S. devisi* and *S. bataviensis* in boat seine and shore seine. *S. devisi* ranged in size between 25 and 100 mm with the dominant sizes at 60-95 mm. Juveniles were available during February-May and August-September.

In the case of *S. bataviensis* the size ranged between 20 and 120 mm in the fishery with the dominant sizes at 30-60 mm and 60-95 mm. *S. devisi* and *S. bataviensis* with gonads in advanced stages of maturity (V-VII) were met with over several months.

Thryssa landings during the year amounted to 25 t compared with 32 t of last year. Trawl and gill net were the main gear used. *T. dussumieri* (67%) was the most dominant species of *Thryssa* followed by *T. mystax*.

At Waltair there has been some improvement in the white bait landings with the annual catch at 204 t, compared with that of last year of 137 t. About 82% of this catch was from shrimp trawl and the rest was from indigenous gear. About 95% of the annual landings by the trawl net was obtained during May-October.

S. bataviensis accounted for 67% of the white bait catch and contributed significantly during April-July, in September and December. Fish between 70 mm and 85 mm length was dominant over the year. Sex ratio of adults was equal. Fish in advanced stages of maturity (V-VII) which formed about 71% of the adult fish over the year was met with from April to December. *S. devisi* accounted for 27% of the white bait catch, and contributed significantly during August. Fish between 70 mm and 80 mm length were dominant in the catches. Sex ratio of adults was equal. Fish in advanced stages of maturity which formed about 87% of the adult fish were met with throughout the year. *Thryssa* landings amounted to 56 t compared with 72 t

of last year. Shrimp trawl landed 98% of this catch. June to November was a good fishery period. *T. mystax* and *T. Setirostris* were the two equally dominant species accounting together for 84% of the *Thryssa* catch. Fish between 125 mm and 155 mm for *T. mystax* and 125-170 mm for *T. setirostris* were the dominant sizes in the fishery.

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

A. NOBLE, M. H. DHULKHED, T. M. YOHANNAN, M. V. PAI, G. GOPAKUMAR, P. NAMALWAR, N. S. RADHAKRISHNAN AND S. REUBEN.

Landings of mackerel at Panjim in Goa was only 112 tonnes in 1982-83 against 408 tonnes of 1981-82, and was confined to only September - November period. Purse-seine was the gear in operation and had a cpue of 40.9 and 112 kg in these years. At Karwar also the landings in 1982-83 were poor, being only 222 tonnes against 854 tonnes of last year. Seventy six per cent of the catch in the year came in April alone. The season during September-December was very poor and during January - March the catch was almost nil. Purse-seine landed 96.4%, *Yendi* 2.4% and Rampan 1.2% of the mackerel at a cpue of 36.1, 2.3, 520 kg respectively. The catches of mackerel by the indigenous gears at Baikampady and by the purse-seine and Mangalore this year were slightly better than that of last year. At Baikampady the catches in the two years were, respectively 23 and 15 tonnes and at Mangalore 3018 and 2867 tonnes. Gill nets were fishing only in the first half of the year and landed 92% of the mackerel catch at Baikampady. The cpue of gillnet *Patta bala* was 48.9 kg. *Rampani* operating during November-December registered a catch rate of 108.7 kg. Bulk of the purse-seine landings of mackerel was observed in May, September and October. After November the Fishery was practically absent. The catch of mackerel

per purse seine was 180 kg. At Calicut the mackerel catch in 1982-83 with 158 tonnes was much less than that of 1981-82 landings (236 tonnes). Gill nets landed 57% of the mackerel at a cpue of 54·14 kg. *Pattenkolli* caught mackerel only in September and yet it contributed to 41% of the total catch.

At Cochin, 1954 tonnes of mackerel were landed in the current year as against 1888 tonnes during 1981-82. Purse seine was the major gear accounting for 1905 tonnes (97.5%) of the annual catch at a cpue of 232.5 kg. Last year, purse seines accounted for 1838 tonnes (97.4%) of the total catch landed at a cpue of 200.7 kg. Though there was a fall in the effort in the current year (from 9157 purse seine units in the preceding year to 8190 units in the present), the catch and cpue showed an upward trend. Drift net units landed 47 tonnes of mackerel in this year at a cpue of 2·4 kg; the catch constituted 2.4% of the total catch. Trawl net catch of the current year was meagre - 2 tonnes constituting 0.1% of the annual catch, the cpue being 0.04 kg. Last year, drift and trawl nets accounted for 2% and 0.6% of the total catch, the cpue being 1.8 kg and 0.3 kg respectively.

The bulk (69.7%) of the purse seine catch of this year was recorded in the first half, particularly in the second quarter (53.9%). This quarter's catch (1026.222 tonnes) was registered entirely in September when the cpue was also high (846.718 kg). This is the highest monthly catch recorded at Cochin since March 1981 (1055.407 tonnes). The first, third and fourth quarters accounted for 15.8%, 19.9% and 10.4% respectively of the annual purse seine catch. Most of the drift net and trawl landings (98.2% and 59.8% respectively) were registered in the first half of the year.

Mackerel fishery at Vizhinjam this year landed 72 tonnes as against 115 tonnes of last year. The fishery was good during February-May. Hooks and line caught 56.5% and the driftnets 43.14% of the total.

On the East coast at Mandapam the landings were 50 tonnes in 1982-83 against 20 tonnes in 1981-82. With estimated landings of about 50 tonnes during the year, the fishery showed marginal improvement over the previous year. At a CPUE of 2.9 kg and 1.7 kg gill net and bag net contributed to 84.5% and 12.9% of the landings. At Kakinada, the landings in 1982-83 totalled 71 tonnes with peak landings (70%) during February-March. Drift nets accounted for 99%. The landings of mackerel by indigenous gears at Lawsons Bay in (Waltair) totalled 53 tonnes in 1982-83 against 71 tonnes of 1981-82. At the outer harbour, shrimp trawlers landed only 12.5 tonnes in the current year as against 32.3 tonnes of yester-year. March had the bulk of catch at Lawson's Bay and bottom set gill net landed 96% with a cpue of 6.6 kg. The shrimp trawls at outer harbour had good catches in July-September.

The fishery at Panjim being confined to September and October had only new recruits ranging in size between 55 mm and 155 groups with mode at 90 mm group. At Karwar, the fishery by Purse - seine during April - May and partly in September, subsisted on the stock of mackerel with a mode at 250 mm. In September the catch comprised of good amount of new recruits ranging from 75 to 100 mm with mode at 95 mm. The fishery for October - December consisted of new recruits ranging a size between 125 mm & 200 mm. In January the landings comprised of only very small fish of sizes 85 - 100 mm with mode at 90 mm. In February the fishery by Yendi consisted of small fish ranging between

115 mm and 180 mm with a primary mode at 165 mm and a secondary mode at 140 mm. The mackerel landings in Mangalore area up to September in general comprised of big fish with the peak mostly at 250 mm. In September the mackerel catch at Mangalore was based on fish ranging from 105 mm to 275 mm with modes at 115 mm (3.6%), 180 mm (6.2%), 230 mm (17.5%) and 250 mm (10.8%). In October the size range was mainly between 155 mm and 260 mm with a major mode at 200 mm and a minor mode at 240 mm. The sizes in November ranged between 145 and 190 mm with major mode at 180 mm and an almost equally important one at 150 mm. On the whole the fishery for the year here had the primary peak at 200 mm group (13.28%) and the secondary peak at 250 mm group (10.61%). The size of mackerel caught at Baikampady by Rampan ranged between 135 mm and 160 mm (mode at 145 mm) in November and from 175 mm to 195 mm (mode at 180 mm) in December.

The overall size-ranges of mackerel in the purse seine and drift net catches at Cochin during the year were 85-280 mm and 170–290 mm respectively. The modal sizes in the purse seine catches ranged from 100 mm in May to 260 mm in September, and in the drift net landings from 175 mm in October to 270 mm in July. In April, November, February and March, the purse seine fishery drew support mainly from adults. In May, the fishery operated on young (85-140 mm) as well as adult fish (190-280 mm). In September and October, the fishery comprised both young (150 mm) and adult fish, the latter to a greater extent. The large-scale purse seine landings in September were in the size-range 150-275 mm and the modal sizes varied between 155 mm and 260 mm. The fishery was supported mainly by 1-year and 2-years old individuals. The drift net fishery operated mainly on adults during the year.

Table: Age composition of mackerel (No./gear) in the non-selective gear at different centres during the fishing seasons 1981-82 & 1982-83.

Centre	Fishing gear	1981 - 1982 Age class				1982 - 1983 Age class			
		0 - year	1 - year	2 - year	3 - year	0 - year	1 - year	2 - year	3 - year (+)
Goa	Purse seine	—	No data	—		6,081	0	0	0
Karwar	Purse seine	572	1,178	229	1	152	74	186	6
	Rampani	3,473	14,404	1,447	0	172	1,978	0	0
Mangalore	Purse seine	0	246	842	6	43	684	660	2
	Rampani	—	Not	sampled	—	255	1,513	0	0
Calicut	Pattenkolli (B.S)	95	11	83	0	231	0	0	0
Cochin	Purse seine	313	1,320	598	5	33	983	802	16
Vizhinjam	Shore seine	32	5	0	0	8	1	0	0

Age : 0-year (< 159 mm), 1-year (160-229 mm), 2-year (230-269 mm) and 3-year (> 270 mm) (+)

At Vizhinjam, fish ranging in length between 90-290mm were observed in the year. The drift nets landed bigger fish at modal sizes 250-265 mm. Though hooks and lines also had big fish in the catches, the fish in Achil ranged from 90 mm to 220 mm with a mode at 130 mm group. Shore-seine catches, constituted only of small fish ranging from 115 to 195 mm with mode at 125 mm.

Drift net catches at Mandapam area ranged between 170 mm and 280 mm. The modal sizes were at 230-240 mm in April-August period. A few fish of size range 120-145 mm with mode at 130 mm marked fresh recruitment in August during the year. The size distribution of the mackerel caught at Madras ranged from 50 mm to 245 mm with predominant sizes at 55-90 mm, 130-135 mm, 180-190 mm and 230-240 mm. The mackerel broadly ranged in size between 105 mm and 265 mm in Drift net catches at Kakinada with major mode shifting from 215 mm in April to 240 mm in September showing a growth of 25 mm in 5 months. Entry of small size fish ranging from 70 mm to 95 mm in March indicated fresh recruitment of the year. At Waltair, mackerel ranging in size from 40 mm to 245 mm with modal sizes at 75 mm, 125 mm and 220 mm were observed in the landings.

The age composition of the mackerel (No./gear) in the non - selective gear at different centres during the fishing seasons 1981-82 and 1982-83 is given in the accompanying table. It is observed that during 1982-83 season the fishery was mainly sustained numerically by the 0-year and 1-year age classes whereas in 1981-82 season 1-year and 2-year old fish predominated. The relative abundance of 0-year recruits also appears to be lower during the current season compared to the previous season. In general the predominance of the 0-year class is higher at the northern centres compared to the southern ones in both the seasons.

The fishery at Panjim comprised only of young and immature fish. Females were predominant (57%). At Karwar similar condition in the young fish was observed at the beginning of the season. Mature and spent fish were recorded in April, May and September. At Mangalore sex-ratio was equal, with mature fish (33-37%) and spent fish (50-67%) dominating during May-October period. At Cochin, slight preponderance of males was noticed. Advanced mature and ripe fish prevailed (36%) in the catches during the year. These were followed by immature (24%), spent (21%), spent-recovering (10%), mature and maturing individuals. Advanced stages of maturity (IV-VI) were encountered relatively more from April through July. Spent fish occurred in greater proportion in April and from August through October. Spent-recovering individuals occurred more frequently in September, October, February and March. The large-scale purse seine landings in September were made up more (58%) of spent fish. At Vizhinjam mature fish (IV-V) during May-June and spent fish (VII) during September-November were mainly recorded.

At the East coast centres sexes were equal. Fish in maturing. (III-IV) and mature (V-VI) condition were recorded generally during March-June months. Thereafter spent fish occurred.

Rare specimens of *R. faughni* ranging in size from 240 to 242 mm at Kakinada and from 200 mm to 245 mm at Waltair were observed in February and March. The fish were in running and partially spent condition.

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

M. V. PAI. C. MUTHIAH, T. M. YOHANNAN, P. N. RADHAKRISHNAN NAIR, K. M. S. AMEER HAMSA AND G. LUTHER.

Along the South Kanara coast, 1067 tonnes of seer fishes were landed during 1982-83 (September-March) as

against 996 tonnes of the preceding year (April & September-March). Drift gill nets (95-135 mm mesh) operated from non-mechanised and mechanised craft accounted for the catch as was the case last year. The monthly average catch and annual cpue of the current year were 152.4 tonnes and 33.3 kg respectively as compared to 124.5 tonnes and 30.4 kg of last year. In spite of effort remaining more or less the same during the current and previous years, the catch and cpue increased marginally in this year. The non-mechanised and mechanised units contributed 45% and 55% respectively to the total catch of the year as against 50% each last year. The cpue of mechanised and non-mechanised units stood at 63.4 kg and 33.3 kg as against 54.3 kg and 30.4 kg respectively in 1981-82. The period September-November was the most productive when 88% of the landings were recorded. For non-mechanised and mechanised units as well, the highest catch and cpue were registered in November and September respectively.

The king seer (*Scomberomorus commerson*), spotted seer (*S. guttatus*) and streaked seer (*S. lineolatus*) constituted 76.5%, 23.4% and 0.1% respectively of the annual catch. When compared to last year, the king seer catch declined by 11.2%. The king seer was best noted during October-November (195 tonnes, 196 tonnes) and spotted seer during November-December (82 tonnes, 98 tonnes;) streaked seer occurred occasionally in November, December and February. The first two species occurred all through the fishery season.

The king seer ranged in size from 360 to 1230mm, the dominant size-group being 825 mm. Fishes in the size-range 501 to 1000 mm supported (94%) the fishery. The spotted seer varied in length between 301 and 570 mm with a mode at 435 mm. Fishes in the size-range 361 to 480 mm formed the core of the fishery.

Purse seiners landed 15 tonnes of king seer at Mangalore during April, May and September. Good quantities of juveniles of king seer and spotted seer were caught in trawls and Bollingerbale (gill net of 25 mm mesh).

At Calicut, the drift net Ozhukkuvala and the mackerel gill net Ayilachalavala brought in 77 tonnes of seerfishes during the year as compared to 102 tonnes in 1981-82. As observed earlier, the third and fourth quarters were highly productive; catch rates were also good then. The highest catch (16 tonnes) was recorded in December and cpue (262.4 kg) in July. Drift net was the principal gear operated in the fishery which accounted for 99.8% of the annual catch. Ayilachalavala brought in the rest of the catch in February. The king seer constituted 96.7% of the total catch of seer fishes followed by the spotted seer. The drift net cpue during the year stood at 19 kg. and that of mackerel gill net at 0.1kg. The annual cpue for the pooled catches of both gears was 19 kg.

S. *commerson* landed by drift net units ranged in size from 400 to 1049 mm. The fishery was supported by the size-range 650-899 mm with a peak at 825 mm The monthly modes ranged from 575 mm in July to 975 mm in December The annual mode was at 825 mm with a minor one at 675 mm.

At Cochin, drift net units landed 323 tonnes of seer fishes as against 238 tonnes of the preceding year. The annual cpue was 16.6 kg. as compared to 11.1 kg. of last year. The third and fourth quarters of the year together accounted for 66.8% of the total catch (though effort expended was marginal - 28.2%). Last year, these quarters accounted for 67.6% of the annual catch. The highest catch (67 tonnes) was recorded in October followed by landings in January and December (50 tonnes and 33 tonnes respectively). The highest cpue (49.9 kg.) was

registered in December followed by values in October and January 46.3 kg. and 44.3 kg. respectively). The cpue was consistently high from October through March.

The king seer and spotted seer comprised the drift net catches, the former constituting most of them. For *S. commerson* the overall size range was 360 to 137 mm. The fishery drew its support from fish at and around the dominant modal sizes though different months. These ranged from 575 mm, in June/October to 875 mm. in August. In May, king seer in the size-range 220-382 mm. with a mode at 325 mm. were landed by purse seiners.

The spotted seer ranged in size from 320 to 690 mm. The prominent modes were 425 mm in February and 475 mm. in May / September - January / March.

At Vizhinjam, drift nets operated from non-mechanised and mechanised boats, and hooks & lines from non-mechanised craft brought in 69 tonnes of seer fishes as against 56 tonnes in the previous year. This year's catch constituted 1.2% of the area's catch of 'all fish' as compared to 1.0% of last year (when shore seines were also operated). The third quarter accounted for 49.1% and the second half of the period 49.9% of the annual yield. Last year, these time parts accounted for 74.6% and 76.2% respectively of the total catch. During 1982-83, drift net non-mechanised and drift net-mechanised units yielded 84%, 14.2% respectively of the total catch. In 1981-82, the respective values were 69.2% and 27.3%. This year, seer fishes constituted 23.3% and 22.2% respectively of the catch of 'all fish' landed by drift net-mechanised and drift net-non-mechanised units. As in the previous year, most of the annual catch was brought in during September-December. The bulk (82.7%) of the year's catch was recorded in September and October (23 tonnes and 28 tonnes respectively).

The highest catch of seer fishes (24 tonnes) in the drift net-non-mechanised units was recorded in October and maximum cpue (16.4 kg.) in September. The annual cpue of these units was 3.8 kg. In the case of drift net-mechanised units, the highest catch (4 tonnes) and cpue (26.6 kg.) were also in the same months. On the whole, these gave better monthly as well as annual cpue (annual 14.8 kg.)

The king seer was predominant in the catches followed by the spotted seer. The former ranged in size between 510 and 910 mm, and the latter between 438 and 596 mm.

In the Tuticorin area (covering Tuticorin North, Punnakayal, Kayalpattinam, Vaipar and Harbour Point), 357 tonnes of seer fishes were landed as against 251 tonnes last year. This year's catch registered 42% rise over that of previous year. Drift nets (Paruvalai and Podivalai), hooks & lines, bottom set nets and shore seines brought in the catches. Last year, drift nets, troll lines, hand lines, long lines and bottom set nets yielded the catches at the first four centres listed above and Veerapandianpattinam. The current year's seer fish catch constituted 22% of the total fish catch of the area as compared to 18% last year. Unlike the case last year (when Paruvalai yielded 55.5% of the seer fish catch of the area at 19.4 kg./unit), the present yield was largely (62.5%) accounted for by hooks & lines at a cpue of 20.3 kg. This gear was followed by Paruvalai (28.4%) at 18.2 kg. cpue; Podivalai followed next Centre-wise, Tuticorin North registered most of the catch (79.6%) of the area followed by Punnakayal (15.5%), Kayalpattinam (3.5%), Vaipar (1·2%) and Harbour Point (0.2%).

In the area as a whole, the second and third quarters accounted for the maximum catch (74.4%), the third quarter registering 49.8%. Last year, the third and fourth quarters recorded 58.8% of the total catch. At Tuticorin North too, the second and third quarters recorded a major part (74%)

of the catch, the third accounting for 46.2%. At the other four centres, the third quarter accounted for 63.5% of the annual catch followed by the first quarter (16.7%). The catches and catch rates fluctuated during different months at the centres because of variety of gears employed.

The king seer, streaked seer and spotted seer constituted the catches in the order of their abundance. Overall, king seer formed 94.1% (336 tonnes), streaked seer 5.2% (19 tonnes) and spotted seer 0.7% (2 tonnes) in the catches during 1982-83. While king seer occurred throughout the year in the drift net and hooks & lines catches, in the landings of bottom set nets and shore seines it was met with from August onwards. The occurrence of other two species was not consistent. The king seer was dominant in the catches of all but one gear, viz., shore seines werein spotted seer predominated. The overall size-range of king-seer during the year was 150-1250 mm and modes ranged between 185 and 1175 mm.

At Lawson's Bay, Waltair, 126 tonnes of seer fishes were landed by artisanal fishermen as against 107 tonnes of 1981-82. This year's catch constituted 24.8% of the total fish catch of the area as compared to previous year's 14.7%. In 1982-83, hooks & lines accounted for the bulk 89 4%: 113 tonnes) of the catch followed by bottom set gill nets (10.2% : 13 tonnes); shore seines, boat seines and gill nets yielded the rest of the catch. Last year too, hooks & lines was the major gear operated in the fishery yielding most of the catch (90.6%); this was followed by bottom set gill nets (9.2% of the catch). This year's first and second halves accounted for 58% and 42% respectively of the annual catch of seer fishes. Last year, the respective values were 46.1% and 53.9%. In this year, the second quarter recorded the highest yield (46 tonnes: 36.8% of the annual catch) followed by the third (25%), first (21.2%) and fourth (17%) quarters. This year's cpue was 3.3kg. The monthly catch rates varied between 1.1 kg. in April

and 6.2 kg in September when lowest and highest catches were recorded.

The hooks & lines catch was better in the first half year (63 tonnes: 55.6% of the annual). Of this, 39 tonnes of seer fishes were landed in the second quarter. As compared to last year's 2.6 kg, this season's cpue of hooks & lines was 3.3 kg. The landings of bottom set gill nets were better in the first half year (10 tonnes : 80.4% of the annual). This was again reflected in the catch of the second quarter (7 tonnes). This season's cpue of the gear was 1.7 kg as against 1.3kg of last year. The months of high production for hooks & lines were August and September, and for bottom set gill nets June, July and September. The yields of other gears were meagre.

The spotted seer formed the core of the fishery accounting for 77 tonnes (61.1%) of the total catch of seer fishes. Last year, the species formed 58.7% of the landings. Hooks & lines brought in 66 tonnes of spotted seer and 47 tonnes of king seer. Bottom set gill nets accounted for 11 tonnes of spotted seer and 2 tonnes of king seer. The spotted seer was best taken from May through september and November and king seer almost through the year by both gears.

At the Outer Harbour, Visakhapatnam, about 10 tonnes of seer fishes were landed by hooks & lines units from October through March with a cpue of 2.7 kg. The spotted through seer formed 71.52 of the seer fish catch and king seer the rest.

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

V. M. DESHMUKH, ALEXANDER KURIAN AND M. ZAFFAR KHAN

The Bombay duck fishery, along the Saurashtra coast was poor compared to last year. This decrease in the

landings during the current year was ascribed partly due to the distribution in the fishery caused by the cyclone. At the fishing centre Rajpara an estimated catch of 13,950 tonnes of Bombay duck was landed at the catch rate of 78.3 kg per haul compared to 22,449 tonnes landed at the rate of 131.5 kg per haul during the same period of last year. The fishery was good during October-November period. The highest monthly catch rate was observed during October 82 followed by November '82 when the catch rates were 186 kg and 161 kg per haul respectively. Large quantities of Bombay duck were landed at Veraval by trawlers during post-cyclone period (late November 82).

The size of Bombay duck in the catch ranged from 30 mm to 345 mm. In most of the months the catches were dominated by smaller size groups less than 75-90mm. The annual average size for the fish was 129 mm. and the monthly maximum being 177 mm in December 82. The fishery at this centre was mainly supported by 0-year class followed by 1+year class.

The female fish dominated the catch. Most of the ovaries observed with resting and developing stage. Few running specimen were observed during January and February.

Along the Maharashtra coast the Bombay duck fishery at Arnala in general showed an improvement over the previous year. The total catch estimated for the period was 451 tonnes with the annual catch rate of 36.6 kg per haul; while for last year the estimated catch of Bombay duck was 328 tonnes with the annual catch rate of 22.6 kg per haul. The peak landings (95 tonnes) of the species was recorded during December 82, while the monthly catch rate of 50.1 kg per haul being the highest was observed during January 83. The size of the fish in the catches ranged from 45 mm to 330 mm. The annual primary mode has shifted from 105-120 mm during 1981-82 to 180-195 mm

during 1982-83. The fishery at this centre was mainly constituted by 1+year class. Mean survival was 58.6% and actual mortality was 41.4% during 1982-83 fishing season, compared to 42.4% and 57.6% during 1981-82.

The comparative population parameters of the Bombay duck resource of Arnala for the two fishing season are given in the following Table.

Parameter	Fishing season (1981-82)	Fishing season (1982-83)
Mean survival	42.41%	58.62%
Actual mortality	57.59%	41.38%
Total instantaneous mortality (Z)	0.86	0.52
Fishing mortality (F)	0.73	0.39
Rate of exploitation	48.88%	31.04%
Expected M.	8.70%	10.35%

At Versova the Bombay duck catch was estimated at 1749 tonnes and the fishery was good in third quarter (October-December). The annual catch per haul for the year 1982-83 worked out to 15.7 kg against 17.6 kg per haul for the previous year. The maximum monthly catch rate of 50.1 kg and 46.0 kg was recorded during January '83 and September 82 respectively. The annual average size of Bombay duck was 161 mm which is slightly low as that of last year. The maximum monthly average length of 186 mm was noted during June 82. At this centre the minimum length of the fish was 30 mm while the maximum was 375 mm in the catches. In most months the landings were dominated by less than 210-225 mm size groups. The fishery at this centre was mainly constituted by 0-year

class. The females were dominant in the Bombay duck catches. Gravid fish were generally predominant during May and September-October.

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

S. REUBEN, V. S. R. MURTHY, K. M. S. AMEER HAMSA, P. NAMMALWAR, P. N. RADHAKRISHNAN NAIR K. V. SOMASEKHARAN NAIR, A. NOBLE, ALEXANDER KURIAN AND H. MOHAMMED KASIM

Investigations on the fishery and resources of carangids were continued at Waltair, Kakinada, Tuticorin, Mandapam Camp, Vizhinjam, Cochin, Mangalore, Bombay and Veraval. Although landings of carangids showed an increase at some centres like Kakinada (31%), Tuticorin (26%) and Bombay (3%), they declined at other centres like Waltair (30%) Mangalore (62%) and Veraval (2.2%), showing an overall decline in the catches during 1982-83.

Carangid landings at Waltair totalled 272 t. These declined by 30% when compared to those of last year. Carangids formed 4.7% and 5.1% in the landings by the indigenous gears at the Lawson's Bay and the shrimp trawls at the Fishing Harbour Jetty, respectively. Carangids landed at the Outer Harbour formed 2.6% in the total catches landed there. High catch rates by shore seine in January (5.0 kg/unit) bottom set gill net in September (5.5 kg/unit) and by shrimp trawl in February (6.6 kg/hr) were recorded. The dominant species landed by different gears at the Lawson's Bay were: shore-seine, *Decapterus dayi* (39.3%); bottom-set gill net, *Megalaspis cordyla* (24.3%) and *Alepes* app (23.7%). At the Outer Harbour *D. dayi* (68%) in gill-net and *Carangoides malabaricus* (38.6%), *M. cordyla* (31.9%) and *D. dayi* (22.2%) in the shrimp trawl were important.

M. cordyla examined for growth ranged from 90 mm to 375 mm in total length. New broods were recruited into the fishery during September. The length frequency data revealed the presence of three year classes in the fishery. 1-year class and above dominated the fishery during the first half-year and 0-year class dominated in the second half year. The number of males and females was almost equal. Partially and fully spent fish were met with almost throughout the year. *Acetes* spp, *Stolephorus* sp and euphausids were important items of food. *D. dayi* ranged from 90 mm to 235 mm. 0–year class dominated the fishery. In addition to the 0-year and 1-year class a few fishes which have completed two years were also noticed in the fishery. Males (56%) slightly dominated females (44%). Partially spent fish were seen in the fishery throughout the year Feeding was poor. Fish and crustacean remains were important food items observed.

An estimated 2782 t of carangids were landed at Kakinada forming 16.4% of the total fish landed by the trawlers. When compared to the past year the present catches showed an increase of 31%. January and February were the peak months when 95% of the carangid catch was realised. *Decapterus* spp accounted for 95% of the catch.

The length range of *D. dayi* was 125-215 mm. A general predominance of males was observed in different months. Gravid and spent adults occurred during August, December, January and February with a peak in February. Majority of the fishes had empty stomachs in almost all the months. Fish and crustaceans were dominant in the guts.

A detailed account on the fishery and biology of *Decapterus dayi*, based on the data collected during the period 1979-'82, was prepared.

Carangid investigations were carried out at Mandapam Camp since July 1982. The landings of *Solaroides leptolepis*, the most dominant carangid, were monitored at Rameswaram from the trawl landings (38 t) and at Dhargavalasai from the catches of indigenous gears (1.6 t). While the highest catch rate for trawl net was obtained in October (20 kg/hr) the best catch rate by the indigenous gears was obtained in November (20 kg/unit).

S. leptolepis from Rameswaram examined for growth ranged from 80 mm to 179 mm in length. Recruitment of juveniles into the fishery was observed during July - September. *S. leptolepis* landed at Dharagavalasai by shore-seine ranged from 75 mm to 139 mm in length. There was recruitment of young ones into the fishery in July. Males slightly predominated. Majority of the fishes were in resting and developing stages during July-March. A few gravid females were also observed in July and August.

Carangid landings by the indigenous gears from Tuticorin North, Pinnakayal, Kayapettinam and Vaipar totalled 237 t which formed 14.6% of the total fish catch. The present catches showed an increase of 26% over those of last year. 44.3% of the catch was contributed by hooks and line followed by drift net (39.6%).

Catch rates for carangids were good during June and February-March. *Caranx stellatus*, *C. carangus*, *Scomberoides lysan* and *Caranx* sp were dominant in the catches of drift net; while *C. stellatus* and *Caranx* sp were important in the catches of hooks and line. *C. carangus* was important in the shore-seine fishery. *C. carangus* examined for growth ranged from 120 mm to 450 mm. There was continuous recruitment into the fishery from September to April.

An estimated 667 t of Carangids were landed at Vizhinjam. The present season's catches improved by 12.7% when compared to those of last year. Hooks & line (52.1%) accounted for over one half of the carangid landings. Drift net (18%), boat seine (12.1%) and Achil (11.1%) were the other important gears used for exploiting carangids. Peak catch rates of carangids by different gears were: drift net, 12.5 kg/unit in November; hooks & line, 9.1 kg/unit in August; Achil 14.0 kg/unit in July, shore seine, 17.5 kg/unit in February and boat seine, 13.5 kg/unit in October.

An unusual feature of the carangid fishery this year at Vizhinjam is the total absence of *Megalaspis cordyla*. *Decapterus dayi* was the most important carangid species seen in the landings of hooks & line (26.15%), achil (85.28%) and boat-seine (51.99%). *D. dayi* examined for growth studies ranged from 60 mm to 230 mm. New recruits were seen in the shore seine fishery during November. Males of *D. dayi* were slightly more than females. Ripe, running and spent fish were observed during May-September.

Carangid fishery landed an estimated 483 t by trawl net (52.11%), purse seine (15.14%) and drift net (32.74%) at Cochin. When compared with the landings of last year the present catches declined by 6%. Peak catch rates for trawl net (177.2 kg/unit) and drift net (188.2 kg/unit) were realised in September while purse-seine landed the highest catch rate (6.1 kg/unit) in October. *Alepes kalla* (58.22%) and *A. djeddaba* (32.4%) were dominant carangids landed by purse-seine. In the case of trawl net, *A. kalla* (97.5%) comprised the bulk of the catch, followed by *A. djeddaba* Drift net landings were dominated by *A. djeddaba* (68.7%) and *Scomberoides commersonianus*.

The size of *A. kalla* studied for length frequency ranged from 70 mm to 130 mm in the trawl net and 80 mm to 155 mm in the purse- seine catches. New broods appeared

in the catches of trawl net from October to April. *A. kalla* was recruited into the purse-seine fishery in May. *A. djeddaba* ranged in size from 120 mm to 300 mm in the purse-seine fishery and 100 mm to 350 in the drift gill net fishery. New recruits of this species entered into the fishery during May and June. Males of *A. djedduba* had slight preponderance over females. Mature fish were encountered in September, October and February and spent fish in September, February and March. 61.2% of *A. djeddaba* had empty stomachs followed by 27.2% full stomachs. *Acetes*, amphimpods, *lucifer*, pteropods and *Stolephorus* sp were important food items.

An estimated 728 t of carangids were landed at Mangalore. The present landings decreased by 62% when compared to those of last year. Purse-seine contributed 58% of the catch while 42% was landed by trawl net. Peak catch rates for purse-seine were noted in May (60.9 kg/unit), November (10.8 kg/unit) and January (10.9 kg/unit). *Alepes kalla* was the most dominant carangid (94.9%) in the landings of purse-seine. The size of *A. kalla* examined for growth ranged from 65 mm to 140 mm in purse-seine and 110 mm to 160 mm in the trawl net landing.

An estimated 349 t of Carangids were landed by the trawlers at Sasson Docks Bombay. When compared to the catches of last year the present catches improved by 3%. Peak catch rate of 3.14 kg/hr was noticed in August. *Megalaspis cordyla* (47.3%) and *Scomberoides* spp (41·3%) dominated the fishery.

The fishery at Veraval landed an estimated catch of 237 t of carangids. This formed 10% of the total catches. A decline of 20.2% was noticed in the landings when compared to those of last year. The peak catch rate of 5.6 kg/hr for trawlers was recorded in November while the gill-net had the best catch rate (38.4 kg/unit) in June. *Atropus* (39.7%), *Scomberoides* sp (26.7%) and

Megalaspis cordyla (19.7%) were important in the catches of trawlers while *M. cordyla* (83.3%) was dominant in the catches of gill net.

The length range of *M. cordyla* examined for growth from trawl net was 200-399 mm and from the gill net 200-499 mm. The size range of *A. atropus* landed by the trawlers ranged from 125 mm to 349 mm while gill-net caught fish ranged from 150 m to 249 mm. Males of *M. cordyla* had slight dominance over females (45.5%). Resting and developing fish were observed throughout the year. 56.8% of the fish had empty stomachs. *Acetes* sp, prawns and fish were important food items observed in the guts of *M. cordyla*.

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

K. V. NARAYANA RAO, P. VIJAYARAGHAVAN, P. P. PILLAI, G. LUTHER, K. RADHAKRISHNA, S. REUBEN, P. T. MEENAKSHI SUNDARAM, R. SOUNDERARAJAN, S. SREENIVASA RANGAN, N. GOPALAKRISHNA PILLAI, R. THIAGARAJAN, P. N. RADHAKRISHNAN NAIR, G. GOPAKUMAR, T. M. YOHANNAN, A. NOBLE, P. DEVADOSS, ALEXANDER KURIAN, S. K. CHAKRABORTY, H. MOHAMMED KASIM AND ZAFAR KHAN.

The catch data on the exploited pelagic fish resources landed by the artisanal and mechanised sectors at the observation centres were analysed and studied for the seasonal distribution and abundance of the pelagic species. The results are briefly summarised below.

The exploited pelagic fish landings at Waltair during 1982-83 season amounted to 1312 tonnes, accounting for 24.3% of the total fish landings. Of this about 38.7% was contributed by the indigenous gear and the rest by trawl. While the pelagic fish component formed 83% of

the indigenous gear, it formed only 16.7% in the shrimp trawl. The most dominant species in the pelagic fisheries were ribbon fishes (21.1%), carangids (19.5%), white baits (15.6%), seerfishes (9.6%), lesser sardines (7.9%), sharks (6.7%) and mackerel (5.0%). Along this coast maximum abundance for the above species was recorded during May & September, June & October-December, March-April & September, May - September, March-April & November, August-October and March, June & October respectively.

As estimated catch of 606 tonnes of pelagic fishes were landed at Madras mainly by drift gill nets (67.2%) and bagnets (23.2%). In the pelagic fish landings along this coast, the most dominant species were lesser sardines (32.6%), carangids (10.1%), *Hilsa kanagurta* (9.0%), seerfishes (8.1%), sharks (6.1%) and mackerel (4.5%). The peak abundance was recorded for the lesser sardine during February-April & Sepetember-November, for Carangids during May-June & August, for *Hilsa Kanagurta* during March-May & August, for seerfishes during June-July & December January, for sharks during April-July and for the mackerel May-June & December-January.

During the year significant quantities of tuna were landed in August 1982 by Thangal fishing off Mandapam. Drift gill nets (Valivalai) which were operated at 145-180 meter depth in the Gulf of Mannar landed an estimated catch of 51 tonnes for a fishing effort of about 134 boat days. Out of the total catch, the share of tunas was 75.9% significantly, predominant species that supported this fishery were the skipjack (76.4%), *Auxis thazard* (12.8%) and the big-eye, *Thunnus obesus* (8.1%). The rest of the tuna catch was contributed by *Euthynnus affinis*. The drift gill nets (76 mm mesh) which were operated at 5-11 metres depths in sub-areas 9-79/4A & 9-79/4B in the Palk Bay during August 1982 landed significant quantities of *Hilsa keele* (65.3%) and *Rastrelliger Kanagurta* (32.7%), out of an

estimated catch of 44 tonnes and for fishing effort of 60 boat days. At Keelakarai, drift gill nets (60 mm mesh) operating in Gulf of Mannar, landed an estimated catch of 91 tonnes. The predominant pelagic species that contributed to the landings were *Chirocentrus* spp (29 6%), sharks (11 4%), seerfishes (9.4%), mackerel (9.2%) and *Hilsa* sp (8.9%). Peak abundance for most of these species in the Gulf of Mannar were recorded during April-May and during August-September period At the Palk Bay centres (Mandapam-Thangachimadam) was estimated 1798 tonnes of lesser sardines were landed by 'Choodaivalai'. The maximum abundance was recorded in June with a catch rate of 136.5 kg. Detailed studies on the drift net fisheries off the Mandapam area are being made to evaluate the pelagic fish resources of the area.

The artisanal fishery at Vizhinjam landed, during the current year, an estimated 4348 tonnes of pelagic fish forming 76.7% of the total fish production at this centre. The bulk of the pelagic fish component was caught by Boat seine (57.3%), hooks & line (14.6%) and the drift net (10.9%). Ribbon fish ranked foremost constituting to 40.5% of the total pelagic fish landings, followed by *Stolephorus* spp (17.3%), carangids (15.5%), lesser sardines (6.0%) and tunas (5.7%). The peak periods of abundance for the ribbon fish, white bait and *Decapterus* were during July-August. Tunas and other carangids had their abundance during April-May and again during September-November. The peak landings of lesser sardines were observed during March, May and October.

The pelagic fisheries, off Cochin coast, landed an estimated catch of 9938 tonnes at Fisheries harbour. Out of which, purse seine accounted for 81.7%, drift gill net 13.5% and shrimp trawl 4.8%. Along this coast the most dominant pelagic species in the landings were the oil sardine (63.3%), mackerel (15.6%) tuna (7.7%), carangids (4.9%), whitebait (4.3%) and

seerfish (3.3%). While the oil sardine and mackerel contribuetd to the bulk (96.1%) of the purse seine landings; tuna, seerfish and mackerel formed about 98.4% of the drift gill net landings. During the current year the maximum abundance of oil sardine was observed during December-February; of mackerel, carangids & white bait during September-October, tuna during April-July and seer fishes during October-December.

At Calicut, the artisanal fishery landed an estimated catch of 3801 tonnes of pelagic fish by Pattenkolli (76.3%), gill net (8.4%), Nethalvala (12.8%) and drift net (2.5%). The landings are contributed by oil sardine (93.4%), mackerel (4.2%), seerfish (2.0%) and by tuna (0.4%). During this year the maximum abundance for oil sardine during August-January, mackerel during June & October and for seerfish during July-October was recorded.

The Mangalore with an estimated annual catch of 26,718 tonnes of pelagic fish, is one of the most productive centres on the west coast. The bulk of this catch was landed by purse seine (92.4%) and the rest by drift gill net. Along this coast the dominant species in the pelagic landings were the oil sardine (68.4%), whitebait (21.3%), seerfish (4.0%), carangids (2.7%) and tuna (2.1%). However, the purse seine landings were dominated by oil sardine (74.0%) & whitebait, (23.1%) and the drift net catches by seerfishes (52.6%), tunas (27.1%) and carangids (15.1%). Off Mangalore coast the maximum adundance was observed during September - November period for the oil sardine, whitebait, seerfish, tuna, carangids and pomfret. A secondary peak abundance for the oil sardine, carangids and mackerel was also evident during April-May months.

At Sasson docks (Bombay) an estimated catch of 2,636 tonnes of pelagic fish was landed by trawl. Highest catch & catch rate were generally observed during May-June and October-December. The predominant component species were clupeids

(53.3%), silver pomfret (27.2%), carangids (12.7%) and ribbon fish (6.3%). Along this coast the maximum concentrations of clupeids were observed during May-June & January - February, Silver pomfret during May-June & October-January, carangids during June & November and of ribbon fish during January-February, May-June and September-October.

The pelagic fish catch at Veraval was estimated at 10,650 tonnes forming 36.8% of the total fish landings. Drift net fishery contributed to 20.8% and trawl fishery to 79.2% of the total pelagic landings. The maximum catch and catch rate of the pelagic component was registered during March-April & October-November by trawl net and during April-May & October-December by drift gill net. Along this coast the major component species in the pelagic fish landings were anchovies (19.7%) dominated by *Thrysse* and *Goilia*, ribbonfish (17.8%) *Lactarius* (17.3%), *Ilisha filigera* 7.2%), *Hilsa* spp. (5.8%). *Chirocentrus* spp (5.4%), Bombay duck (5.0%), squids (4 5%), sharks (4.2%) and pomfret (3.5%). Along this coast the maximum abundance for anchovies, ribbon fish, *Lactarius* sp. *Ilisha* spp. *Chirocentrus* spp. Bombay duck and sharks was observed generally during September-December; for *Hilsa* spp and pomfret during November-January and for spuids during December-March. A secondary peak of abundance was also evident during February - May for anchovies, ribbon-fish, *Lactarius*, *Chirocentrus*, sharks and pomfret.

DEMERSAL FISHERIES DIVISION

1. FB/DR/1.8.1 - Estimation of the stocks of cat - fishes

Y. Appanna Sastry, V. N. Bande, N. Gopinatha Menon, C. Muthiah, M. K. George and H. Mohamed Kasim

Waltair: An estimated 165·7 tonnes of Cat - fishes from small commercial trawlers operating at Visakhapatnam base, 50.6 tonnes from in-shore landings operating at Lawson's Bay were recorded. The catch rates in trawl fishing was 0.8 kg/hour, and 1.3 kg per boat in indigenous gears. *Tachysurus thalassinus* was the dominant species that encountered in all gears forming 86·3% in trawlers and 83.4% in bottom set gill nets, 94.9% in Hook & lines.

The size range studied was 60-540 mm with modes at 190 mm, 230 mm, and 310 mm in trawl catches. In Hook & lines the size range obtained was 160-500 mm with modes at 270 mm, 330 mm and 430 mm. Females in more numbers were encountered in both gears.

The dominant food items examined were crabs, young eel, stromatopods, *Leander* spp and molluscs in trawler catches. The cat-fishes caught by indigenous gears showed preference for crabs, squids and young eels for their food.

Cochin: 453015 kg of cat fish landed at the Fisheries harbour during the year as against 854761 kg in the previous year showing an overall decline of 53%. The decline in the fishery was an account of the drastic fall in the landings of trawlers (40 tonnes against 336 tonnes in 1981). Drift nets contributed 82·86%. The trawlers 8.97% and purse seine 8.17%.

Among the four species *T. serratus* contributed 38·32%, *T. dussumieri* 27.39%, *T. Thalassinus* 27.14%, and *T. tenuspinis*

7.15%. Samples were few and irregular, hence systamatic biological studies could not be undertaken. The young ones of *T. thalassinus* appeared in the trawl catches in the month of June and August. Whereas those of *T. serratus* and *T. tenuspinis* in the month of June.

Two samples of *T. thalassinus* examined during the months July and August mostly contained females in spent resting condition. Two samples of *T. tenuspinis* analysed in July and August were in developing stages.

Crab ranked among the most important food item for both the species followed by prawns and squilla.

Mangalore: The estimated catfish landings during this year amounted to 4444 t with a catch per unit effort (cpue) of 275 kg. as against 4024 ft (cpue 0.23 t) of last year. May witnessed peak catches (67.3%) of the total catch) and cpue. The catches constituted of T. dussumieri (88.14%) and *T. tenuispinis* (11.86%). About 76% of *T. dussumieri* was landed during May and 90% of *T. tenuispinis* in October.

Catfishes landed by trawlers were estimated at 1,094 t with a cpue of 25kg. November-March period recorded 84% of the annual catches of which, March recorded high catches and cpue. The catches consisted of *T. tenuispinis* (90.24%) *T. dussumieri* (9.72%) and T. thalassinus (0.04%). Most of the catches of *T. dussumieri* was obtained during April-May, whereas, *T. tenuispinis* during November - March particularly in January and March. Juveniles of *T. thalassinus* were caught in small quantities in June along with juveniles of *T. dussumieri* and *T. tenuispinis*.

Catfish landings by the drift gill net units (mechanised & non-mechanised) during September to March was estimated at 277 t with a cpue of 7kg. Mechanised units with a cpue of 19kg. contributed 64% and non-mechanised units with a cpue of 7kg. contributed 36% to the annual catches.

Species in the catches were *T. serratus* (32.57%), *T. dussumieri* (24.69%), *T. thalassinus* (6.54%) and *T. tenuispinis* (36.20%).

T. tenuispinis : In the purse seine catches the sizes varied from 102 to 435 with modes at 334, 374 and 414 mm. In the trawler catches sizes ranged from 55 to 430 mm with modes at 74, 174, 204m, 274 and 354 mm. Sizes in the drift gill net ranged from 279 to 430 mm with modes at 344, 374, 414 and 434 mm (88.5%).

T. dussumieri : Sizes ranged from 335 to 980 mm with modes at 469, 849 and 909 mm. The fishery during May & October was supported by fish ranging in size between 409 and 589 mm whereas in February size ranged between 689 and 989 mm.

T. serratus : The sizes of *T. Serratus* caught by gillnets ranged from 330 to 1170 mm with modes at 824 and 974 mm. Ripe, partially spent and spent individuals were recorded in October. The male to female ratio was 9:31.

Bombay : The two main landing centres of catfish resources at Bombay are the Sassoon dock and New Ferry Wharf. The most important catfish species of trawl net catch is *Tachysurus jella* whereas that of hook and line and gill net is *Tachysurus sona*. The total estimated catch landed at Sassoon dock during April '82 to March '83 was 3269.296 tonnes which formed 9.28 percent and that of Ferry Wharf was only 4.95 percent. Analysis of catch and effort of EFP vessels operated from Bombay for April '82 to March '83 showed that 15.6 tonnes of catfishes was landed at Sassoon dock showing a catch rate of 18.50 kg/hr. and interestingly it formed 24.88 percent of total catch by ESP Vessels which expended 819.25 hrs. as fishing effort. Among the operated areas 17-73 (1A) showed as the best area for catfish. The other important catfish species at Bombay is *A. jella*. Its total length measured varied from 20 cm to 35.5 cm. During March, *A. coelatus* was found occuring in dol net catch at Veraval.

Veraval : The catfish landing was good during the year as the landing was 411.2 tonnes as against 383.3 tonnes of last year (27.9 tonnes more). This is because of better abundance of catfish, though there has been a reduction of 8,688·7 tonnes in the total landings of fish. There was no improvement in the contribution of trawlers towards catfish landings, but there was reduction in the trawlers landings of catfish due to reduction in effort as the catch rate remained same. The increase in the catfish landings was due to gillnetters as there was increase in the effort as well as in the catch rate. The abundance of catfish was good during April, June, from August to November and in February. The dominant species was *T. dussumieri* in gillnet landings and in trawlnet landings *T. dussumieri T. thalassinus* and *O. militaris* were dominant.

Calicut : The catfish fishery at Calicut was supported mainly from the catches of hooks and line, drift net and trawl net. During the period July 1982 to March 1983 the all gear catfish catch at Calicut was 339.3 tonnes, out of which 72.4% was contributed by hooks and line, 17.1% by drift net and 10.5% by trawl net. During the period under report the all gear catch per standard effort varied from 55.5 kg in January '83 to 193.9 kg in September '82.

In the hooks and line *T. tenuispinis* was the most dominant species and next in abundance was *T. dussumieri* in the drift net *T. dussumieri* was the most abundant species and next dominant species were *T. tenuispinis* and *T. serratus*; while in the trawl net T. *tenuispinis* dominated the catch.

During the months of August and September the *tenuispinis* fishery was supported mainly by ripe and spent fishes, and females dominated the catch. Similarly during October to December also females dominated the catch and the important maturity stages were III and VII.

2. FB/DR/1.8.2: Resource Characteristics of Perches:

P. Sam Bennet, K. M. Ameer Hamsa, P. A. Thomas, and S. K. Chakraborty.

Regular observations on the resource characteristics of perches were carried out at Tuticorin, Vizhinjam and Bombay. They were caught by drift nets, hook and line gill nets and trawl net. At *Tuticorin* area non-mechanised boats landed 193.5 tonnes of perches during the year. Highest catch was recorded during February. Experimental fishing for perches with collapsible traps were conducted at Tuticorin during the year. The results were not encouraging. Perch landings at *Vizhinjam* was estimated at 315.0 tonnes forming 5.6% of the marine fish landings. The maximum catch was recorded during the month of March with 74.9 tonnes. *Nemipteridae* formed 50.6% of the perch landings at Vizhinjam. Next in importance was *Theraponidae*. At *Bombay* over 1589.3 tonnes were estimated to have landed. Contribution of perch to the total fishery was 2.9%. Peak landings was during the month of October. *Epinephilus diecarthus, Lutianus johnii* were the dominant species of perches at Bombay.

3. FB/DR/1.8.3: Resources characteristics of threadfin breams

T. Appa Rao, V. Sriramachandra Murty, E. Vivekanandan, K. V. Somasekharan Nair, Gracy Mathew, S. K. Chakraborty & S. G. Raje

At Waltair: the private trawlers landed an estimated 489 tonnes of nemipterid fishes forming 11% of total trawl catches with peak catches recorded during November-January period. The length range of catch at Waltair was 75-235 mm.

At Kakinada an estimated 1020 tonnes of nemipterids were landed by private trawlers forming 6% of total trawl

catch. Peak catches were obtained during November-February forming 85% of the catch obtained during the year. The catches showed an increase of 44% over previous year though there was a decline of 11% in the effort. The length range of catch at Kakinada was 55-295 mm.

At Madras the private trawlers landed 945 tonnes of Threadfin breams forming 17.5% of total trawl catches. Peak catches were obtained during July – September period. When compared to the previous year there was an increase of 37% along with an increase of 4% in the effort. The length range of catch at Madras was 55-305 mm.

At Cochin: an estimated 3790 tonnes of these fishes were landed by trawlers. Peak catches were obtained during July - September period; over 93% of nemipterids were landed during these three months. The catches showed an increase of 42% over previous year along with an increase of 21% in the effort. The length range of catch at Cochin was 65-285 mm.

At Bombay : an estimated 4329 tonnes of threadfin breams were landed by trawlers forming 8.3% of total trawl landings. Peak landings were obtained in May at Sassoon dock and in March at New ferrywharf. When compared to previous year the catches showed considerable increase (136%) though there was a marginal increase (5%) in the effort. The length range of catch at Bombay was 95-245 mm.

At Calicut : an estimated 51 tonnes of nemipterids were landed. A decline of 45% in the catch was recorded though there was about 7% increase in this effort. The length range of catch at Calicut was 85-195 mm.

At Veraval : an estimated 359 tonnes of threadfin breams were landed during October 82 - March '83 period. During the six - month period peak catches were obtained in January - February. The length range of catch at Veraval was 103-345 mm.

Along the centres on the east coast *N. japonicus.* and N *mesoprion* were most abundant. At Waltair these species together formed 90% of threadfin breams landed; at Kakinada they formed 95% of nemipterid catches and at Madras they formed 73% of the threadfin bream catches. At waltair the catch of N. *japonicus* showed increase (79%) over previous year but N. *mesoprion* showed considerable decline. At Kakinada N. *japonicus* showed 3% increase over previous year. At all the centres majority of the fishes examined had empty stomachs and the important food items were stomatopods, prawns and teleosts.

4. FB/DR/1.8.4-Assessment of Sciaenid Resources

T. Appa Rao, V. Sriramachandra Murty, E. Vivekanandan K. V. Somasekharan Nair, Gracy Mathew, S.K. Chakraborty & S. G. Raje.

Waltair: An estimated total catches of 375.4 tonnes of sciaendis which contributed to 8.2% of total catches. The catches decreased by 26.3% when compared to last year inspite of increase of effort by 27.4%. When compared to last year, the percentage contribution of *J. carutta* decreased by 1.1% and *J. maculatus* 14.8% while the catches of *P. axillaris* increased by 8.5%. For *J. carutta*, a minimum catch rate of 0.21 and maximum of 1.61 kg/hr were obtained during May and October respectively. *J. carutta* measuring 80-165 mm contributed to the catches and dominant size range was between 125-150 mm.

Kakinada: An estimated catch of 579 tonnes of sciaenids which constituted to 3.4% of total trawl catches were landed when compared to last year. The catches decreased by 32% with simultaneous decrease in the effort by 5.5%. The important species were *Atrobucca nibe, Johnius vogleri, J. carutta, Pennahia macropthalmus* and *Otilithus ruber.* Peak catches and catch rates were obtained in November '82 and February '83. *J. carutta* measuring 115-185 mm

contributed to the catches. Fishes with mature and gravid gonads were obtained in April, June, January and February. The stomachs in majority of specimens were either empty or averted.

Veraval: An estimated catches of 3944 tonnes of sciaenids which contributed to 18.7% of total catches were landed. Out of nine species, *Otolithus ruber, O. cuvieri, Johnius glaucus* are the important species. *O. ruber* ranged from 105-354 mm and *J. glaucus* 110-294 mm in total length. The sex ratio was 51.07: 48.93; for *J. glaucus*, it was 46.3: 53.7. During the period October-March, the ovaries in majority of specimens *O. ruber* were in maturing condition while in *J. glaucus* mature and gravid females occurred during December-March.

Bombay: A total catch of 1654 tonnes of sciaenids were landed which contributed to 4.5% total catches. When compared to last year, the catches had fallen down by about 50.0%. *J. vogleri* and *O. cuvieri* were dominant species while *J. macrorhynus* and *J. sina* were secondary in importance. *J. macrorhynus* measuring 85 - 309 mm contributed to the fishery while *J. vogleri* ranged in total length from 100-324 mm. The size range of O. cuvieri was 100-324 mm. *J. macrorhynus* with mature gonads were reported during November, January and March. Mature specimens of *J. vogleri* are obtained during January - April.

Cochin: An estimated landings of 452.3 tonnes of Sciaenids were landed (C.P.H. 9.03 kg/hr) when compared with the catches of previous year, there was an increase in the catch, *Johnieops dussumieri, J. sina, Kathala axillans, Otolithes ruber, O. cuvieri* are the important species which contributed to the fishery. *J. dussumieri* ranged in size from 40-165 mm. *J. sina* measuring 90 to 170 mm contributed to the fishery.

Madras: From Nasimedu and Madras centres an estimated catches of 300 tonnes of Sciaenids were landed but the

private trawlers. They contributed to 5.5% of total catches. Higher catch rate of 28.3 kg and lower of 2.2 kg/hr recorded in May and September respectively. *Johnius carutta* (26.0%), *Otolithes argenteus* (19.7%), *Pennahia auens* 12.5% and *Kathalla axillans* (11.1%) are the important species of Sciaenids. *J. carutta* measuring 50 - 199 mm contributed to the fishery, with modal length of 110-129 mm. Females with ripe gonads were observed in April and November '82. The food components mainly consisted of *Squilla* sp, fish and prawns. From the indigenous gear 2093 kg of Sciaenids were landed. *J. carutta* measuring 32-159 mm contributed to the catches.

Calicut: 96008 kg of Sciaenids were landed both from mechanised and indigenous craft. Bulk of the catches are realised during the later part of the half year i.e., during the period November '82 to February '83. *Sciaena sina*, *Otolithes ruber*, *Otolithus argenteus* contributed to the fishery. *S. sina* ranged from 62-213 mm contributed to the fishery. Gravid females appeared during November '82 to January '83.

5. FB/DR/1.8.5-Resource characteristics of silver bellies.

V. Sriramachandra Murty, J. C. Gnanamuthu, N. Gopalakrishna Pillai.

Mandapam: The estimated total catch of silver bellies amounted to 3669.9 tonnes as against 3546.2 tonnes landed in last year, the respective CPU being 105.4. kg. and 103.6 kg. The maximum catch and CPU of 1860.4 tonnes and 220.3 kgs. were obtained during the first quarter (April to June). Silver bellies formed 74.1% of the total catch, *L. jonesi* being the dominant species. The 0 year and one year classes constituted the major fishery the size range being 25 to 120 mm. Though mature *L. jonesi* were observed in all the months, the maximum spawning period extended from January to June. The dominant food items of *L. jonesi* were larval bivalves, copepods, diatoms and foraminifera.

Rameswaram: Estimated catch of silver bellies came down to 735.83 tonnes from 10201.1 tonnes landed during last year, the respective CPU being 99.8 kgs. and 117.7 kgs. Maximum catch of 2663.7 tonnes and CPU of 122.7 kgs were obtained in the fourth and first quarter respectively. *L. jonesi* was the dominant species whose size range was 15-120 mm. The 0 year and 1 year classes formed the main fishery. Females predominated over males. Good quantity of mature fish were recorded from January to April.

Pamban: The total estimated catch of silver bellies landed from Gulf of Mannar side at Pamban amounted to 906.8 tonnes as against 998.1 tonnes landed in the previous year. *L. dussumieri* was the dominant species, the size range of which was 55 to 145 mm. The modal categories observed were 70-95 mm and 100-110 mm.

Kakinada: An estimated 976.4 tonnes of silver bellies were landed forming 5.6% of the total trawl catch. Good catches and catch rates were obtained during December-March period. *L. bindus* and *S. insidiator* were most dominant forming 76% of the catch of silver bellies. *L. bindus* of the size range 17-127 mm contributed to the fishery. The size range of *S. insidiator* was 47-112 mm.

Madras: There has been a decrease in the total catch and CPU of silver bellies, the estimated catch being 409.7 kgs which formed 7.6% of the total trawl catch at Kasimedu. Highest and lowest catches were recorded in April '82 and February '83. Quarterwise analysis of the catches revealed that the catches were going down from 1st quarter to the fourth quarter. *L. bindus* and *S. insidiator* were the dominant species and formed together 67% of the total silver bellies catch. *L. bindus* of the size range 35-130 mm contributed to the fishery, the 0 year and one year classes dominating the catches. Males and females were more or less equally represented in the catches.

Mature fish were available almost throughout the year but their percentage was high in June, July, September and December.

6. FB/CUL/ 1. 1. 1 - Culture of marine fishes

K. Dorairaj, R. S. Lal Mohan, A. Raju, V. S. Rengaswamy, R. Marichamy, & S. Lazarus.

Mandapam Camp: A total of 1,17,800 fry and 26,373 fingerlings of *Chanos* were collected and during the process of collection and acclamatisation in the temporary field tanks, 12.6% mortality occured. A total of 1, 25, 940 *chanos* seeds were transported from the various collection centres to the fry rearing laboratory at Mandapam Camp with very high survival rate. Out of the collections made at Mandapam 26,500 live *chanos* fry and fingerlings were transported to Tuticorin, Calicut and Madras for culture purpose. 20,000 fry reached Tuticorin with 100% survival 1760 fry and fingerlings to Calicut with 99.5% survival and 4803 fry and fingerlings to Madras with 96.7% survival rates.

The fingerlings of milkfish and mullet measured 121.9 mm (21.2 g) and 42.5 mm (2.5 g) respectively at the time of stocking. In July '82 after a rearing period of 10 months for milkfish and 9 months for mullet. At harvest milkfish attained the size of 329.1 mm (227.2g) and mullet of 190.1 mm. The yield/ha. and survival were 1405.5 kg (86.7%) for milkfish and 64.4 kg (10.3%) for mullet. A fresh experiment was started during August '82 with milkfish and mullet in the ratio of 2:1 at an overall stocking rate of 1000/ha. In 7 months period, milkfish showed the growth rate of 27.1 mm (17.3 g) and mullet of 13.7 mm (4.1g) in 6 months. The stock in the earlier and fresh experiment were fed with groundnut oil cake and ricebran in equal proportion at the rate of 5-10% of the body weight of the fish. In the unfertilised pond, *chanos* and mullets which

were stocked in September and October '81 respectively were harvested in July 1982. The yield/ha. as well as the survival rates were 1288.9 kg and 81.2% for chanos and 85.9 kg. and 11.4% for mullet. A fresh experiment was initiated during August '82. During the culture period in both the experiments. supplementary feed such as rice-bran and groundnut oil cake were provided in equal proportions at the rate of 5-10% of the body weight of the fish. Work on 5 net enclosures were completed.

The enclosures were stocked with *chanos* fry collected from the lagoon. The .25 ha. pens were stocked with chanos fry at the rate of 4000, 6000 and 8000 per ha. Good growth was observed. The salinity during the period was rather high in the range of 56.6 to 83.4 ppt. The average length increment was about 2.2 mm per day and the weight increment was 1.4 g/day. A pen of area .5 ha was stocked with chanos fry at the rate of 1270/ha. The increment in length was 1.1 mm per day and that of weight was .8 g. One of .25 ha. pen was again restocked with 865 numbers of fingerlings of chanos collected on 18.11.82. An attempt was made to culture the milkfish in eel ponds, along with the Indian short-finned eel, *Anguilla bicolor bicolor*. No supplementary feed was given to the milkfish; between they subsit on the luxuriant growth of phytoplankton in the tank. When eels were harvested after completion of one year, milk fish was also harvested after three months of rearing. The monthly growth rate works out to 47.3 mm in length and 15.2 g in weight. Envisaged by the preliminary results, another consignment of 126 nos. of milkfish fingerlings were stocked in eel tank on 21.8.82. The Stocking rate was 70,000/ha. The milkfish were found to grow well in the tank.

The primary productivity of the culture sites were studied regularly from October onwards. The primary productivity in these areas except, pillaimadam lagoon were observed to be very high. The tank in which eels and chanos are cultured

combinedly showed very high values. The primary productivity in pillaimadam lagoon varies due to changes in water level, rainfall and salinity.

The oxygen level in the ponds is always lower than the levels generally found in the sea. The salinity is affected by water level and temperature.

Tuticorin:

Fish culture experiments were carried in six ponds in an area of 1.5 hectare. Composite culture with *chanos* and *Scylla serrata* as well as *Chanos* and *Penaeus indicus* gave good growth rate but survival and recovery was poor because of poaching. The *chanos* stocked at 20 mm have grown to 346 mm in 7 months period. In monoculture system with *Chanos* only 310 kg/ha was recorded from pond D. Weekly observations on water temperature, salinity and dissolved oxygen content of the rearing media were made.

Calicut:

Two sets of culture experiments were completed and one set was initiated during the year. The pearlspot, *Etroplus suratensis* was cultured in four ponds having a total area of 411 m water column and the milkfish, *Chanos chanos*, was cultured in 9 ponds having a total area of 2358 m water column. The stocking size of *Etroplus* was 14.4 mm (0.075 g). Harvest was done after 201 days and the mean size of the fish was 117.9 mm [39.4 g]. A daily increment of 0.78 mm [0.19 g] was noted. It gave a production rate of 464 kg per hectare with a survival rate of 46.5%. With regard to *Chanos* culture, out of 1677 numbers of seeds introduced for culture, at the time of harvest 1200 fishes were recovered giving a survival rate of 72%. A total of 210. 2 kg was obtained at harvest which works out to a production rate of 1085.7 kg/ha. The daily increase ranged from 1.4 mm to 2.03 mm in length and from 0.77 g to 1.60 g in weight in various ponds.

The ponds (84m²) were again stocked with 250 number of *Etroplus* with an average size of 26.8 mm [0.4 g] and observation are being made on the growth of the fish.

7. FB/CUL/1.1.3 - Culture of grey mullets

V. Gandhi, G. Mohanraj, A. Raju, V. S. Rengaswamy and L. Krishnan.

The project work was conducted in 2 centres namely Narakkal and Mandapam.

At Narakkal centre data on maturation and spawning periods of the mullet species *M. cephalus* and *L. persia* were collected through regular sampling of specimens from the catches obtained in chinese dip nets and cast nets. At Mandapam, data in relation to the above aspects on the species, *L. macrolepis* was collected from specimens caught in Kalamkatti valai in Thonithurai and Manoli island.

At Narakkal regular monitoring of a broodstock of *M. cephalus* and L. parsia kept in a 0.1 ha. pond in the laboratory was performed throughout the report period. At Mandapam centre about 34 adults of *L. macrolepis* were released into a 0 24 ha pond during September '82 with a view to raise a broodstock. Breeding experiments, one in the case of *M. cephalus* and 17 involving 46 females in the case of *L. parsia* specimens were performed at Narakkal centre. In the case of *M. cephalus* the ova could be made to advance from 2nd to 3rd stage of maturity by hormone administration. In the case of L. persia of the 46 females treated, 16 responded to treatment. Of these 4 spawned naturally, 6 were stripped and 6 were left as they were since ova were not fully mature. In 3 of the specimens which were allowed to spawn naturally, eggs got fertilized and underwent development for periods varying from 4 to 10 hours and then stopped. In 2 cases the eggs hatched out to larvae. Of these in one case the larvae numbering around

5000 were reared for 12 days alone. At Mandapam centre 10 adults of *L. macrolepis* were treated with either synthetic hormones or carp pituitary homogenete. 6 specimens responded to treatment and in 4 atresia set in. Of the 6 which responded in 3 cases the eggs got fertilized. But further development of eggs did not take place. Wild seed of *L. parsia* collected from Puduvype area were used in a feeding experiment to test 4 slightly different diets to study the influence of vitamins and minerals on the growth, conversion efficiency etc. of the mullet seed At Mandapam centre a total number of 4205 fingerlings of the species *V. Seheli* and *L. macrolepis* were collected from Thonithurai, Manoli island and Dhanushkodi. 3 sets of monoculture experiments on *V. seheli* begun in September '81 were closed in September '82. The harvest gave production rates of 135 kg, 164 kg and 59 kg per hectare in the expts I, II and III respectively. 3 new monoculture experiments on *V. seheli* were resumed in 3 ponds of the size 200 sq. m in September '82.

8. FB/CUL/1.2 - Induced breeding and culture of eels (Anguilla)

K. Dorairaj and D. Kandasami.

Mandapam Camp: Two culture experiments in 12' dia tanks were conducted. The total weight of eels in one tank increased from 30 kg. to 35.1 kg, showing a net weight increase of 5.1 kg in one year. The average weight of eels had increased from 103.45 g to 141.53 g, with a net weight increase of 38.08 g. The overall survival rate was 85.5%. In the other tank, the net weight increase was 7.1 kg and the average weight increase per eel was 30.2 g with a overall survival rate of 89.9%. In both the experiments, the weight increase was very low. Very impressive result was obtained in an another culture experiment conducted in an outdoor cement tank. 9kg of eels was stocked at a rate of 500 g/sq. m. The

size of the eels at stocking ranged from 254 to 346 mm with an average of 299 mm and the weight from 24.0 g to 72.0 g, with an average of 43 g. The eels were fed with an artificial feed. At harvest after one year of rearing, a total of 198 numbers of eels weighing 48.18 kg in total we ght was obtained. The average length and weight of eel at harvest were 489.02 mm and 243.33 g respectively which works out to a monthly average increase of 15.9 mm in length and 21.0 g in weight per eel. The survival rate was 2.18 kg/sq. m. The artificial feed had given a gross conversion ratio of 11.1 : 1. During the season, 11,000 elvers weighing 15 kg were collected from Srivaikundam anicut and transported to Mandapam camp with 100% survival rate. The elvers are proposed to be utilised for experiments on sex reversal in eels.

Tuticorin: The Scientist at this centre was deputed to undergo a training in 'Fish and shellfish Nutrition' in the Faculty of Fisheries Kagoshima University, Japan and hence no bio-chemical work was carried out during the period. The Scientist has participated in the live elever collection programme at Srivaikundam anicut and in the packing and transportation of elvers from Tuticorin to Mandapam Camp.

CRUSTACEAN FISHERIES DIVISION

In the capture fisheries the salient features of the prawn fishery during the year 1982-83 were :

1. Overall production of prawns in the country showed only a marginal increase from that of the previous year.

2. The penaeid prawn catches at the most important landing centre, Neendakara in Kerala State remained at the same low level as in last year.

3. While the landings at Neendakara remained stationary at the lowest level all the other observation centres showed increase in catches when compared to previous year, except Tuticorin.

4. The non-penaeid prawn fishery showed the same trend of decline in the north west coast centres of Veraval and Bombay and increase at the east coast centre at Kakinada.

5. The abundance of juvenile penaeid prawns in the estuarine environments showed a general improvement this year except in Cochin backwaters where the rate of recruitment of the principal species *Metapenaeus dobsoni* and *Penaeus indicus* remained to be much lower than in the previous year.

6. Stomatopods forming a by-catch in prawn fishery has been landed in maximum abundance at Mangalore during this year.

The salient feature in culture fisheries of crustaceans are as follows :

1. A new technique using a dry microparticulate formula feed has been developed for hatchery production of marine prawn seed at Narakkal.

2. Spectacular enhancement of growth in spiny lobsters has been obtained by bilateral ablation of eyestalk at Kovalam, Madras.

3. For the first time in India *Penaeus japonicus*, the kuruma shrimp has been cultured in the ponds at Mutukkadu.

4. The larvae of the crab *Scylla serrata* have been reared from the first zoea to the first crab stage under laboratory conditions, at Tuticorin.

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

M. J. George, Manmadan Nair, G. Sudhakara Rao, S. Lalitha Devi, D B. James, M. Rajamani, K. N. Rajan, K. K. Sukumaran, K. Y. Telang, G. Nandakumar, S. Ramamurthy, M. Aravindakshan, V. D. Deshmukh, N. S. Kurup, P. V. K. Rao, C. Nalini, K. K. Balasubramanian, K. Chellappan, O. Tippaisamy, V. Suresh, S. Lakshmi, Manickaraja, J. B. Varma, B. P. Tumber, A. Y. Mestri, P. Tirumulu, C. K. Dinesh.

In the penaeid prawn fishery the landings remained almost at the same level of lowest figures reached in last year at the most important landing centre in Kerala State, namely Neendakara. With the result the overall production figures for the resource did not show any substantial increase during the year when compared to previous year. However, all the other observation centres, excepting Tuticorin in Tamil Nadu, showed increased catches in this year. The catch figures at Tuticorin alone showed a steep decline.

The estimated landings of penaeid prawns along with catch per unit, effort species composition and their percentage representation, peak season of fishery and price structure are given in tables 1 and 2. Among the penaeid prawns

TABLE No. 1 PENAEID PRAWN FISHERY AT VARIOUS CENTRES IN 1982-1983

	Gujarat	Maharashtra	
	Veraval	Sasoon Dock	New Terry Wharf
I MECHANISED FISHERY			
1) Catch in tonnes	1896	10179	8774.5
2) Catch/effort (Hrs)	4.2 kg/ha	50.8 kg/ha	399.1 (kg/units)
3) Important species	j, l, k, b, e, i	b, c, d, j, n, l	j, c, b, l, m
4) % of prawns			
5) Productive months	12, 10, 11, 1	10, 9, 8, 12	9, 11, 10, 12, 3
II INDIGENOUS FISHERY		SASOON DOCK (DOLNET)	VERSOVA (DOLNET)
1) Catch in tonnes		174.1	318.2
2) Catch/effort (kg)		13.57 kg/boat	29.73 kg/boat
3) Important species		l, n, d, j	l, j, n, k, b
4) % of prawns		9.34	5.85
5) Productive months		5, 4, 12, 11, 3	10, 3, 12, 11
III PRICE STRUCTURE (Rs)			
1) Large	35 — 70	50 — 150	
2) Medium	15 — 35	20 — 30	
3) Small	10 — 15	10 — 12	
4) Tiny	2 — 6	5 — 8	

Important Species

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. crassicornis
m) M. stridulans

TABLE No. 1 contd.

		Karnataka				Mangalore			KERALA	
		Karwar		Malpe						
		Trawl catch	purse seine	trawl catch	purse seine	trawl catch	purse seine	Calicut	Cochin Fisheries Harbour	Sakthikulangara
I										
	1)	944	39	646.2	322	1976	449	217	2957	9425
	2)	7.4 (kg/hr)		4.8 (kg/hr)		8.4 (kg/hr)		30.2 (kg/unit)	16.33 (kg)	16.2 (kg/hr)
	3)	j, a, c, b	a	a, j, c, f	a	j, a, c, f	a	j, a, c, f	j, a, f, c	j, f, a, c
	4)							36.4		
	5)	1, 2, 3, 4, 5	9	9, 11, 4, 12, 2	9	12, 9, 1, 3, 2, 11	9	1, 7, 10, 12, 2	5, 6, 4, 9,	7, 8, 6, 5, 10, 9
II						ULLAL	BAIKAMPADY			
	1)	11				3.7	2.7	49.4		
	2)	15.1 kg						18.8 kg/unit		
	3)	g, a, j, h			a		f	a, f, j		
	4)									
	5)	8, 7, 6			9		8			
III										
	1)			57—80		50—80		55—90		
	2)			20—43		16—44		45		
	3)			8—17		9—14		14—18		

TABLE No. 1 contd.

		TAMILNADU			ANDHRAPRADESH		ORISSA
		Tuticorin	Mandapam	Madras	Kakinada	Waltair	Paradeep
I							
	1)	163	757	246	2911	627	694
	2)	1.27 kg/hr	2.9 kg/hr	1.54 kg/hr	12.94 kg/hr	3.0 kg/hr	4.7 kg/hr
	3)	i, f	i, b	f, c, a, i	c, a, f, j, d	c, f, m, a, l, h	c, b, h, k, l, a
	4)						
	5)	6, 7, 8, 11	6, 3, 8, 2, 5	6, 3, 8, 2, 5	11, 12, 2, 3, 7, 8	11, 9, 8, 7, 10	12, 11, 10, 1, 5
II					UPPADA		PENTAKOTA
	1)				247		119.5
	2)				0.47 kg/hr		0.34 kg/hr
	3)				a, f, c, j		g, f, b
	4)						
	5)				12, 2, 7, 9		10, 11, 12
III							
	1)				60—120		50—105
	2)				30—40		25—40
	3)				8—20		6—12

TABLE No. 2. Percentage of penaeid prawn species at different centres in Trawl Fishery Indigenous gear given in parenthesis

	SPECIES	GUJARAT	MAHARASHTRA		KARNATAKA		
		VERAVEL	Ferry Wharf	Sasoon Dock	Karwar	Malpe	Mangalore
1)	Solenocera crassicornis	26.1	12.2	3.1 (37.4)			
2)	Penaeus indicus					3.4	2.3
3)	Penaeus merguiensis				1.8 (40.0)		
4)	Penaeus monodon				0.2 (6.0)	0.3	0.4
5)	Penaeus semisulcatus	2.6					
6)	Penaeus penicillatus	1.0					
7)	Metapenaeus dobsoni				23.8 (35.2)	44.6	34.1 (100.0)
8)	Metapenaeus affinis	6.4	22.7	24.8	15.2	2.3	1.2
9)	Metapenaeus monoceros	3.7	23.1	21.4	18.3	12.2	12.4
10)	Metapenaeus brevicornis		1.5	3.1 (18.1)			
11)	Metapenaeus Kutchensis	5.2					
12)	Parapenaeopsis stylifera	38.3	27.9	31.1 (16.3)	40.7 (11.6)	37.2	49.6
13)	Parapenaeopsis hardwickii	10.3	2.8	(0.1)			
14)	Parapenaeopsis sculptilis			(26.2)			
15)	Metapenaeopsis stridulans		6.1				
Other penaeid prawns		6.4	3.7	16.5 (1.9)	(7.2)		

TABLE No. 2 contd.

SPECIES	KERALA			TAMILNADU			ANDHRA PRADESH		ORISSA
	Calicut	Cochin Fisheries harbour	Sakthikulangara	Tuticorin	Mandapam	Madras	Kakinada	Waltair	Paradeep
1)								10.0	6.3
2)	9.0 (2.8)	5.0	10.4	40.0	0.5	42.0	9.0 (8.9)	18.0	(14.8)
3)							2.1 (1.3)		2.3 (61.2)
4)		0.2	0.1			1.9	5.7 (1.2)	4.9	9.2 (4.4)
5)			0.1	60.0	82.4	8.2	4.2 (0.6)	1.0	
6)									1.1
7)	30.5 (94.5)	39.2	7.8			23.6	20.5 (71.0)	15.3	5.9
8)	8.5	0.4	0.5		17.1		3.8 (1.0)		21.3 (19.6)
9)		4.9	1.9			24.3	23.2 (4.7)	26.9	33.9

TABLE No. 2 contd.

SPECIES	KERALA			TAMILNADU			ANDHRA PRADESH		ORISSA
	Calicut	Cochin Fisheries harbour	Sakthikulangara	Tuticorin	Mandapam	Madras	Kakinada	Waltair	Paradeep
10)							6.3 (2.2)		
11)									
12)	52.0 (2.7)	50.3	78.1				6.7 (4.2)		2.8
13)							3.3 (2.2)		6.7
14)									
15)									
Other penaeid prawns			1.1				15.2 (2.7)	17.0 6.9	1.4 9.1

Parapenaeopsis Stylifera ranks first in overall abundance. One interesting feature noticed during the year is the landings exclusive catches of *Metapenaeus dobsoni* by purse seines in the centres along the south west coast.

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

S. RAMAMURTHY, M. ARAVINDAKSHAN, S. LALITHA-DEVI, V. D. DESHMUKH, V. S. KAKATI, J. B. VARMA, A. D. SAWANT, B. P. TUMBER, K. K. BALASUBRAMANIAN.

The non-penaeid prawn fishery exhibited the same trend as in last year. Compared to 1981-82, this year the fishery at Veraval declined marginally while at Bombay it declined by 30%. At Kakinada the non-penaeids showed an increase of 1.26 times that of the previous year. Here the brackish water catches of nonpenaeids also showed increase. *Acetes indicus* was the major constituent of the catches at all the Centres. *Nematopalaemon tenuipes* and *Exhippolysmata ensirostris* were the other important species in that order of abundance. The size groups of *A. indicus* at Bombay ranged from 14-29 mm.

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

C. SUSEELAN, MANMADHAN NAIR, S. LALITHA DEVI, D. B. JAMES, V. S. KAKATI, N. S. KURUP, K. K. SUKUMARAN, G. NANDAKUMAR, P. V. K. RAO, K. N. GOPALAKRISHNAN, K. CHELLAPPAN, C. K. DINESH, K. KOUMUDI MENON, P. THIRUMULU

Routine experimental fishing carried out in the estuarine environments indicated active recruitment of penaeid prawns during November-January at Karwar, Mangalore and Madras and in September at Cochin. While *Penaeus Indicus* and *P. merguiensis* showed preponderance at Karwar, the former species along with *Metapenaeus dobsoni* dominated in the shore seine collections at Mangalore. In Cochin backwaters considerable decline was noticed in

the rate of recruitment of *P. indicus* as compared to the previous year especially during the postmonsoon months (December- March) when normally this species appears in maximum abundance. A drastic reduction was also noticed in the recruitment of *M. dobsoni* ("thelli" during the later half of this year, which would suggest a corresponding decline in its fishery for the following period.

The juvenile prawn catch showed improvement at Mangalore, Calicut, Madras and Kakinada although at the last centre slight decrease was noticed in the catch rate. The Cochin backwaters repeated low annual production of the principal species *M. dobsoni* and *indicus* which have been showing a gradual declining trend in abundance for the past few years. In Ashtamudi backwaters these two species constituted the bulk of the stakenet catches. At Arkhakuda (Puri) the CPUE for prawns improved marginally although the total catch for this year was slightly less than in the previous year. The most dominant species in the fishery were *M. dobsoni* at Karwar, Mangalore, Calicut, Cochin and Quilon, *M. monoceros* at Kakinada and *P. indicus* at Puri.

Relationship of mesh size and size of prawns in prawn fishery (Revised as an IDP Project) (CF/RE/1.1.6)

C. SUSEELAN, M. M. THOMAS, V. S. KAKATI

Suitable experimental trawl nets have been designed and fishing trials with 16 and 18 mm cod-end mesh sizes were carried out.

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

E. V. RADHAKRISHNAN, P. V. KAGWADE, V. D. DINESH, K. Y. TELANG, A. MOHAN, W. VENUGOPALAM, M. MANICKARAJA, V. SURESH, K. K. BALASUBRAMANIAN, A. Y. MESTRY, B. P. TUMBER, O. TIPAISAMY.

Decline in the estimated landings of spiny lobster was noticed at all observation centres except Bombay and

Calicut. The improvement at Bombay was mainly because of the increased landings of the sand lobster *Thenus orientalis*. The catch of the palinurid lobsters declined at Bombay also. However the landings of the palinurid lobster *Panulirus homarus* and *P. polyphagus* near Calicut alone showed improvement. The sand lobster *T. orientalis* was landed in good quantities at Madras also.

The crab landings showed an improvement over the landings of the previous year at all the three centres, Mangalore, Madras and Kakinada, catch being the highest at Kakinada.

Assessment of Stomatopod resources (CF/RE/1.7)

M. M. KUNJU, D. B. JAMES, N. S. KURUP, K. K. SUKUMARAN, G. NANDAKUMAR, G. SUDHAKARA-RAO, KOUMUDI MENON, C. NALINI, O. TIPAISAMY, DINESH, P. THIRUMULU.

Stomatopods form one of the major components of the by catches of the trawl landings, contributing even upto 35%. Among the centres which were covered for resource studies, namely Karwar, Malpe, Mangalore, Calicut, Cochin and Madras, during the year under report, maximum landings were recorded at Mangalore. At Madras the catches were very poor in this year. The fishery was exclusively supported by single species *Oratosquilla nepa* in all centres excepting Madras, where a number of species were found.

Field culture of Marine prawns (CF/CUL/1.1.1)

M. S. MUTHU, P. VEDAVYASA RAO, K. H. MOHAMED, N. N. PILLAI, S. K. PANDIAN, MARY K. MANISSERY, SYED AHAMED ALI, A. LAXMINARAYANA, P. E. SAMPSON MANICKOM, M RAJAMANI, G. NANDAKUMAR, M. KATHIRVEL, K. DEVARAJAN, M. RAJAGOPALAN, S. LAZARUS.

At Narakkal, Cochin: A 0.6 ha pond stocked with 20 mm size hatchery produced seed of *P. indicus* @ 50,000 per hectare yielded a harvest of 160 kg/ha after 73 days of culture. The recovery rate was 33% and the size at harvest was 117 mm/10.3 gm. Three other experiments conducted in 0.1 ha and 0.05 ha ponds were seriously affected by "softprawn" disease and were utilised for studies connected with project code No. PNP/14.

At Calicut: In a 714 m^2 polythene lined pond on the sandy beach of Calicut *P. indicus* seeds (18 mm size) produced at the Narakkal Prawn Culture Laboratory (NPCL) were stocked at the rate of 4/m^2 and fed with a pelletised feed prepared at the NPCL. In a culture period of 85 days 100.8 kg of pellets were fed to the prawns. The harvest yielded 25.35 kg or 355 kg/ha. The food conversion ratio was about 4. The survival rate was 96.1% and the size at harvest 110 mm /9.2 gm.

In another set of experiments 6 polythene lined ponds varying in size from 80 to 250 m^2 were stocked with NPCL produced seed of *P. indicus* at densities varying from 2 to 9.5 per m^2. Three of the ponds were leaking and the water could not be held properly. In the other 3 ponds also the survival was poor as the salinity was reduced to 1.1 ppt by the heavy monsoon rains and the production averaged only 121 kg/ha in 83 to 98 days of culture.

A third set of experiments using seeds of *P. indicus* and formula feed produced at NPCL is in progress.

At Madras: At the Muttukkad farm near Madras, seed of *P. monodon* reared in the Laboratory and collected from the wild were stocked in the 7 newly constructed ponds varying in size from 0.02 to 0.5 ha at stocking densities ranging from 1000 to 15,500 nos/ha. Although the tiger prawns attained a size of 165 mm/37 gm and 168 mm/38.5 gm in 135 days (stocking density 5600 nos/ha) and 90 days

(stocking density 1000 nos/ha) the production was only 33 kg/ha and 19.2 kg/ha respectively. The low production can be due to four causes (a) low stocking density (b) high salinity $>$ 40 ppt (c) abundance of predators and (d) poaching.

Similarly laboratory reared *P. indicus* seed stocked in 0.5 and 0.4 ha. ponds at Muttukkad for 100 and 73 days respectively also yielded poor production rates of 92.6 kg/ha and 14.4 kg/ha respectively apparently due to the same causes listed above. The natural productivity of the ponds also appears to be low.

For the first time in India, an attempt was made to culture the Kuruma shrimp (*Penaeus indicus*) at Muttukkad. A total of 1100 juveniles (64 mm/2 gm) Collected from the backwaters were stocked in a 0.15 ha pond. The prawns grew rapidly and attained a size of 130 mm/17 gm in 63 days. The experiment is continuing. The extremely fast rate of growth observed at Muttukkad opens up the possibility of culturing this highly priced species in India for the export market.

At Tuticorin: Six experiments in the field culture of *P. semisulcatus* and *P. indicus* were conducted in ponds varying in size from 0.04 ha to 0.25 ha. The experiments were viciated by poaching. In two experiments which are in progress, laboratory produced seed of *P. semisulcatus* have grown to size of 103 mm/9.7 gm and 79 mm/4.6 gm in 65 days and 44 days respectively.

At Mandapam: *Penaeus indicus* seed (19-27 mm) collected from the wild were stocked in three ponds 800 sq.m, 800 sq.m and 400 sq.m at stocking densities of 50,000, 60,000 and 50,000 nos/ha respectively. When they were harvested at the end at 135 days 220 days and 213 days respectively the prawns had grown to the size of 99 mm/7.5 gm, 116 mm/9.5 gm and 113 mm/9.3 gm. The production rates were

181 kg/ha, 241 kg/ha and 285 kg/ha respectively in the three ponds.

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

K. H. MOHAMED, M. S. MUTHU, N. N. PILLAI, S. K. PANDIAN, A. LAXMINARAYANA, MARY K. MANISSERY, SYED AHAMED ALI, M. KATHIRVEL, K. DEVARAJAN, M. RAJAMANI, E. V. RADHAKRISHNAN, M. VIJAYAKUMARAN.

At Narakkal, Cochin: During the year, a new technique for large scale production of penaeid prawn seed using a dry microparticulate formula feed was developed. The feed was compounded from inexpensive locally available raw materials such as groundnut oil cake, fish meal, dried mantis shrimp, prawn waste and tapioca and was fortified with vitamins and minerals. The formula feed was used in powder form, the particle size being less than 50 microns. The larvae were grown in outdoor tanks filled with 2 m^3 of seawater filtered through 60 micron mesh nylobolt cloth. The daily ration of formula feed was offered in 4 equal instalments at 6 hourly intervals and the larval thanks were vigorously aerated. Apart from providing nutrition for the larvae, the feed, under the influence of sunlight, helps to create a natural ecosystem conducive for their survival. The easy to dispense dry feed has greatly simplified the larval rearing procedures and has given survival rates upto 71% from nauplius to post larvae (PI_1) stage.

Using this new technique the nauplii of *Penaeus indicus* obtained from 121 spawners (21 wild, 100 eyeablated) were reared in the laboratory and 20 lakhs PI_1 stage postlarvae were produced during the year. A total of 7,93,000 stockable size prawn seeds (16-20 mm total length) were supplied to local prawn farmers, the Kerala State Fisheries Corporation and to the CAS in Mariculture.

Broodstock management techniques were further improved and slaked lime was used to regulate pH of the medium instead

of Sodium carbonate to reduce costs. Pond reared *Penaeus indicus* were used for eyestalk ablation and during the year 176 females spawned viable eggs 3-5 days after removal of of eyestalk.

At Kovalam, Madras: The new technique of larval rearing developed at Narakkal Prawn Culture Laboratory (NPCL) was adopted for rearing the larvae of *Penaeus monodon* at the Kovalam laboratory. Nauplii from 20 females (9 wild, 11 eyeablated) of *P monodon* were reared in the laboratory and a total of 1.85 lakhs of PI_1 postlarvae were produced. *Lagenidium* infection and power failure led to mass mortalities in 13 experiments.

Using the powdered formula feed developed at Narakkal, nauplii from 29 *P. indicus* (25 wild, 4 eyeablated) were also reared at the laboratory and 6.24 lakhs PI_1 postlarvae were produced.

Penaeus monodon females obtained from the sea and from the Pulicat lake were unilaterally eyeablated; twelve of them spawned once, 4 spawned twice and 3 spawned three times after eye ablation. The marine specimens took 17-25 days to mature and spawn after eyestalk removal while the specimens from Pulicat Lake spawned 30–44 days after ablation.

Similarly 17 females (7 from sea, 10 from backwaters) of *P. indicus* matured and spawned after unilateral eyestalk ablation. Four of them rematured and spawned a second time. While the marine forms spawned 2-5 days after eyestalk removal the backwater specimens took 6-15 days to mature and spawn after ablation of eyestalk.

At Tuticorin: Work on rearing the larvae of *Penaeus semisulcatus* and *P. indicus* using live feed organisms was continued. A total of 35 *P. semisulcatus* and 18 *P. indicus* spawners collected from the sea, spawned in the laboratory.

However the survival rates were very poor, the maximum being 14.2% from nauplius to postlarva I stage. This is mainly due to the development of unsuitable species of phytoplankton in the outdoor cultures.

Culture of commercially important crab (CF/CUL/1.1.3)

R. Marichamy

Two pond culture experiments using juveniles of *Scylla serrata* collected from the wild were conducted during the year. In a 0.3 ha pond 820 crabs 42 mm/13 g in size were stocked in October 1981 and harvested in September 1982 one year later. The crabs had grown to a size of 150 mm/580 g at the time of harvest. The survival was only 28% and the yield 444 kg/ha. In another 0.13 ha pond 1000 juveniles 37 mm/7 g in size were stocked in July and harvested 7 months later. The crabs at harvest were 140 mm/442 g in size. The survival was 32% and the yield 1116 kg/ha. The crabs were fed with trash fish during the culture period @ 5% of body weight.

Eye stalk ablation led to maturation of the ovary and spawning in 5 weeks time. But the eggs did not get attached to the pleopods of the female.

Ovigerous wild females liberated upto 2 million zoea in the laboratory. The larvae were reared to the crab stage in aquaria. There were 5 zoeal stages and 1 megalopa stage. The megalopa stage was reached 17-20 days after spawning. The megalopa metamorphosed to the first crab inster in 8-10 days. The larvae were fed with rotifers during the first 2 zoeal stages and with Artemia nauplii in the later stages.

Design of prawn hatchery for prawns (CF/CUL/1.1.4)

K. H. Mohamed, M. S. Muthu, K. V. George

The construction of the prawn hatchery by the CPWD was taken up this year and the hatchery tanks are nearing completion.

Artificial insemination and breeding of prawns (CF/CUL/1.1.5)

M. S. MUTHU, K. H. MOHAMED, A. LAXMINARAYANA

For the first time in India the spermatophores from the mature males of *P. indicus* and *P. monodon* were extracted by electrical stimulation, using a simple device. The structure of the spermatophores and sperms were studied. The males were able to produce a fresh set of spermatophores 2-3 hrs after the first electroejaculation and the same male could be used for obtained many spermatophores over a period of time. In the case of *P. monodon* the freshly extracted spermatophores were quickly transferred into the thelycum of the female in the intermoult stage. Some females retained the spermatophores but died before spawning, due to other reasons. Artificial transfer of spermatophores into the thelycum of *P. indicus* was not possible in the intermoult stage. The sperms inside the spermatophores stored in refrigerated seawater remain viable for 24 hrs. atleast. Experiments to stimulate *in vitro* shedding of fertilizable ova by using various chemicals and hormones are in progress.

Feed development for the intensive culture of marine prawns (CF/CUL/1.1.6)

SYED AHAMED ALI, K. H. MOHAMED, M. VIJAYAKUMARAN, MARY K. MANISSERY.

Last year a successful prawn feed compounded from squilla meal, prawn waste, groundnut oil cake, fish meal and tapioca was developed at the Narakkal Prawn Culture Laboratory. Now the groundnut oil cake in this feed was replaced by wheat bran, rice bran and *Rhizophora* leaves respectively and feeding experiments were conducted in 3' diameter plastic pools using juveniles of *Penaeus indicus*. All the three ingradients lowered the growth rate and decreased the food conversion efficiency compared to the control diet containing groundnut oil cake.

Another diet incorporating tea seed cake in the place of groundnut oil cake was also compounded and feeding

experiments were conducted. The feed was not acceptable to the prawns perhaps due to its bitter taste and the food conversion efficiency was very low compared to the control diet.

At Madras the red crab *Charybdis* sp. which is landed in large quantities by the trawlers during January to June was used as one of the raw materials in the compounded diets prepared for feeding the postlarval prawns, broodstock prawns and lobsters. The results were encouraging.

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

E. V. RADHAKRISHNAN, M. VIJAYAKUMARAN

Bilateral eyestalk ablation experiments were carried out on three spiny lobsters, *Panulirus homarus*, *P. ornatus* and *P. polyphagus*. Three to sevenfold increase in weight gain was obtained in ablated *P. homarus* when compared to normal ones. While the normal lobsters take 18 months to reach a marketable size of 200 gm the eyeablated ones attain this size in 6 months time. Eyestalk ablation increased moulting frequency, shortened intermoult period and improved food conversion efficiency. Food conversion factor in ablated lobsters ranged from 1.7 to 2.5 while that of the control varied from 2.6 to 7.5.

The effect of eyestalk removal on *P. ornatus* was more spectacular; in a period of 7 months an ablated lobster gained 1.2 kg in weight while the control animal gained only 43 gm in the same period. The present experiments clearly demonstrated for the first time the presence of MIH factors in the eyestalk of the spiny lobsters.

Eyestalk ablation also accelerated development of gonads. In males this resulted in swollen was deferens and in females ovary development. In mature females, ablation resulted in pink haemolymph due to resorption of ovary in some and oviposition in others. The secondary sexual characters did not develop in ablated females.

Effect of four types of feed on moulting frequency and weight gain in ablated lobsters was also studied. Growth was poor on a diet of fish while it was good when they were fed with mussel and clam flesh.

FISHERY ENVIRONMENT MANAGEMENT DIVISION

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

A. V. S. MURTY, C. P. RAMAMIRTHAM, D. S. RAO K. G. GIRIJAVALLABHAN, S. KRISHNA PILLAI, R. MARICHAMY, S. MUTHUSWAMY AND TECHNICAL STAFF

A study has been made on the inter-relation of plankton production, upwelling and dissolved oxygen content of the nearshore pelagic waters off the west coast of India.

The functional relation of dissolved oxygen with plankton biomass and upwelling and that of plankton biomass with upwelling and thermocline stability were determined for the nearshore pelagic waters off the west coast of India.

It was observed that the rate of consumption of dissolved oxygen per unit plankton biomass was found tremendously large at low values of standing crop of plankton and the rate is less at high standing crop.

The changes of intensity of upwelling along the west coast of India within the shelf were studied from two angles namely depletion of oxygen in the near-surface waters as well as rate of cooling of the same on account of upwelling. Both the methods revealed that the rate of intensity of upwelling along the coast has two peaks one off Cochin and the other off Kasargod.

The observations made at different centres are summarised in the following:

KARWAR

The rise in temperature observed during the summer months was followed by a slight fall in June. Inspite of

the inclement weather, cloud cover and the monsoon-conditions over the region, the temperature of the Karwar waters registered a significant increase in July prior to undergoing further decline in August. However, warm conditions prevailed between September and November and manifested in a gain of a few degrees of temperature notably in October. The Karwar waters experienced another spell of a steady decline beginning from December and this time it extended upto February. The increase in temperature noted in March was felt almost with equal intensity at all the three depths monitored.

The salinity of the Karwar region which was on the increase in the summer months suffered a steady decline starting from June upto August. The monsoonal influence on salinity lingered for a while and could be discerned even in September. It was followed by a steady increase and high values well above 34‰ were recorded in March.

The dissolved oxygen content at the surface continued to be relatively high during the summer and monsoon months while those of the deeper layers registered a marked decline notably during the latter season. Though the decrease observed at the surface between August and October exceeded 1 ml/L, the values recorded thereafter until January showed little variations. On the other hand, the subsurface layers showed remarkable recovery between September and November and remained rich in the dissolved oxygen content till March.

The changes observed in the values of pH were restricted to the south-west monsoon season. It remained around 8.3 during the rest of the period.

The concentration of inorganic phosphate which was relatively high, recorded further increases during the south-west monsoon months. Following a fall registered in September it never exceeded 1.25 μg at p/l till the end of the period under review. The nitrite content was remarkably high

between April and August. However, it was reduced to traces in September and low values were encountered till March.

The Karwar waters were poor in silicate during April-May. However, enrichment of the region with this nutrient was noticed during the monsoon months. The silicate concentration was high in September even though the values recorded were almost half of what was observed in the previous month. Except for a slight improvement noted in December the silicate content of the Karwar waters remained below 5 μg at Si/l upto the end of the period under review.

CALICUT

Surface temperature varied from 27.3°C in December to 30.3°C in May. Bottom temperature varied from 26.7°C in December to 30.0°C in May. Temperature was observed to be lowest in December and highest in May. Generally high salinity was observed in pre-monsoon period but higher salinity was observed in November also. Dissolved oxygen fluctuated from 2.47 mg/L. to 6.21 mg/L. Generally lower values were obtained in September. Phosphates varied from 0.62 μg at/l in April to 2.48 μg at/l. Lower phosphates values were obtained in pre-monsoon period. Silicate ranged from 7.50 μg at/l. to 27.05 μg at/l. Higher silicate values were obtained from September to November. Lowest values were obtained in May. Nitrate varied from 0.21 μg at/l in May to 0.83 μg at/l in September. Nitrates were higher in post monsoon period but higher values were obtained in October also.

TUTICORIN

Hydrological observations of the shelf region covering important fishing grounds of Tuticorin coast and industrial coasts areas were carried out. The depth in these grounds was measured in the range 4-42 mt. Water was turbid during May-August and again in November-December 1982. During

the last two weeks of March 1983, *Trichodesmium* bloom was noticed all along the coast.

Both the surface and bottom water samples were collected and analysed. The seasonal variations of surface water temperature closely follow the trend of atmospheric temperature. There were two maxima in a year. The first peak was noticed in May 1982 and the later in October 1982. Similarly two minima were observed in July 1982 and December 1982. From August 1982 onwards the bottom temperature was generally higher than the surface value. The surface salinity was recorded in the range 30, 72-35.80‰. The maximum was noticed in April 1982 and the minimum in November 1982, both in surface and bottom samples. The dissolved oxygen content varied from 4.5 to 6.0 ml/L and higher values were noticed during the post-monsoon period. The oxygen content was high in bottom samples during November-January. pH of the coastal water was recorded in the range 7.60-8.00. The presence of inorganic phosphate was noticed in negligible percentages except in March 1983. A maximum of 0.7 μg at/l was recorded from the surface sample collected near Spic coast in March 1983. Nitrate was rich in the bottom samples collected near Spic during May and July 1983 at 5.4 and 3.0 μg at/l respectively.

MANDAPAM

Hydrological studies were continued in the inshore waters of Gulf of Mannar and Palk Bay. Collections were made on the same day on both sides by using the vessel Sagitta by crossing the Pamban pass. Water samples were collected in the fishing grounds of Gulf of Mannar are also included. The water samples collected for the estimation of salinity, dissolved oxygen, pH and nutrients. From July onwards bottom samples at three meter depth were collected. Atmospheric and sea surface temperature were also recorded at the place of collection.

The salinity ranged from 30.8‰ (January) to 35.6‰ (September) in Gulf of Mannar while at Palk Bay it ranged

from 27.38‰ (January) to 35.30 ‰ (September). The salinity of bottom samples were slightly higher in both the places.

The dissolved oxygen content ranged from 3.03 ml/l (June) to 6.24 ml/l (January) in Gulf of Mannar. While in Palk Bay it ranged from 3.37 ml/l (June) to 5.83 ml/l (November). The oxygen content of bottom samples were slightly lower in both the places.

The sea surface temperature in Gulf of Mannar ranged from 27.1°C (January) to 30.6°C (March) while in Palk Bay it ranged from 26.1°C to 31.2°C (April).

VIZHINJAM

The sea surface temperature ranged from 28.05°C to 30.05°C during the year. The maximum value was recorded in June. Salinity of the inshore waters showed decreased values in June. This factor indicated an increasing trend soon after the monsoon rains. Dissolved oxygen content varied from 3.65 to 5.05 ml/l. Inorganic phosphate values were within the range of 0.97 to 2.58 μg at/l. The nitrite content of the inshore waters showed variation from 0.17 to 0.48 μg at/l.

Phytoplankton and primary productivity of the EEZ (MBO/PP/1.1)

K RADHAKRISHNA, K. G. GIRIJAVALLABHAN.
C. P. GOPINATHAN: C. V. MATHEW, RANI MARY JACOB, G. M. KULKARNI AND TECHNICAL STAFF

During the year Phytoplankton and Primary Productivity investigations have been continued along the west coast at Karwar, Calicut and Vizhinjam and along the east coast at Tuticorin, Madras and Waltair. At Mandapam Camp the Project had to be discontinued from July '82.

West Coast : Along the west coast the highest productivity during the year was recorded off Calicut, followed by Vizhinjam (open waters) and Karwar.

KARWAR

Light penetration was maximum in May, just before the onset of the monsoon - 6.3m and minimum in August-1.1 m. During the monsoon months of June, July, August and December through March the euphotic zone did not reach upto the bottom at this station.

Surface primary production was highest in December (630.9 mgC/m^3/day) followed by January (490.9 mgC/m^3/day) and June (470.25 mgC/m^3/day) and lowest in November (217 mgC/m^3 day). It was generally low in July, August, October and again in February and March.

Near bottom primary production was highest in February (363.2 mgC/m^3/day). When it exceeded the surface value; it was lowest in March (less than 1 mgC).

CALICUT

Light penetration was maximum in December/January, when the euphotic zone extended to the bottom and minimum in April (5m station) and September (10 m station)

Primary production at surface reached the record level of 1730 mgC/m^3/day at the 5m station in November and 1260 mgC/m^3/day at the 10m station in October. The lowest surface production was recorded in January - 70 mgC/m^3/day at the 5m station and 80 mgC/m^3/day at the 10m station in February.

Near the bottom, production varied from 100 mgC/m^3/day to 620 mgC/m^3/day at the 5m station and 40 mgC/ to 790 mgC/m^3/day at the 10 m station. An anamolous situation is obtained in January when very high production of 620 mgC/m^3/day near the bottom at the 5 m station and a very low production of 40 mgC/m^3/day were recorded near the bottom at the 10 m station. At the latter station, the mid depth production in January averaged 210 mgC/m^3/day. The low productivity at the surface and high rate at the lower levels in January and February

seen to indicate photoinhibition at the surface, as borne out by the high sect in disc readings.

Column productivity off Calicut was high, more so at the 10 m station, during the months of observation. Such high values as 6.65 gC/m²/day at the 10 m station in October and 5.45 gC/m²/day at the 5 m station in December were recorded.

VIZHINJAM

The productivity (mgC/m³/day) values at the two stations are tabulated.

	Bay station	Open waters
Gross		
Maximum	633 - November	720 - February
Minimum	218 - April	121 - March
Net		
Maximum	232 - August	454 - July
Minimum	43 - March	64 - March

TUTICORIN

Productivity was estimated regularly in Punnakayal area (Station depth 20 m). At one station in Manappad productivity was estimated only in May and June. Gross productivity (gC/m³/day) was very high both at the surface and near bottom in April. Surface productivity dropped to a low level in June, shot up in July and dropped again in August, whereas bottom productivity was uniform. In June and August bottom productivity was 3-4 times higher than surface productivity.

MADRAS

Sampling for phytoplankton and primary productivity was carried out from various areas as dictated by the fishing programme of the departmental boat Cadalmin III.

Dominant genera of phytoplankton, temperature, salinity and dissolved oxygen were observed from 5 samples during April, May and June.

Blooms of *Noctiluca* in the latter half of August and *Chaetoceros* bloom in early September and *Coscinodiscus* bloom in January were noticed.

WALTAIR

Surface productivity values appeared to be uniform at the shallow and relatively deep stations. Gross productivity ranged from 168 - 512 mgC/m^3/day and net productivity from 91 - 340 mgC/m^3/day.

Productivity of the aquatic macrophytes in the coastal areas (MBO/PP/I.3)

P. V. RAMACHANDRAN NAIR, C. P. GOPINATHAN, GEETHA BHARATHAN AND TECHNICAL STAFF

From June '82 onwards, a new aspect of study has been started on the biomass of seaweeds present in the coastal areas of Tuticorin. Using a metallic frame of 1m^2 samples of seaweeds were collected fortnightly/monthly from the harbour area of Hare Island near to the new light house from 0.5 m and 1 m depths. The biomass of algae varied from 10 g/m^2 in wet weight to 840 g/m^2 (in August) For seagrasses the variation was comparatively less (30-150 g/m^2).

It was found that throughout the period under observation, the agarophyte *Gracilaria edulis* found to be abundant in the Hare Island, especially during the period August-October and January-March. Similarly, the alginophyte

Dictyota dichotoma and *Padina gymnospora* formed the major seaweeds almost throughout the year in this area.

The seagrasses represented by three genera form the second important macrophytic vegetation in this area. Compared to the seaweeds, the quantity of seagrasses are less and they were present seasonally.

Neustonological Investigations (MBO/NU/1.1)

P. PARAMESWARAN PILLAI AND TECHNICAL STAFF

Time-series distribution of hydrographic parameters from the surface and three different depths have been recorded by the analysis of samples collected especially for oxygen and salinity analysis. Based on temperature and salinity distribution data, density distribution at different depths have also been noted. Highest surface temperature (30.0°C) was recorded in the month of May and the lowest value (25.4°C) in August, the latter phenomenon coinciding with the period of upwelling. Salinity values at the neuston layer were almost uniform during the pre-and postmonsoon seasons. Highest value of salinity (35.39‰) was recorded during May and lowest value (19.70‰) during July. Dissolved oxygen content at the surface film fluctuated between 3.68 ml/l in May and November and 5.6 ml/l in May.

Biomass distribution of the neuston and epineuston constituents was estimated by displacement method. Relatively low biomass values were recorded during the monsoon and pre-monsoon period, and the values ranged between 0.8-1.9 ml/20 minutes haul during the period of observation.

Analysis of neuston and epineuston samples indicated the occurrence of 11 groups of holoplankters and 7 groups of meroplankters. Faunistic distribution, with special reference to the eggs and larvae of commercially important finfishes and shellfishes in space and time and in relation

to hydrographic parameters were studied and data recorded for further analysis.

Secondary Production (MBO/PL/1)

K. J. MATHEW, T. S. NAOMI, C. V. MATHEW. K. RANGARAJAN. P. A. THOMAS, RANI MARY JACOB, PON SIRAIMEETAN, S. KRISHNA PILLAI, K. G. GIRIJAVALLABHAN AND TECHNICAL STAFF.

At the respective centres collection of zooplankton was made from fixed stations at fortnightly intervals using a half metre ring zoo plankton net. The volume of the plankton was determined by displacement method. The samples were analysed for estimating the numerical abundance of the various groups, their inter - relationships and variations in relation to hydrological conditions. Correlation studies were also made with the fishery of the respective areas.

At Cochin the investigations on the distribution, ecology and biology of Euphausiacea of the south east Arabian sea have been completed and a report has been submitted.

Fish eggs and larvae (MBO/FEL/1.1)

K. C. GEORGE, K. RENGARAJAN, RANI MARY JACOB, K. G. GIRIJAVALLABHAN, S. KRISHNA PILLAI, PON SIRAI MEETAN AND TECHNICAL STAFF

25 Plankton samples were collected during the year in 13 day trips with a 43.5' mechanised boat. Except in August, were only the nearshore station was worked, in all the other trips one nearshore station at 15m and one offshore station at 30m depths were worked. The collections were made by continuous oblique hauls covering the entire depth column using the twin cone Bongo 20' net with 0.5mm square mesh.

Live ichthyoplankton was collected from both the stations in June, September, November, December, January and February for laboratory rearing.

Plankton biomass was relatively low in the inshore as well as offshore station throughout the year (annual average value 0.15 and 0.16 ml/m^3 respectively). Copepods, Decapods and Chaetagnaths were the dominant plankters.

Fish eggs and larvae were collected in relatively more numbers in the offshore station (annual avarage eggs 67/m^2 and larvae, 54m^2 respectively). The peak month of occurrence of fish eggs was in November in the inshore station, the bulk of the eggs were small (0.5mm dia), round ones, most probably carangid type eggs. In May in the offshore station fish eggs were found in good numbers (average for the month 250/m^3) among which *Stolephorus* eggs constituted a good percentage. The least number of eggs was found in August in the inshore station (2/m^2).

The maximum number of fish larvae collected was in November in the offshore station (125/m^2) *Stolephorus* larva constituting the bulk. The minimum number of larvae was also in the same month at the nearshore station (1/m^2). Fish larvae were caught in good numbers from the offshore station during April, May and January. *Stolephorus* larvae were present in almost all the stations throughout the year with good numbers in April, May and November. *Sardinella* larva were present only during July and early August. Mackerel larvae was caught from the offshore station in April and July only. In January *Bregmaceros* larvae were caught in good numbers from the offshore station. Flat fish larvae were present consistently in the April May collections, and carangid larvae during July-August period. Sciaenid and Ambassid larvae were present throughout the year. Trypauchenid and Gobiid

larvae also occurred round the year. Other larvae identified were those of Leiognathid, Sphyraenid and Sillaginid.

On the whole the offshore station was relatively warmer, more saline and better aerated. For the area covered by both the stations, the minimum surface temperature was 25.4°C (August) at the inshore station and minimum surface salinity recorded was 20.85‰ (July) and maximum 36.02‰ (February), minimum dissolved oxygen at surface was 3.67 ml / L in November and maximum 7.13 ml/L in January all the values observed at the inshore station.

From the live icthyoplankton collected in June 6 types of eggs were sorted out, out of which 3 types hatched out in the laboratory and the larvae were reared. Type 1 was on oval egg with a knob, belonging to *Stolephorus* sp. The hatched out larva from this egg lived for 2 days. Type II was an oblong egg and the hatched out larva lived for 4 days. 30 myotomes were countable in this larva. The specimen remains to be identified. Type III egg was spherical, diameter ranging between 0.9 - 1.0 mm and the larva from this egg lived for 5 days.

The live material collection made with a Neuston net in September was very poor and contained neither eggs nor larvae.

In November 4 types of live eggs collected hatched out the same day but failed to develop. One type belonged to *Stolephorus* sp. The others were all round eggs, diameter ranging from 0.6 - 1.0 mm.

The three types of round eggs collected in December had a diameter range of 0.6/0.8 mm. They all hatched out and lived a maximum of 3 days. Of these, the larva which hatched out from an egg with a diameter of 0.7mm. seems to be a carangid.

In January two types of eggs were collected in good numbers. One type had a diameter of 0.6mm, single centrally placed oil globule of 0.1mm diameter, with fine dark chromatophores, embryo pigmented, yolk clear and with very narrow perivitelline space. The larva which hatched out from this egg had 26 myotomes and they lived a maximum of 3 days. The other type of egg had a diameter of 0.9 mm, single oil globule of 0.2 mm diameter with fine dark chromatophores, yolk clear, colourless and with narrow perivitelline, space. The larva which hatched out from this type of egg had 30 myotomes and they lived for 3 days. The above larvae are yet to be identified.

In February only one type of egg was collected which hatched out in the laboratory and lived for only 2 days. The eggs were of 0.6 mm diameter: with single oil globule of 0.1 mm diameter.

The dead eggs and the larvae from the live collection were preserved in 4% formalin and camera lucida drawings of good specimens were made.

Seaweed Resources Investigation (MBO/SW/1.1)

V. S. K. CHENNUBHOTLA, N. KALIAPERUMAL AND TECHNICAL STAFF.

Preliminary survey to assess the availabilty of seaweeds was carried out from Athankarai to Madras. The number of species occurring is less and no commercial harvesting is being done. The entire coastline is either muddy or sandy without rock formation except at Mahabalipuram and its vicinity. The algal flora occurring at Muttukadu Fish Farm, Mahabalipuram, Kovalam and Pulicat Lake was observed on 4-3-83 and 5-3-83.

Seaweed growing at Mahabalipuram

Seaweeds are growing on the two boulders situated in the subtidal region near the shore temple and in the

intertidal region on the granite stones dumped for breaker wall to protect the shore temple. Except these, there are no other rocky formation in the coast. The bottom is sandy.

Flora observed in Pulicat Lake

Algal collection was made in Pulicat Lake from the area between Pulicat and Annamalaichery covering the places namely Kottakuppam, Avrivakkam, Moosamanilock, Karimanal, Gunakuppam, Edamani and Light house area.

Culture of economically important seaweeds (MBO/SW/1.2)

V. S. K. CHENNUBHOTLA, N. KALIAPERUMAL, GEETHA BHARATHAN AND TECHNICAL STAFF

Field culture of seaweeds

Fragments of *Gracilaria edulis* were pretreated with different concentrations of IAA, GA and NPK and cultured in velon screen bags and nylon net bag at 3m depth area in Palk Bay near Fish Farm. Untreated plants were also cultured simultaneously. 600g. seed material was introduced in each bag. The plants in all bags were healthy initially and showed signs of regeneration from the cut ends. But after 45 days plants treated with IAA, NPK, and also controls showed very good growth. The plants gained a weight of 1020, 1125, 1060 and 755 g. from an initial weight of 600 g. in control and those treated with NPK, IAA and GA respectively. As there was no further growth due to attachment of ascidians inside the bags, the experiment was discontinued.

Field culture of edible sea weeds *Ulva lactuca* and *Acanthophora spicifera* was attempted in the open shore environment at subsurface water level in 3m deep station at Palk Bay. *Ulva lactuca* was introduced in 4 coir rope nets and *Acanthophora spicifera* in 2 coir nets and 1 HDP rope net. The fragments of both plants were healthy when observation was made after one week. But after one month

all the nets were found without any plants. This may be due to degeneration of plants or removal of plants from the nets by wave action.

With a view to find out the possibility of cultivating *Gracilaria edulis* in lagoon, 15 kg of seed material was introduced in long line coir ropes at Pillaimadam lagoon on 23-3-82. The plants were healthy for 10 days and after one month all plants degenerated. It was due to heavy sedimentation over the plants and high salinity and water temperature caused by low water level condition in the lagoon.

Cultivation of *Gracilaria edulis* and *Turbinaria conoides* were carried out in Gulf of Mannar in 3 m depth area. The seed materials were treated with ascorbic acid before introduction on HDP rope nets. Totally 21 nets with *Gracilaria edulis* and 3 nets with *Turbinaria conoides* were introduced. The plants did show good growth even after one month because of sedimentation and attachment of animals on the culture nets. Hence the culture nets were removed in the month of February.

Pond culture of seaweeds

The agaroid yielding edible seaweed *Acanthophora spicifera* was cultured on 2 HDP rope nets of 5x2 m size in a pond (1800 sq.m area) at Fish Farm.

Laboratory culture of seaweeds

The edible seaweed *Ulva lactuca* was cultured in the laboratory using tufflite tanks and plastic troughs. After 92 days excised pieces of *Ulva lactuca* pretreated with Ascorbic acid and cultured in 18‰ had grown to 800 g. from 100g.

Laboratory culture experiments on sporulation and germination in *Gracilaria corticata* carried out at Madras did not yield fruitful results probably due to infection by protozoa.

The growth of excised thalli was found to be encouraging in apical portions rather than in based parts.

Attempts were made to cultivate *Gracilaria verrucosa* and *G. corticata* in Muttanadu farm.

Enhancement of seaweed production by management of solar radiation (FED/SW/1.3)

V. S. K. CHENNUBHOTLA, N. KALIAPERUMAL, A. V. S. MURTY AND TECHNICAL STAFF

Culture experiment was conducted with *Gracilaria edulis* with a view to enhance the production by management of solar radiation. Various light filtering materials such as glass sheets (5.5 mm, 3 mm and 2 mm thick), PVC sheets (5 mm, 7 mm, 10 mm & 15 mm gauge thick) and acrylic sheets (yellow, green, blue and red colour sheets) were placed over the tanks to filter the sunlight. After 60 days comparatively good growth (1.7 fold increase) was found in the tanks in which 5.5 mm thick glass sheets, 5 mm gauge thick PVC sheet and yellow acrylic sheet were used as light filters.

Investigations on energy flow in Ecosystems MBO/EE/1.3

C. P. RAMAMIRTHAM, A. G. PONNIAH, I. DAVID RAJ AND TECHNICAL STAFF

The monsoon effects were perceptible in the investigational area by late May and early June. The drastic decrease in surface and subsurface temperature values especially at the purely oceanic stations were observed and likewise the high dilution of the surface waters due to heavy precipitation. All these were indicative of upwelling.

The gradual progress in the season showed more clear evidence of upwelling and during mid July at the 10 m station the surface bottom difference in temperature

was nearly 3.5°C. In the offshore station at 20m depth the thermocline could be observed to start at the 5m level and in this station the temperature at the 10m level was only 22.5°C whereas the surface temperature was 26.8°C. By mid August, the near coastal regions were occupied by a single cold water mass of temperature between 23 and 24.5°C. The surface dilution was drastic and the surface bottom differences in salinity was nearly 10‰ and the fishery was very poor too.

The change over from monsoon was observed during September-October period. February and March exhibited the features of the approaching summer, in the sense that the temperature values in the vertical column have increased and the winter temperature inversions have disappeared.

At the 10m station, the highest volume of zooplankton viz, 28.5 cc. was observed during August and the volume range was between 0.2 and 28.5 cc.

Trawl net operations were also conducted during the trips. During the first quarter *Ambassis* sp. and *Nemipterus japonicus* dominated in the catch. In the first week of April, *Ambassis* sp. formed the major portion in the catch Towards the end of the month *Leiognathus* sp. and *Nemipterus japonicus* dominated in the catch. The catch during June composed of *Parapenaeopsis stylifera*.

Of the two carnivorous fishes *Otolithus argentatus* and *Tachysurus tenuspinus* selected for estimation of calorific values of food consumed adequate samples were got only of smaller *T. tenuspinus*. Only about 64% of the fishes had stomach contents and only 9 individuals had identifiable food materials which were bivalves and crabs. Their calorific value were 573 kcal/gm dry weight and 3.12 kcal/gm dry wt. respectively. The fish, Caracuss had a calorific value of only 4.423 kcal/gm dry wt. There was not sufficient gonadal tissue for calorific analysis. In *Otolithus argenteus* only 23% had stomach contents and the food material

could not be identified. Therefore only the calorific value of fish Caracuss was estimated and found to be 4.143 kcal/gm dry wt.

Mud Bank Investigations (MBO/MB/1.1)

A. V. S. MURTY, K. J. MATHEW AND A. REGUNATHAN

Field trips were conducted to the reported places of mud bank formation namely Narakkal, Thottappally and Karimpuram and made observations the various aspects of the mud banks and the fishery there.

It was observed that the mud bank stretched for about 3 km. northwards from the spillway mouth. The average fish and prawn catch was estimated to be 50 kg and 100 kg respectively per canoe. Among prawns *M. dobsoni* dominated the catch. During this season about 70% of the country crafts operated in the mud bank area was mechanised.

A study of the reported mud bank at Karimpuram (Nattika) showed that a typical mud bank did not occur there. It was found that rather sluggish waters extending over a wide area existed. The fishery was exclusively of oil sardines during this season.

Marine Pollution in relation to protection of living resources (MBO/MP/1.1)

P. V. RAMACHANDRAN NAIR, V. KUNJUKRISHNA PILLAI, A. G. PONNIAH, P. KARUPPASWAMY, S. MUTHUSWAMY, R. MARICHAMY AND TECHNICAL STAFF

Acute pollution in the industrial area in the suburbs of Cochin consequent on the construction of a bund across periyar river was investigated. The effect of highly acidic water in the prawn culture fields downstream was monitored and the area of recovery was also identified.

An environmental monitoring of water quality was conducted in the Cochin backwaters and the connected

Chitrapuzha river in the vicinity of the industrial area of Ambalamugal was carried out in July. It was found that very high values of ammonia, nitrite and inorganic phosphate were leaching out. Signs of high eutrophication also was visible. The ammonia at times exceeded the allowable limits. Further monitoring in both ecosystems are being continued.

An Atomic Absorption Spectrophotometer has been installed and commissioned in the laboratory and standardisation of selected heavy metals is in progress.

The Mobile Laboratory of the Institute has been used for monitoring hot spots of pollution in Kerala and Tamil Nadu. The reports of which are under preparation.

Environmental monitoring of aquaculture systems (MBO/MP/1.2)

V. KUNJUKRISHNA PILLAI, A. G. PONNIAH, V. CHANDRIKA, P. KARUPPASWAMY, GEETHA BHARATHAN, M. RAJAGOPALAN, K. G. GIRIJAVALLABHAN AND TECHNICAL STAFF

At present, data are collected at Cochin, Madras and Mandapam.

COCHIN

Sampling area - Fish and shellfish culture ponds at Valappu (Vypeen Island). Collection and analysis of standard hydrographical and geochemical parameters were regularly carried out during the year mainly to study the fluctuating trends of the environmental parameters and their possible effects, if any, on the cultured organisms. The four ponds and the two canals feeding water to them were sampled at 16 stations regularly once in a month. For the field trips, the Mobile Laboratory of the institute were utilized. The parameters measured were water temperature, pH, Eh, Dissolved oxygen, Ammonia, Nitrite, Nitrate, Phosphate and

Organic carbon in the sediment. Calcium, sodium and potassium were also intended to be analysed from the samples collected. The only significant point noticed was the very high values of nutrients in the pond water, especially followed by the monsoon months. However, inspite of very high concentrations of nutrients in the water and organic matter in the sediments no instance of fish mortality was reported during the period of study. The ecosystem appeared to be balanced and maintained itself against the heavy inputs of nutrients.

MADRAS

Sampling area - The prawn and finfish culture farm is developed at Muthukkadu near Madras. Environmental monitoring were carried out from three stations in the open area and one each from the stocked ponds. Water samples were analysed for salinity and dissolved oxygen. It is reported that salinity showed considerable fluctuation varying from 29.76 ppt. to 51.73 ppt.

During the first week of December, 1982 the scientist visited the sampling area along with the project associate working at Madras. The strategy for future work was discussed and also decided to take up analysis of some additional parameters like nutrients and soil analysis as well. A sampler designed at Hqts. and fabricated locally to collect sub-surface water samples were handed over for the use at Muthukkadu. It is also suggested that one of the associates can visit Cochin in due course to get familiarize with operational techniques of some of the instruments such as Flamephotometer, Spectrophotometer, Eh measurement etc.

MANDAPAM

Regular data on water temperature, salinity and dissolved oxygen were collected from Mullet culture ponds, Chanos culture ponds and Polyculture ponds. Other than this,

samples were collected and analysed from the pen culture site at Pillaimadam. Very high fluctuations were reported from the pen culture site (upto 144.0 ppt.) in the first half of September, probably as the result of evaporation of the lagoon waters.

Investigations on the pesticide residues in the environment and living resources of the estuarine and inshore waters (MBO/MP/1.3)

V. KUNJUKRISHNA PILLAI AND TECHNICAL STAFF

Primary, intermediate and working standards were prepared for 12 common organochlorin pesticides. Other than this, one standard for mixed DDT were also prepared. Work on column evaluation and column efficiency have been completed with the help of a reporting integrator which is added to the main instrument set up recently.

For the present the analysis is taken up to obtain a baseline information on the distribution and abundance of DDT and its metabolites in the common backwater clam *Villoritta* sp. which may be considered as an indicator species for pesticide residue concentration in this area. Samples were collected from selected stations for preliminary investigation. The methodology adopted is that of Holden and Marsden. An aliquot tissue sample is soxhlet extracted with hexane and eluted through either an alumina column or silica column and reduced to 5 ml fractions before injection to the Gas chromatograph. Certain initial problems were encountered in the sample preparation and analysis due to impurities present in the solvents and chemicals. Steps are taken to overcome the same by reported purification processes. The above programmes of work is progressing satisfactorily.

Investigations on coral reef resources (MBO/CR/1.1)

C. S. GOPINADHA PILLAI

A resurvey of the Minicoy atoll was conducted. There are signs of mass mortality to corals - This has caused a drastic change in the overall annual life of the lagoon. Coral fishes have dwindled.

The reasons for the mass mortality are below to be. (1) excessive silting, (2) stirring of coastal sand by recent sea erosion, (3) *Acanthaster* predation. (4) natural deterioration of the biota.

Ecological studies of mangrove swamps (MBO/MS/1.1)

M. S. RAJAGOPALAN, G. S. DANIEL SELVARAJ AND TECHNICAL STAFF

COCHIN

Ecological studies of the mangrove areas in the Cochin backwater from Perumbalam in the south to Chittoor in the north were carried out. Data on the distribution of mangrove vegetation, their growth, physico-chemical parameters in the mangrove creeks and adjacent backwaters, and on the resident and migratory fauna were collected and analysed.

From January to June 1982, surface temperature and salinity showed increasing trend in the different stations with variations in values among the stations depending on their proximity to Cochin bar mouth. Salinity values in the Perumbalam island rarely exceeded 15‰ at any time during the year. Whereas in the islands near Cochin salinity values upto 34‰ could be recorded. From July to August and from middle of September to October near freshwater conditions prevailed in all the mangrove islands. Dissolved oxygen values fluctuated from 2.46 to 8.40 ml/l at different stations.

Primary productivity in the harbour mangrove station showed variation from 5.6 mg C/m^3/hr. in February to 130.0 mg/m^3/hr. in June first week. The average productivity is around 500 mg C/m^3/day.

At Perumbalam during summer months the mangrove creeks and ponds dry up and mangrove vegetation such as *Acrostichum aureum* and *Acanthus ilicifolius* perish in considerable quantities. The litter production is estimated at 2.5 to 3.0 kg/sq. m. With pre-monsoon showers fresh growth of these species were observed.

Mangrove islands north of Cochin harbour were surveyed during the year. The Thanthoni island is a narrow strip of island extending to about 2 km. in the north south direction. The northern part has been converted at as coconut groves and paddy field. In the southern part about 5 ha area is colonised by typical mangroves. *Acanthus ilicifolius* is the dominant vegetation bordering a prawn culture pond of about 1 ha. Behind this zone, isolated stands of *Avicennia officianalis, Rhizophora mucronata, R. apiculata* and *Excoecaria* occur. Seedlings of *Rhizophora* planted on an experimental basis showed a poor annual growth rate from 25 to 60 cm in average height from the ground.

The inter tidal zone of Thanthoni mangrove has a rich population of fiddler crabs at 50-70/sq.m. Juveniles of *P. indicus, M. dobsoni, Haplocheilus melastigma, Ambassis dayi, Therapn* sp. and *Etroplus* spp form the mainstay of the migratory fauna in the creeks and ponds. Prawn culture by traditional prawn filtration method is resorted to in the island.

KAKINADA

The mangrove areas around Kakinada were studied for physical, chemical and biological features. Data were collected from nine fixed stations and general surveys were also

conducted in five estuarine areas during summer and monsoon months. At Station IV diurnal observations were also carried out at 3-monthly intervals.

In general the mangrove waters were observed to be highly turbid throughout the year. Properties such as salinity, dissolved oxygen, nutrient content etc. were higher during the first and second quarter of the year. Phytoplankton showed two peaks, one if summer and the other in winter months.

Both penaeid and non-penaeid prawn seeds are abundant in the mangrove areas. *Metapenaeus dobsoni*, *M. brevicornis* and *M. monoceros* form the greater percentage. *Macrobrachium malcolmsoni*, *M. rude* and *M. rosenbergi* form the non-penaeid prawn resource. Correlation has been found between the abundance of prawn seeds in the mangrove areas and the composition of the catches in the local fisheries in the estuaries and bays.

Investigations of marine mammals and turtles (MBO/MM/1.1)

E. G. SILAS, M. RAJAGOPALAN, A. BASTIAN FERNANDO

During 1982 in the months of March and April a total of 18,090 baby turtles of the species *Lepidochelys olivacea* have been released into the sea as a conservation measure. In December 1982 survey has been in some of the fish landing centres of Balasore District, Orissa and Midnapore District, West Bengal. Landings of Olive Ridley turtles were noticed at Digha and the details are as follows:

Males:	Carapace length	67-72 cm
	Carapace width	56-68
	Plastron length	50-54
	Plastron width	42-50
Females:	Carapace length	65-69 cm
	Carapace width	54-64
	Plastron length	49-59
	Plastron width	40-54

Data collected on the stranding of a male sperm whale physeter catodon of the size 9.06 metre at Pudupet, Tranquebar, Tamil Nadu in June 1982.

First instance of record of a false killer whale *Pseudorca crassidens* measuring 4.47 metres was observed near Marakanam, Tamil Nadu.

The growth of Olive Ridley *L. olivacea* in captivity is monitored and the growth in two years as follows: Carapace length 275-349 mm; Carapace width 280-350 mm, plastron length 229-303, plastron width 207-282 mm and weight 5.2 to 9.7 kg.

During 1983 in February and March a total number of 8133 eggs of Olive Ridley turtle were collected for conservation from Madras coast.

During 1983 in February and March the Gahirmatha turtle rookery was visited and data collected on the nesting beaches and strandings of marine turtles due to incidental catch in fishing gears, off Orissa coast.

Mariculture Productivity. Application of Biotechnology to increase the production of fish in culture ecosystems (FED/MC/P 1.1)

D. S. RAO, P. P. PILLAI, K. J. MATHEW, K. RENGARAJAN

In order to know the effect of triacontanol, before applying it to prawn culture, it was thought worthwhile to study its effect on the growth of flagellates first. Accordingly 3 series of experiments were conducted on the culture of *Isochrysis galbana* (1) using Miraculan (Triacontanol of M/s. Kay Laboratories Ltd, as growth promoter for agricultural crops like rice, wheat etc) (2) using the aqueous extract of Lucerne plant material and (3) using alcoholic solution of pure triacontanol. Each series of experiments were conducted at different concentrations with controls. The different concentrations of triacontanol (used as Miraculan as well as

alcoholic extract of pure chemical) were 0.1, 0.5, 1.0, 5.0, 10, 50 and 100/μg and the same concentrations of Lucerne extract were used in the second series of experiments. In the first two series of experiments the culture entered the stationery phase in 15 days and no conspicuous changes due to the addition of either Miraculan or lucerne extract were noticeable from the controls. In the third series of experiments the destruction of organisms were noticed in the experimentals.

Mariculture Engineering - Development of a low-cost technology for construction and maintenance of culture ponds (FED/MC/E 1.1)

P. BENSAM

A low-cost sluice was planned, designed and constructed, for flowing water from one pond to another. Two Wind Mills of *"Poghil"* type were installed during the first quarter in the fish farm with the aid of a Madras firm. Structural work for construction of breakwaters opposite the main sluice in order to prevent sand deposition was designed, prepared and approved as project work.

Mariculture Instrumentation (FED/MC/I 1.1)

P. BENSAM

One set of upturned showers was installed in a pond, for throwing jets of water pumped in, thereby enabling the water jets to absorb atmospheric oxygen and increasing dissolved oxygen content. A few sprinklers procured from a commercial firm were also installed successfully. Action was taken to fabricate and instal wind-operated water stirrers, with the aid of a Madras firm.

Fish behaviour (FED/Misc/2)

C. S. GOPINADHA PILLAI AND MADAN MOHAN

The fish samples collected from different localities in Minicoy were identified to the species level and quantitative

and numerical analysis were carried out with a view to studying the structure and composition of resident fishes in different microhabitats.

Studies on the length frequency, age and growth, food and feeding habit and breeding periodicity were also carried out on four species namely *Chromis caerulis, Dascyllus aruanus, Abudufduf glaucus* and *Acanthurus triostequs.*

In addition to this more than 50 species of reef fishes were analysed to study their food relationship and their choice of habitat within the reef environs. Qualitative and quantitative analysis of the resident forms from various habitats were made to have an understanding of the structure and composition of the reef flat icthyofauna of Minicoy.

Application of underwater acoustic technology in fishery research (FEMD/Misc/3)

S. NATARAJAN

Procured the Hydrophone P & K type 8103 and precision conditioning amplifier BK type 2650. Recorded the noise produced by eel and lobster using domestic tape recorder, connected the output of the tape recorder to the Pyeunicom chart recorder and found no response.

Assessment of the mesopelagic fish resources of the E. E. Z (FED/Misc/4)

K. RENGARAJAN, K. J. MATHEW, I. DAVID RAJ

A preliminary survey of the backwater at Muttukadu was taken up to map out the occurrence of Marphysa (polychaete) which is in great demand by the fishermen as a bait. The location of the worm was indicated by the presence of the egg mass. The young worms were seeded in a layer of mud to observe their further growth.

Studies on utilization of wind energy (FED/Misc/6)

PADMINI R.

As a case study along the East coast of India, where wind energy is maximum utilised in propelling the fishing boats, two stations-Tuticorin and Madras were taken up. Fishing operations making use of wind energy were studied in detail. A detailed study of the various aspects of sea and land breezes over Tuticorin and Madras, such as time off onset, duration, directional changes and their impact on fishing activities is carried out.

Introductions of low cost instrument technology in fishery research (FED/IT/1)

S. NATARAJAN

Circuit has been designed and wired up for electronic larvae counter. Mechanical parts are fabricated, tested and found one transistor 2N 2368 in the multiviberator was getting open circuited within an hour of switching on. Modified and developed the sensing circuit using transister BC 148. Wired up the circuit, tested and found functioning satisfactorily. Assembled the system and tested with Artimianaupli larvae of 6 days old. Tested and found functioning satisfactorily with 5% error (under counting). However when tested with 2 days old artemia larvae the counter missed many. Approximately 30% is under counting. Further developed the sensitivity of the sensing circuit and found improvement.

Single Cell Protein (SCP) production from micro-algae (FED/BT/1).

P. V. RAMACHANDRAN NAIR, V. K. PILLAI AND TECHNICAL STAFF

Microalgae have been identified as a source of Single Cell Protein. In connection with the mass production of

high protein algal food in mariculture, the estimation of the protein content of some algal species have been taken up.

Four species of microalgae were grown in the laboratory under axenic conditions and the total protein content of these was estimated following the procedure of Lowry *et al.*, 1951. The algal species were isolated locally from the estuarine and inshore regions of Cochin. The protein content was determined during the exponential phase of growth and in stationary phase. The species tested and the respective protein contents are given below.

		Protein as % dry wt.	
	Species	*Exponential culture (5 days)*	*Stationary culture (20 days)*
1.	*Tetraselmis gracilis*	54.00	42.00
2.	*Isochrysis galbana* (Cochin strain)	51.3	37.8
3.	*Synechocystis salina*	41.0	33.12
4.	*Chromulina freiburgensis*	58.40	40.16

Chromulina freiburgensis was found to have relatively high protein content (58·4%) of the dry weight whereas in *T. gracilis* and *I. galbana* (Cochin strain) it was 54.0% and 51.3% respectively. *S. salina* had the lowest protein content (41%) among the four. Irrespective of the species, in stationary phase cultures, the protein content decreased, the range being 33-42%.

Development of suitable digestor for Bio-Gas production from coastal villages (FED/BT/2)

V. CHANDRIKA

The viability of particular bio-gas plant design depends on the particular environment in which it operates. Therefore,

the research problem becomes one of providing a structure in which technology can combine to produce both the appropriate hardware for various environment and the infrastructure that is necessary to ensure successful performance of bio-gas digesters in different environments.

The anaerobic cow-dung digesters (4 Nos.) was set up (working volume 20 litres) to study the microbiological aspects of the digester when seawater was used for mixing purposes. The first one was kept as control with cow-dung and freshwater. The pond one was mixed with 33‰ sea water, third one with 23‰ sea water and the fourth one with 13‰. After two week's time methane was produced in the control only. In the experimental digester only CO_2 + H_2S production was noted. In the initial stages of fermentation all the experimental digesters were infested with fungal infection - white layer over the scum can be seen for two week's time. In the fresh water control digester purple sulphar photosynthetic bacteria developed in the bottom portion whereas it was not seen in the experimental digesters. The condition was the same in all the three salinities. So it was concluded that the sea water having 13 ‰ is not favourable for the production of methane in the bio-gas digesters.

PHYSIOLOGY, NUTRITION AND PATHOLOGY DIVISION

With the increasing thrust on the exploitation of fish resources through capture and culture means it has become essential to have a clear understanding of the various physiological processes, system by system, of the harvested organisms and of the complexity of their interactions to the dynamic ecosystem in which they live to further these exploitation means. Similarly, with the increasing appreciation of aquaculture to augment fish production, studies on food and feeding and nutritional requirements of cultivable organisms are receiving greater attention to aid in the development of efficient and suitable feed which could bringforth the maximum growth and survival of the species. Another field which has attracted the major share of attention in evolving better management and strategies of culture is the diseases affecting the cultivable organisms and their control. To facilitate investigations in all these vital aspects a full-fledged Division, namely, the Physiology, Nutrition and Pathology Division was started in April 1982 at the Institute.

To begin with, the Division in the background of facilities available, selected a few research programmes which form complementary to the major on going research projects on the culture of candidate species and at the same time related to the major disciplines of the Division. The main research projects undertaken in 1982-83 included:

— **Physiological studies:** Respiratory metabolism and energy utilisation in *Panulirus polyphagus;* free amino acid and protein variations in *Penaeus indicus* cultured in different salinity media; reproductive physiology of grey mullets and *P. indicus;* architecture of neurosecretory cells of pituitary gland and their structural changes in relation to gonad cycle in *Etroplus suratensis.*

- **Nutrition** : Nutritional requirements of the eel, *Anguilla bicolor bicolor*, the lobster, *Panulirus homarus* and of the fry and fingerlings of mullets (*Mugil* spp) and the milk fish (*Chanos chanos*) and of the larvae and juveniles of the penaeid prawns, *P. indicus* and *P. monodon*.

- **Pathological studies** : Survey of diseases encountered in the farmed marine finfishes and shellfishes; sporozoan infestation in *P. indicus* and *P. semisulcatus* and pathobiology of the 'soft' prawns.

PROGRESS IN RESEARCH PROJECTS

Free amino acid and protein levels in *Penaeus indicus* as a function of selected environmental factors (PNP/1)

A. G. Ponniah, V. S. Kakati and P. Karuppaswamy

The experimental design to analyse free amino acid (FAA) and protein levels in haemolymph, muscle and hepatopancreas of *P. indicus* as a function of selected environmental factors was formulated. The methodology of moult staging and withdrawal of haemolymph from live animals was perfected. The method of Lee and Takahashi (1966) for the estimation of FAA was standardised.

The range of protein and FAA values observed in the different tissues was within the range reported for other crustaceans. Within a single collection, FAA values were more variable than protein values of the tissues analysed. Hepatopancreas showed higher variability both in protein and FAA levels as compared to muscle and haemolymph. When compared between different months, significantly higher differences were observed between the months with regard to haemolymph FAA and hepatopancreas FAA and protein and percentage dry matter.

Further experiments to correlate the variation in FAA and protein levels with the environmental parameters are in progress.

Respiratory Physiology and energy utilisation of spiny lobster' *Panulirus polyphagus* (PNP/2.)

Mohamed Kasim

Oxygen uptake in *P. polyphagus* (carapace length 28-50 mm; weight - 14.5-85.1 g) in different salinity media varying from fresh water to 80‰ salinity and at different oxygen partial pressure at ambient temperature was studied. Salinities, 9.7‰ and 78.7‰ were found to be the lower and the higher lethal levels respectively. The sublethal level was recorded at 19.75‰ salinity. The lobster in terms of oxygen consumption rate showed relatively better performance at 48.7‰ salinity, while there was little difference in the rate of oxygen consumption between the salinity range of 28·8‰ and 39‰. The results of the experiments conducted in lobsters which were acclimated to salinities of 17, 32, 39 and 50‰ showed that the rate of oxygen consumption in general was uniformly high at the higher oxygen partial pressures, but decreased towards the lower oxygen partial pressures. At the lethal salinity, the rate of oxygen consumption was low, although the oxygen partial pressure was high. It was indicated that the lobster could survive at the lowest oxygen partial pressure for considerable time without using the external oxygen. However, this observation needs further confirmation. The tolerance capacity of the lobster to different salinities was found to shift to either to a higher level or to a lower level depending on the acclimation salinity.

Controlled breeding of grey mullets and *Siganus spp.* (PNP/3)

A. R. Thirunavukkarasu, L. Krishnan and G. Mohan Raj

Twenty specimens of *Mugil cephalus* were maintained in a brackishwater pond (0·02 ha) with a view to study the

maturation process of gonads in captive conditions. The fishes were fed with an artificial diet having a protein level of 34.76% and enriched with vitamin E at a rate of 100 mg/kg of the diet. The observations on the maturation of gonads were progressing.

An hypophysation experiment on the female *M. cephalus* (60 cm size) obtained from the inshore sea off Narakkal near Cochin was conducted. However, the fish succumbed to infection in the middle of the experiment.

Juveniles of *Siganus javus* and *S. canaliculatus* were collected from the Mandapam region and were stocked in the ponds for observation on the maturation of the gonads.

Correlation between the structure of the pituitary and changes in the gonad of the pearl spot, *Etroplus suratensis* (PNP/4)

A. D. Diwan and L. Krishnan

Pituitary glands and gonads from different representative maturity stages together with the biological data of *E. suratensis* were collected. The preserved gonad material was sectioned and stained in Dielafield's Haematoxylin and Eosin stains for further study. Similarly, the pituitary samples were prepared for histological and histochemical studies.

Reproductive physiology of decapod crustaceans (PNP/5)

N. Surendranatha Kurup and A. Lakshminarayana

The neurosecretory bodies in the eyestalk of *P. indicus* were mapped out in the first year of the project. However thereafter very little progress could be made due to the involvement of scientists in other important projects. The project was therefore discontinued.

Nutrition

Nutritional requirements of fry and fingerlings of the milkfish, Chanos chanos and mullets (Mugil spp.) (PNP/6)

R. Paul Raj, D. C. V. Easterson and D. Kandaswamy

With a view to evaluating the effects of fortification of vitamin premix and mineral mixture to artificial diets based on fish meal, fish oil and wheat flour on the growth, survival, conversion efficiency and body composition of the fry of *Liza parsia*, one set of experiments was conducted at Narakkal. The dry weight gain of the fishes fed with vitamins and minerals were superior to those in the control.

Microparticulate diets (Particle size, 75 and 160μ) were prepared using beef liver, ground nut cake, sesame cake, fish meal, tapioca flour, fish oil, soybean oil, vitamins and mineral mixture to conduct feeding experiments on the hatchlings of *L. parsia*.

Test diets formulated with purified ingredients to understand the protein requirements of fry of *L. macrolepis* and *L. parsia* showed that the diet with 40% protein level indicated relatively higher growth and survival rates in *L. macrolepis*. Further experiments were progressing.

Nutritional requirements of Anguilla bicolor bicolor (PNP/7)

D. Kandaswamy

Twelve types of test diets having different composition from one another and using four different binding agencies were prepared and these were tested for their keeping quality and acceptance to the eels. It was found that the diet prepared with a binding material of carageneen and agar agar in 1:2 ratio was found to be most suitable, as the diet was light, soft, not leaching the nutrient for several hours into the water and acceptable to the animal. Further feeding experiments using this diet were planned.

Cataloguing of chemical and biological data on conventional and non-conventional feed ingredients suitable for cultivable marine organisms in India (PNP/8)

R. Paul Raj, M. S. Rajagopalan, Syed Ahamed Ali,
M. Vijayakumaran and D. Kandaswamy

A source form has been prepared for cataloguing the chemical and biological data on feeds, based on the International Net Work of Feed Information Centres. Necessary guidelines for analysis of feeds and conduct of experimental trials are being formulated.

The proximate composition of ninety five feed ingredients have been collected from the literature. These include both conventional and non-conventional feed ingredients. Proximate composition of a few feed ingredients have also been determined by analysis.

The amino acid profile of fifteen feed ingredients including live food organisms have been catalogued from the literature. A comparison of the amino acid profile of penaeid prawns with that of many animal protein sources shows that the essential amino acid, arginine content is very high in penaeid prawns whereas, ingredients such as casein fishmeal, meat meal are limiting in this amino acid, which is suspected to be required in more quantities by crustaceans. This could be compensated by the inclusion of oil cakes such as sesame cake, coconut cake, groundnut cake, sunflower cake etc., which contain high levels of this amino acid.

Fatty acids profile of 11 vegetable oils available from India were recorded Among these, high levels of the one of the essential fatty acids for crustaceans and finfishes, linoleic acid (18;2W6) has been found in soybean oil, cotton seed oil, linseed and peanut oil. Linseed oils is one of the richest sources of linolenic acid (18:3w3), another fatty acid essential for crustaceans and finfishes. The oil of Tung has been observed to contain very high percentage of eleosteanic

acid, while castor oil has 87 per cent ricinoleic acid. Biological evaluation is necessary to ascertain the suitability of these two oils as lipid sources for crustaceans and finfishes.

The fatty acids profile of a few marine organisms, fish and shrimp head oil, shows that most of these are rich in eicosapentaenoic acid (20:5w3) and docosahexaenoic acid (22:6w3), which have been reported to be essential for crustaceans and finfishes, in addition to linolenic acid. The marine lipids seems to be the most ideal form of lipids for crustaceans and finfish diets. A combination of vegetable and marine based lipids would be sufficient to satisfy the essential lipid requirements of crustaceans and finfishes.

The mineral profiles of fish meal, shrimp meal and oil cakes showed that they are rich in calcium, phosphorus, magnesium etc. Data on the trace minerals are being recorded.

Brewer's yeast and animal liver and glandular tissues are rich sources of B-vitamins, which can be included in compounded diets. The presence of adventitious toxins in the feeds is also recorded.

Among the animal protein sources, squilla meal, trash fish, prawn peeling, clam meat, mussel meat and crab meat were available throughout the year. The quantity of squilla landed at Madras is about 15 tonnes per year, Feeds based on squilla meal gave good results with post-larvae and juveniles of *Penaeus indicus* and *P. monodon*. A new source of ingredient which could be used in diet formulations for crustaceans is the 'red crab' *Charybdis* spp. and about 125 tonnes per year of this species are landed at Madras mostly during the period January to June. The crude protein content and total lipid content of this crab by dry weight are 32% and 7%. Feed prepared with this crab meal is tested on prawn and lobsters.

Squid meal, edible oysters and pearl oysters were identified as sources suitable for feed ingredients at Tuticorin. The proximate composition of edible oysters were, moisture 75 to 80%, crude protein 11.2%, crude fat 2.25%, glycogen 4.85% and ash content 2.38%. The proximate composition of pearl oyster meat were, moisture 78.5%, crude fat 5.28%, crude protein 13.25%, glycogen 1.6% and ash 1.37%.

Nutritional requirements of penaeid prawn larvae and juveniles (PNP/9)

Syed Ahamed Ali and M. Vijayakumaran

Two purified diets (PDL 1 and PCL 2) were prepared in particulate size (PDL 1 - 45 μ - 150 μ; PCL 2-37 μ) and fed to protozoea I of *P. indicus*. With the diet PDL 1, the larvae grew to protozoea II stage. PCL 2 was composed of case in, 57.7%; starch, 31.7%; linoleic acid 0.5%; lecithin, 0.01%; metheonine 0.01%; and vitamin and mineral mix, 4.0%.

The experiment to study the effect of calcium and phosphorus in the diet on the growth of *P. indicus* showed that the body calcium was slightly increased with increase in the dietary calcium, while the body phosphorus showed a decreasing trend as the dietary phosphorus increased. However, the food conversion could be improved when the calcium and phosphorus in the ratio of 2 : 1 was included in the diet.

Addition of 0.2% of vitamin B group in the feed was found to improve the growth of juvenile *P. indicus*. But no significant difference in the food conversion value was recorded.

Nutritional requirements of spiny lobsters (Panulirus sp.) (PNP/10)

M. Vijayakumaran and E. V. Radhakrishnan.

Two test diets (TD I and II) having similar composition of case in (50%), sucrose (10%), glucose (5%), starch

(4%), Agar agar (3%), Cellulose (6.4%), Cholesterol (0.5%), Shark liver oil (10%), Vitamin and mineral mixture (11.6%) and water were prepared, one in the uncooked form and the other autoclaved for twenty minutes. The two diets had a protein level of about 48.5%. The feeding experiments carried out by feeding these diets on *P. homarus* indicated that the lobster preferred the TD II diet and showed a normal growth rate.

Development of artificial and processed natural diet for rearing bivalve larvae (PNP/11)

D. Kandaswamy, P. Muthiah, S. Dorairaj and A. Chellam.

Isochrysis sp. and *Monochrysis* sp. were cultured and freeze dried for feeding experiments on bivalve larvae.

Microparticulate diets were prepared by using egg yolk, oyster extract, casein, albumin, yeast powder, soybean, lecithin, lysine, cholesterol, arginin, fish and vegetable oils, skim milk, vitamin and mineral mixture with carageenan and zein as binding agents were fed to the edible oyster and pearl oyster larvae. However, as the particulate size was large (40μ), it was found not suitable for rearing the larvae. Further feed development attempts were progressing.

Investigations on fish and shellfish diseases (PNP/12)

S. Mahadevan, K. Rengarajan, D. Dorairaj, Ramachandran and K. Appukuttan.

The Project was started in 1976 and completed in March 1983. The main objective of the project was to make a survey of the various types of diseases which occured amongst the farmed stock in the Institute's mariculture farms at Madras, Mandapam, Tuticorin, Vizhinjam and Cochin. The diseases encountered in the farmed *P. indicus*, *P. monodon* and *Metapenaeus affinis* at Cochin; *Scylla serrata* at Tuticorin; *Crassostrea madrasensis* at Tuticorin; *Perna viridis* at Madras and Vizhinjam; *Chanos chanos* at Tuticorin and *Anguilla bicolor bicolor* at Mandapam were recorded.

Amongst prawns, the Hemorrhagic septicemia due to *Pseudomonas* sp; *Vibriosis* caused by *vibrio anguillarum* and myxobacterial infection by *Chondrococcus* sp. were encountered in *P. indicus*, *P. monodon*, *M. affinis* and *M. monoceros*. Mortalities of prawn larvae due to *E. coli*, flagellates and ciliates were also recorded. Remedial measures to treat the moribund specimens by following standard methods (Amlacher, 1970) were successfully tried in the laboratory conditions.

In oysters, instances of Digenetic trematode infection by *Bucephalopsis haimeanus* causing castration of gonads was sporadically found. The life history of the species was studied upto the release of metacercariae. While intermediary host for transmitting the trematode from oyster to oyster could not be identified, transfer of oysters from the tidal creek to open sea conditions was found to keep down the incidence of infestation to less than 0.5%.

Instances of predation of oyster hings by a gastropod, *Cymatium cingulatum* was recorded. Manual removal of the predator helped to eradicate them and reduce mortality.

Haemorrhagic septicemia, skin lesions and Columinaris diseases were found in the milk fish, *Chanos chanos* cultured at Tuticorin.

Several diseases such as cripple body disease, white patch disease, cauliflower disease and cyst formation were encountered in the Indian short - finned eel, *Anguilla bicolor bicolor* cultured at Mandapam Camp. Various deformities due to the cripple disease were studied.

Large scale mortality of elvers collected during November and December, '82 from Srivaikundam Anicut area was recorded. However, the causative factors for the death of elvers could not be identified.

Mass mortality of *P. monodon* larvae reared in the experimental hatchery at the Field Laboratory at Kovalam

was reported in May '82. This was found to be due to the infectious phycomycetons fungus, *Lagenidium* sp. The pathogen was found in the stored seawater, seawater in the culture tank, phytoplankton culture, dead as well as live larvae. The source of infection was suspected to be from the sea water. The prophylactic measures and the precautions to be taken to eradicate the pathogen from the hatchery were suggested.

Sporozoan infestation in commercially important prawns (PNP/13)

D. B. James

Appreciable number of *P. indicus* and *P. semisulcatus* infested by the microsporidan parasite *(Thelohania duorara)* causing the muscle of the prawn white or 'cotton' was reported from Madras, Tuticorin and Mandapam Camp. At Madras, the percentage occurrence of the infested *P. indicus* was from 0.5 to 2% of the species caught by trawl nets, while in *P. semisulcatus* it was from 0.5 to 3.2%. In both the species, the specimens measuring above 130 mm were generally found infested with the parasite. Further observations on the extent of its impact in the wild prawn population were continued.

Studies on Pathobiology of 'Soft' prawns (PNP/14)

P. V. Rao, K. H. Mohamed, P. V. Ramachandran Nair, M. S. Muthu, C. P. Ramamirtham, A. D. Diwan, R. Paul Raj, N. N. Pillai, V. K. Pillai, A. G. Ponniah, Syed Ahamed Ali, V. S. Kakati, A. Lakshminarayana, S. K. Pandian, Mrs. Mary K. Manissery and S. Karupuswamy.

Considerable loss of stocked population and production occurs in *P. indicus* cultivated in the grow out system around Cochin due to an abnormal condition known as 'soft' prawns. The prawns with this syndrome become emaciated, loose weight, exoskeleton becomes thin, fragile and the prawn

feels 'soft' to touch. To investigate this problem, a multi-disciplinary project was initiated in April, 1982. Since then, the following data were collected.

For intensive studies the prawns cultured in the ponds attached to the Prawn Culture Laboratory at Narakkal were regularly monitored. In the first culture operation which started from 22-4-1982 with the stocking of 3648 *P. indicus* seed (22.28 mm average size) in a pond of 0.1 ha, the 'soft' prawns were observed in the first half of September, 1982. In the second culture experiment in another pond of 0.1 ha with a stocking density of 4400 *P. indicus* seed (13.5 mm average size) stocked in April 1982 'soft' prawns were encountered in May when they attained an average size of 86.7 mm. The percentage of 'soft' prawns increased in the following months, but decreased in July/August. In the third experiment which was conducted between January and March, the prawns showed normal growth and healthy condition throughout. In the fourth experiment, however, carried out during the same period in the adjacent pond, 'soft' prawns were encountered in March.

In the first week of March, 'soft' prawns were reported in the polythene-lined ponds at Calicut. The prawns in these ponds were stocked in January.

In the farmers' field 'soft' prawns were reported in February and April 1982. However, the incidence of 'soft' prawns during the 1982-83 season appeared to be relatively less intensive as compared to that of the previous year.

Data on environmental parameters such as salinity, temperature, dissolved oxygen, p^H and EH and on biological aspects (size, weight and sex ratio) of the 'soft' prawns were collected for detailed analysis.

To investigate whether the deficiency of nutrients in the diets of prawns causes the 'soft' condition, nutritional experiments were conducted with 6 purified diets, each diet

prepared deficient in one of the nutrients such as protein, fat, calcium, phosphorus, ascorbic acid (vit. C) and Vitamin B. complex. The results of the experiments showed that the 'soft' prawns fed with diets deficient in phosphorus, calcium, ascorbic acid and vitamin fully recovered indicating that this condition was not caused by the deficiency of these nutrients. However, the prawns fed with the diet deficient in protein did not recover and those fed with lipid deficient diet, the recovery was not satisfactory. Further experiments to collect more data on the lead given were in progress.

Biochemical studies carried out on the hepatopancreas of 'soft' prawns revealed that the lipid content was relatively low (7.5% to 19.7%) in soft prawns as compared to healthy prawns (18.5-195%). Microscopical examination of the hepatopancreas also showed that this organ in the 'soft' prawn was devoid of fat globules and in pycnotic condition.

Studies on the seasonal fluctuation in the calcium content in the haemolymph, muscle, and exoskeleton in the cultured prawns in the brackishwater environment showed that relatively high levels of calcium in the muscle and low levels in the exoskeleton were observed in June, when the salinity of the pond water decreased due to monsoon rains. This difference in the calcium levels in the haemolymph, muscle and exoskeleton indicated some imbalance in the absorption and transportation of calcium from the haemolymph to the integument via the muscle.

Gills, muscle tissue, hepatopancreas, cuticle and mid gut of the normal and 'soft' prawns were fixed in Bouin's and Zenker's fluid for detailed histological studies.

Quantitative and qualitative data on the bacterial flora were collected from the 'soft' and normal prawns. The bacteria isolated from the prawns and from the ponds where prawns were cultured belonged to *Psuedomonas*, *Vibrio*, *Bacillus* and *Micrococcus*. *V. anguillarum* was isolated from the

exoskeleton, muscle, blood and hepatopancreas of 'soft' prawns and from the habitat. Further studies are in progress.

The gut content analysis of the 'soft' prawns showed that the gut, although found full or gorged in most cases, the food material (detritus, higher plant bits, filamentous algae, pennate diatom, blue green algae, foraminiferans and crustaceans) were found in a less digested condition.

General observation on the occurrence of 'soft' prawns in the grow-out system indicated that the phytoplankton blooms appearing in the ponds might be toxic affecting the feeding/metabolism of the prawns; the stress condition brought about by the presence of large number of *Tilapia* which compete for food and space in the ponds with the stocked prawn might indirectly cause softness.

LIBRARY AND DOCUMENTATION DIVISION

Management of Fisheries Information Services (LD/DI/1.1)

K. N. KRISHNA KARTHA, M. J. GEORGE,
S. K. DHARMARAJA, G. SUBBARAJU,
M. S. RAJAGOPALAN, KRISHNA SRINATH,
K. KANAGASABAPATHY, E. JOHNSON, S. GIRIJAKUMARI,
A. RAJESWARI MENON, A. KANAGAM,
L. R. KAMBADKAR, EDWIN JOSEPH, LALITHA SEKHARAN.

Work done during the year

The Library and Documentation Division was started at the Institute in 1982 as per the VI Plan proposals to strengthen the Library, documentation, reprography services. To begin with, this project on Management of Fisheries Information Service was started this year with the objective to 1) evolve appropriate measures of collection, collation and dissemination of scientific information in different aspects of marine fisheries to serve the needs of R & D efforts, 2) to assess the adequacy of information sources, 3) to evaluate effectiveness of information resources available in the library and 4) to give information about latest documents added to library.

The scientists involved in this project have rendered commendable voluntary service in addition to their normal scientific work on various matters such as referring, collection and compilation of information, printing of scientific and technical reports.

During 1981-82 and 1982-83 all the backlog of scientific papers submitted by the scientists have been cleared and the *Indian Journal of Fisheries* has been made up-to-date in the issue of 4 numbers during this period.

The *Marine Fisheries Information Service-Technical & Extension Series* has now become a standard source of reference

for up-to-date information on all aspects of research and development in marine fisheries sector. During 1982-83 twelve numbers have been published and these contain a wide range of information on marine fisheries, lead articles on important aspects and information of recent developments in other countries in marine fisheries.

CMFRI Bulletin No. 32 issued during the year gives a comprehensive report on the Resources of tunas and related species and their fisheries in the Indian Ocean. This report has become a valuable source of information for the fishing industry for taking investment decision on tuna fishing.

CMFRI Bulletin No. 33 contains an useful analysis of the fishery resources of Exclusive Economic Zone of North west coast of India based on the survey carried out by CMFRI scientists on board the Polish vessel *M. T. MURENA*.

In connection with the Workshops/Seminars organised by the Centre of Advanced Studies in Mariculture, Manuals on Research Methodologies on specified topics have been brought out as CMFRI *Special Publications*. These Manuals are widely used by research workers in various universities and Institutions in the country.

New approaches to fish stock assessment for developing proper management measures has been brought out in *CMFRI special publication* No. 10 entitled "Analysis of Marine Fish landings in India".

The *Annual Report* of CMFRI contains comprehensive information on the progress achieved in each research project of the Institute. It also gives useful information on the advisory and consultancy service provided, official meetings attended by the scientists, membership in different committees, deputation of scientists abroad, list of distinguished visitors to the Institute, Symposia, Seminars etc. organised during the year and list of staff members. The

report has a large mailing list consisting of ICAR institutes, Government Departments and Institutions abroad. The Annual Report for the year 1980-81 was published during 1982-83 and the report for 1981-82 is in press.

The *CMFRI News Letter*, brings out information on recent achievements in the research programmes of the Institute, current activities, development of infrastructure and on the participation of the staff in various activities. It also contains information on appointments, promotions, awards won by the staff. 4 numbers of News Letters were issued during the year.

In order to give effect to the various recommendations of the Official Language Implementation Committee, the Institute brings out Hindi translations/versions of the Annual Report, Marine Fisheries Information Service, News Letters etc.

The Library section was actively engaged in book procurement and acquisition of periodicals both at Headquarters and at the Research Centres. A total of 528 books and 2840 periodicals were added to the Headquarter's Library. As usual inter-library loan and other facilities were extended to various Government Departments, Institutions, Universities and to visitors from abroad. During the year a project for compiling the 'Complete Holdings of the Libraries of the Institute has been started. The Library at Calicut was re-organised for listing the holdings. Publications issued during the year by the Institute are given below:

1. *Indian Journal of Fisheries*. Vol. 28
2. *CMFRI Bulletin* No. 32 - Resources of tunas and related species and their fisheries in the Indian Ocean by E. G. Silas and P. P. Pillai.
3. *CMFRI Bulletin* No. 33 - Fishery resources of the Exclusive Economic Zone of the northwest coast of India by S. V. Bapat and others.

4. *Marine Fisheries Information Service* - Technical and Extension Series Nos. 34-35.

5. *CMFRI Special Publication* No. 8 – Manual of research methods for fish and shellfish nutrition.

6. *CMFRI Special Publication* No. 9 - Manual of research methods for marine invertebrate reproduction.

7. *CMFRI Special Publication* No. 10 - Analysis of marine fish landings in India - a new approach by K. Alagaraja & others.

8. *Current Awareness Service*-A monthly for internal circulation.

9. *Samudra Matsyaki Suchana Seva* in Hindi - For 6 issues of MFIS.

10. *Annual Report* for the year 1980-81.

11. *CMFRI News Letters* Nos. 16-19.

INTER DIVISIONAL PROJECTS

Identification and isolation of suitable planktonic micro-organisms as food of bivalve larvae and their mass culture. (CMFRI/IDP/20).

C. P. Gopinathan, A. Chellam, P. Muthiah and S. Dharmaraj.

The isolation and identification of microplankters, occurring in water samples from the pearl and edible oyster beds, was initiated at the Karapad field laboratory, Tuticorin. Cutlure tubes containing several enriched media were inoculated with the filterate obtained by filtering water samples through 10 micron bolting nylon mesh. After ten days the culture tubes indicated the growth of Chlorophycean and Chrysophycean flagellates. Pure cultures of the following species were made from these. They are tentatively identified

as, *pavlova (Monochrysis)* yellow in colour, *Tetraselmis* green in colour and *Dunaliella salina* red in colour due to the red hematochrome in its chloroplasts.

At the Karapad laboratory mass cultures of 9 species of microalgae have been maintained in various media for ready use as larval food. Of these, the Chrysophycean flagellate *Isochrysis galbana* are maintained in large scale for feeding the edible and pearl oyster larvae. For the first time the settlement of the larvae of *Crassostrea madrasensis* in laboratory condition has been achieved by feeding the larvae with *Isochrysis*. Similar results were obtained in the case of the pearl oyster larvae also. Attempts to maintain mass cultures of *Pavlova* sp. are proving successful. Spat formation of the edible oyster has been achieved by feeding the larvae with this flagellate. Experiments indicate the possibility of using *Isochrysis* and *Chlorella salina* for inducing maturation in edible oyster.

Altogether, 20,500 liters of pure culture of *Isochrysis* and 7000 liters of *Pavlova* in their exponential phase of growth have been supplied to the hatchery for feeding oyster larvae.

Population studies by mark release experiments on commercially important fishes and prawns. (CMFRI/IDP/16).

P. Vijayaraghavan and M. M. Thomas.

As the preceeding mark recapture experiments indicated that the seaward migration of prawns from the backwaters of Cochin was probably not as massive as had so far been assumed and that the migration occurred between January and August, it was decided to mark and release 10,000 prawns during this period in the present year in the back-waters within the Cochin harbour. Further, based on the results from the earlier experiment, the lower size limit of

the prawns to be tagged was raised from 35 mm to 50 mm since prawns above this size seemed to be more likely to be involved in the seawards migration.

In 25 tagging operations i.e. 6 in April, 6 in May, 10 in June and 3 in July 1982, 8740 prawns belonging to species *Penaeus indicus*, *P. cemisulcatus*, *Metapenaeus, dobsoni*, *M. monoceros* and *M. affinis* were tagged and released within the Cochin harbour. In all 3870 *indicus*, 1921 *affinis*, 2486 *monoceros*, 403 *dobsoni* and 60 *cemisulcatus* were released. Of these, 366 prawns were recovered from the backwaters itself and 109 from the sea. Since no reliable data was available for estimating the strength of the juvenile prawn population within the backwaters, no attempt could be made to assess the extent to which the emigrant prawns from the backwaters supported the marine stock on which the fishery off Cochin was based. However, from the results obtained by the tagging experiment it may broadly be said that hardly one third of the prawn population in the backwaters reaches the trawling grounds off Cochin.

The most significant of the results obtained from the tagging experiment is the recovery of eight prawns of *P. indicus* species, which were released in the cochin backwaters, from the Tinnevelli and Kanyakumari coasts. It had so far been assumed the four species of prawns did not move beyond the areas from where they were being usually fished. Some details of these recovered prawns are presented in the following table:-

Date of release	Date of recapture	Days in liberty	Growth in liberty mm	Place of recovery	Distance covered km	Average speed km / day
29-4-82	5-7-82	61	42.0	Ovari	330	5.41
29-4-82	13-7-82	75	41.0	Tengapatnam	220	2.93
1-5-82	11-8-82	103	72.0	Kuttapani	333	3.23
22-5-82	21-7-82	68	39.0	Manappad	380	5.58
29-5-82	2-8-82	94	66.5	Ovari	330	3.51
29-5-82	13-7-82	45	21.0	Keelamuttom	246	5.47
3-6-82	9-9-82	99	97.0	Periathali	377	3.81
?	10-7-82*	—	—	Enayam	226	—

* The prawn was lost by the fisherman.

Stock assessment of commercially important fishes in the exploited zone. (CMFRI/IDP/15).

K. Alagaraja, T. Jacob, N. Narayana Kurup, M. J. George, M. M. Thomas and C. Suseelan.

Catch and effort data on prawns exploited in the Cochin area for the years 1981 and 1982 have been compiled.

Biological data on *Penaeus stylifera* and *Metapenaeus dobsoni* for the years 1977, 1978 and 1979 and for the year 1977 respectively have been analysed.

Remote Sensing and Fisheries (CMFRI/IDP/17).

G. Subbaraju, P. V. R. Nair, V. K. Pillai, A. G. Ponniah and Technical Staff

The technique of Remote Sensing was utilized on the west coast of India in a Joint Experiment Programme with EFP, SAC for studying chlorophyll *a* concentration in the surface water. It was observed that chlorophyll *a* concentration showed a high value of about 6.4 mg m^{-3} during October followed by a sharp fall during November (about 1.7 mg m^{-3}) and December (about 1.4 mg m^{-3}). This was compared with the available fish catch rate (kg/hr) data of the study area of the period from 1977-1981. The mean monthly fish catch rate values were 83.1, 57.3 and 44.7 kg/hr for October, November and December respectively. The fish catch rate data (pertaining to total fin-fish) also showed a decreasing trend with time. A relationship thus could be established between pigment data and fish catch.

CENTRE OF ADVANCED STUDIES IN MARICULTURE

The Centre of Advanced Studies in Mariculture (CAS) was started in June, 1979 at the Institute to accelerate the process of development of mariculture in the country through research, education and transfer of technology. To accomplish this objective, the Centre instituted a M.Sc. (Mariculture) programme in close collaboration with the University of Cochin and a Ph. D. programme to tackle problems encountered in the identified priority areas in mariculture through mission- oriented research programmes. Besides, the Centre organised workshop and seminars, made available modern research facilities through procurement of equipments, and organised advanced training in overseas institutes in the identified specialised areas to enhance the competency of the scientists and faculty members.

9 candidates admitted in 1980 to M. Sc. (Mariculture) successfully completed the course in September, 1982. Subsequently, 3 of the candidates got employment in a private sector company operating prawn culture, 5 went in pursuit of higher studies and one candidate was awaiting employment in fisheries research institute. The second batch of the academic session 1981-83, comprising of 12 candidates, completed the second semester of the course, while the third batch (10 candidates) was admitted in December, 1982.

In the Ph. D. programme, 13 scholars were undergoing the course. Four scholars of the first batch qualified through their course work and were advancing with valuable observations in the concerned research topics assigned to them.

During the period, the Research Scholars observed that the juvenile *P. indicus* showed maximum growth rate, when it was reared in a medium with 20‰ salinity. It was also found that the ammonia excretion was lowest in the

medium of 20‰ salinity, and it increased gradually both in lower and higher saline media, the highest value being recorded in the media of 35‰ salinity.

Investigations on the spawning biology of *Perna indica* and *P. viridis;* histological and histochemical studies on the ova and sperm, and experiments on the effect of ganglion ablation on the spawning of *P. indica,* as well as the effect of environmental parameters on reproductive behaviour of the mussels were continued with encouraging results.

Various aspects of growth kinetics of the blue green alga, *Synechocystis salina* was studied based on the culture maintained in the laboratory. During the period, salinity tolerance of the species, growth variability, photosynthetic activity and nutrient requirements for the growth of the species were studied.

Studies on seasonal and diurnal aspects of sporulation in *Gelidiella acerosa, G. corticata, Gracilaria edulis* and *Hypnea,* indicated that there is no rhythmic liberation of tetraspores in all the species. However, periodicity in shedding of carpospores was found in *G. corticata,* and *G. edulis,* but not in *Hypnea* sp. In all these species peak tetraspore output was found during night, except in *G. acerosa.*

Time-bound research programmes on nutritional requirement; salinity tolerence; effect of ammonia, nitrate, and nitrite and oxygen requirement of larvae and post-larvae of *P. indicus;* prawn seed transportation; abundance and distribution of benthos in prawn culture systems; metabolic and excretion rates in *P. indicus* and comparative study on protein, carbohydrate and fat content during ovarian maturation in nature and induced maturation experiments in *P. indicus* were also carried out by the Research Scholars.

During the period under report, CAS in Mariculture organised 2 National Workshops, one on 'Fish and Shellfish

Nutrition' and the other on 'Marine Invertebrate Reproduction'. The main theme of these workshops was on the research methodologies in the concerned subject and the participants were directly involved in the conduct of experiments, data collection, analysis and interpretation.

A series of four seminars were given by the Expert Consultants who visited the Centre during the year. The Faculty Members and the Research Scholars also gave four seminars each, the former on their experiences and observations made during the training in the overseas institutions, and the latter on identified topics of current interest. These seminars were actively participated by the Scientists, Professors and Lecturers of the University of Cochin, and Kerala Agricultural University, besides the Scholars of CAS in Mariculture.

More recently Dr. Akira Machii of National Research Institute of Aquaculture, Japan, an expert in 'Tissue Culture' and Dr. A. L. S. Munro of the Marine Laboratory, Department of Agriculture and Fisheries, Aberdeen, U. K., a well-known fish pathology Expert commenced their consultancy assignments from 22nd and 28th December, 1982 respectively. Dr. B. J. Bye, Marine Laboratory, Lowestoft, U. K. joined the Centre as Expert Consultant in the field of fish and shellfish genetics, in April-May, 1982.

Five Scientists of the Institute were sponsored during the year for advanced training, one each in the field of finfish and shellfish Reproductive Physiology, Fish nutrition, Bioenergetics, Endocrinology of fishes and shellfishes, and cage and pen culture. After completion of their training; the scientists are actively involved in the follow up of the recommendations/suggestions made in their report.

Individual training programme in *Macrobrachium* culture and crustacean genetics, fish seed production, seaweed culture and genetics, and crustacean physiology were being processed and finalised. Several subject matter areas such

as culture of mullets, bait fish culture, culture of groupers, fish genetics, pearl oyster culture, milkfish culture, and culture of ornamental fish, Aquaculture Economics, water quality management and *Eucheuma* culture were identified for arranging advanced training of scientists.

To provide enhanced facilities for research and education, laboratory equipments were procured under the UNDP input. These were Rotavapor, Fibretech System, Soxtec system, Kjeltec system, Digestion System, Amino acid analyser, Gas chromatograph, osmometer and U. V. lamp. Orders were placed for the supply of Centrifuge, Cartridge Filter and Research Microscopes.

During the period an FAO/UNDP/UNESCO Technical Advisory Mission comprising of the following members visited the Centre on 18th and 19th October, 1982 and reviewed the activities of the Centre.

1. Dr. A. W. El-Moursi
   Agricultural Education Officer
   Agricultural Education & Extension Service

2. Mr. T. Worku
   Programme Specialist
   Division of Education Policy and Planning

3. Mr. D. R. Malhotra
   Senior Programme Officer and

4. Mr. V. Kumar
   Administrative Officer
   ICAR/UNDP Cell,
   Krishi Bhavan
   New Delhi.

Besides, periodic meetings of Faculty Members were held to review the progress of research and education at the CAS in Mariculture.

KRISHI VIGYAN KENDRA OF CENTRAL MARINE FISHERIES RESEARCH INSTITUTE NARAKKAL-682505

Staff:- M.M. Thomas, P. Karunakaran Nair, K.A. Unnithan P. K. Martin Thompson, K. N. R. Kartha, A. N. Mohanan, P. Radhakrishnan.

Progress of work:

During 1982-83, 23 batches of training were conducted of which 1 batch of 10 day duration and the rest were of 2-5 day duration. A total of 416 farmers were trained of which 240 were farm women. The total number of trainee days occupied was 2003. The farmers were trained in mariculture of prawns.

The farmers were regularly taken on conducted tours to Valappu where the Institute's Lab-to-Land Programme is being implemented and on board *R. V. Cadalmin* for collection of spawners. The techniques of scientific prawn farming was demonstrated as the Prawn Culture Laboratory at Narakkal.

Innovative ideas in training:

i. During each training course for farm-women, special classes on Child care, nutrition and hygeine were arranged with the help of Gramasevikas of the local N. E. S. Block.

ii. A two days "Science camp" for the benefit of students and teachers of the Little Flower High School, Narakkal was organised to provide them with opportunities of getting work experience by way of utilising the practical training facilities developed at the Kendra. Local farmers also participated in this camp.

iii. A two days refresher course for the ex-trainees was conducted. Guest lecturers from Nationalised

Bank of the locality and also the subject matter specialist in Animal husbandary of North Parur Polyclinic took classes to the farmers on financing the mariculture project and integrated farming techniques respectively.

iv. A one day refresher course on "Eradication of predatory organisms using "Ammonia" was held. The course was arranged as part of the implementation of the new 20 point programme of the Prime Minister

Outstanding achievements:

The first phase of the Lab-to Land Programme of the Institute came to an end by June 1982. The staff of the Kendra played a commendable role in the successful implementation of this programme. Under this project a harijan society of 136 families were helped to adopt the new technology of integrated farming of prawns/Fishes/Paddy/ Vegetables/Coconut to enhance their socio-economic condition. The working capital of the society, which was around Rs. 30,000/- at the start, increased to over Rs. 1,00,000/- at the end of the programme. The vegetables cultivated on the bunds of the farm also have fetched the society Rs. 1,600/- during the year. The coconut seedlings planted on the bunds of the farms have started yielding.

The first phase of the Lab-to land programme has created an employment opportunity to the member of the society to the tune of over 2,000 man days.

The Society has established a Library where 980 books are available at present. In addition, dailies (4 Nos) weeklies (7 Nos) monthlies (4 Nos) etc. are also being provided to the members for day to day reading. A radio has also been installed at the campus of the society.

A cash award has been set apart for those students of the harijan families of the society, who successfully

complete the secondary education. Special merit award of Rs. 51/- has also been set apart to the best student who scores the maximum mark in the S. S. L. C. examination.

A free tuition class is run by the AMSF to the benefit of the student community of the colony.

The society runs a daily chit fund to create saving mentality among its members.

Loan assistance to its members is also provided for medical aid, childrens education, marriage and also for thatching of their houses. In addition, monetory assistance is provided to the members for performing Cremation/burial functions in the event of any death occurring in the families of the members.

Thus the most significant and relevant aspect of the farming success has been the effort expended and the interest shown by the farmer-trainees under the technical guidance of the Kendra. This programme has set an example as to how a harijan society, whose members are essentially daily wage earners, could develop a shallow marshy land into a productive prawn farming unit.

Radio Talks given :

1.	Brackish water fish farming	— Shri P. Karunakaran Nair
2.	An interview with the farmers undergoing training at KVK Narakkal.	A farmer trainee and staff members of KVK.
3.	A visit to Farm Science Centre	— Dr. M. M. Thomas Shri P. Karunakaran Nair and trainees participated.
4.	Training facilities in Prawn farming	— Shri Asokakumaran Unnithan.
5.	An interview with a progressive prawn farmer	— An ex-trainee and staff members of KVK.
6.	Scientific collection of prawn seeds	— Dr. M. M. Thomas

Seminars :

1.	"Prawn farming" "A new venture"	— Dr. M. M. Thomas
2.	"Scientific Prawn Farming"	— Shri P. Karunakaran Nair
3.	"Economical feasibility of scientific prawn farming"	— Shri K. N. Rasachandra Kartha
4.	Brackish water fish culture-A comparative study of Prawn filtration and Prawn Culture	— Shri P. Karunakaran Nair
5.	Scientific Prawn Culture-Package of practice	— Shri K. Asokakumaran Unnithan
6.	Training facilities in Prawn culture	— Shri P. Karunakaran Nair.

visitors to KVK

1. Dr. P. G. Rumeau, FAO Representative in India, New Delhi.
2. Shri K. P. Padmanabhan, Dy. Director of Fisheries, Pondicherry.
3. Dr. T. Subramanian, Department of Zoology, University of Madras.
4. Dr. Ang Kou Jers, Faculty of Fisheries and Marine Science, University of Agriculture, Malayasia.
5. Shri Venkataraman, Regional Information Officer, Press Information Bureau, Madras.
6. Mr. Moretti Alessondrew, Venice, Itally.
7. Mr. Loix Brigide, Fish Culture Technologist, Itally.
8. Mr. Ursin Erik, Danish Institute for Fisheries and Marine Research, Denmark.

9. Mr. Larsen Hans, Danish Institute for Fisheries and Marine Research, Denmark.
10. Mr. Larsen Fette -do-
11. Mr. A. G. Kalawar, Fisheries Advisor to Government of Maharastra, Bombay.
12. Mr. Robert A Stella, American Embassy, New Delhi.
13. Mr. S. K. Dutt, -do-
14. Dr. S. S. Pillai, I. N. S. R. I., New Delhi.
15. Mr. D. L. Malhotra, Sr. Programme Officer, U. N. D. P., New Delhi.
16. Dr. A. W. Elmoursi, F. A. O., Rome, Italy.
17. Dr. T. A. Worku, UNESCO, Paris.
18. Dr. B. B. Lal, Ministry of Agriculture, New Delhi.
19. Dr. P. J. Sanjeevaraj, Head of Department of Zoology, Madras Christian College, Madras.
20. Dr. K. Jauncey, Institute of Aquaculture, University of Sterling, U. K.,
21. Dr. A. N. Bose, Professor of Aquacultural Engineering, I. I. T., Kharagpur.
22. Mr. S. C. Hota, Director of Fisheries, Orissa.
23. Dr. N. K. Jaiswal, Director (Extension) N. I. R. D., Hyderabad.

MOLLUSCAN FISHERIES DIVISION

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

K. Nagappan Nayar, S. Mahadevan, K. A. Narasimham, K. Rangarajan, K. Satyanarayana Rao, P. S. Kuriakose, R. Sarvesan, K. Ramadoss, M. E. Rajapandian, K. K. Appukuttan, G. P. Kumaraswami Achari, G. Syda Rao, N. Ramachandran, Kuber Vidyasagar, K. S. Sundaram and G. Radhakrishnan.

The estuaries of Sharada, Champavathi, Nagavali and Vemshadhara rivers in Andhra Pradesh were surveyed for the molluscan resources. Beds of Clam *Meretrix casta* and oyster *Crassostrea madrasensis* were located at some centres. While the oyster is collected by fishermen for culinary use, the clams are exploited on a very moderate scale for lime making. The blood clam *Anadara granosa* continues to support a clam fishery of some magnitude in Kakinada Bay and the annual production at Yetimoga village on the bay was estimated at 131 t.

The landings of sacred chank *Xancus pyrum* at Tuticorin, Sippikulam and Tiruchendur together were 978, 417 numbers, of which 340, 714 were full size-I, 577, 876 were full size-II and 59, 827 were wormed. Oysters *(Crassostrea* and *Soccostrea* spp.) were obtained from different centres along the east and west coasts and species identity was established. A good clam bed of *Mesodesma glabratum* was recorded in the sandy sediments on the approach to Hare island on Tuticorin coast.

The chank landings at Sakthikulangara, Eravipuram, Varkala, Paravur, Veli, Sangumugam, Vizhinjam, Enayam, Colachel and Kadiyapatnam on the Kerala coast were estimated to be 10,570. The chanks were landed in trawl nets at Sakthikulangara, in gillnets at some centres and by diving at Enayam, Colachel and Kadiyapatnam.

The clam resources of Ashtamudi Lake, particularly the beds at Dalavapuram, came under heavy exploitation with the beginning of an export trade for frozen clam meat. *Katelysia opima* formed the major species (90%) in the area. The resource, along with hydrological conditions of the lake, was monitored more closely and the export processing of clam meat upto counts 1000-1500/kg was studied. The annual production of brown mussel *Perna indica* at Vizhinjam, Enayam, Colachel and Kadiyapatnam was estimated at 209 t.

Along the Karnataka coast, the clam fishery was observed in the Mulky estuary, with production at 1659 t, which showed a 74% increase over that of 1981-82 production. *Meretrix casta* was the dominant species contributing 1552 t and *Paphia malabarica* the rest. The latter species showed a decline of 48% from the previous year. A survey of the Kalinadhi estuary was completed and the standing crop of molluscs (excluding shell deposits) comprising of *Meretrix meretrix M. casta, Villorita* sp. and *Paphia malabarica* was estimated to be 1128 t. Oyster beds of the estuary were also surveyed.

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

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

R. V. Skipjack made a trial cruise off between Cochin-Mangalore with pelagic trawl during February 1983 and juvenile squids (*Loligo duvaucelii*),20–90 mm, were collected. Between Kasaragod and Mangalore, cuttlebones, 5-15 cm length, of *Sepia aculeata* were observed floating in good numbers. The constant mechanical problems of the vessel precluded any systematic work on the cephalopod resources.

The squid jigging machines were overhauled and platforms for installing the machines were fabricated.

Cephalopod catch data of the vessels of the Exploratory Fisheries Project and Integrated Fisheries Project of Govt. of India were examined. The vessels *Meena Utpadak*, *Meena Sachadak* and *Matsya Vigyani* of EFP and *Samudradevi*, *Klaus Sunnana*, *Tuna*, *Velameen*, *Kalava II* and *Norind-II* of IFP operated from Cochin base. Bottom trawl was the commonest gear used. High opening fish trawl was operated from *Velameen* in July with no cephalopod catch. *Klaus Sunnana* and *Tuna* operated pelagic trawls during July-August, with no cephalopod catch in July, and cephalopod catch rates ranging 3.33 - 6.67 kg/ha in August from areas 9-75 and 10-75. In the bottom trawl operations, the cephalopod catch its percentage composition and CPUE in area 9-76 were 2934 kg, 1.9% and 1.82 kg/h respectively; in area 9-75 the respective figures were 2408 kg, 6.2% and 7.49 kg/h. The CPUE in other areas was 4.01 kg/h in 8-76, 0.40 kg/h in 10-75, 0.07 kg/h in 10-76 and 2.89 kg/h in 11-75 and was also equally low in other areas operated. Cuttlefishes *Sepia pharaonis*, *S. aculeata* and *S. elliptica* were predominant and squid *Loligo duvaucelii* was caught occasionally.

The vessel *Matsya Nireekshani* of EFP which was concentrating on the Wadge Bank resources, landed 11,324 kg of cephalopods forming 8.69% of the total catch of the vessel during Jan-Dec. 1982. The monthly cephalopod catch ranged from 70 kg (2.97%) in January to 3,722 kg (29.1%) in October. Although the vessel operated in major areas 7-76, 7-77, 7-78, 8-76, 8-77, 8-78, 9-75 and 9-78 in depth range 30-255 m, 56.5% of the total cephalopod catch came from area 7-77 and 38.7% from area 8-76, indicating their abundance.

Off Bombay *Meena Ayojak* and *Meena Sangrahak* operated in the major areas 17-72, 17-73, 18-72, 19-71 and 19-72

during April 82 - February 83 and landed a total cephalopod catch of 2924 kg for an effort of 784.75 hours, yielding an overall catch rate of 3.73 kg/h. The average CPUE was 4.55 kg/h in 17-72 which gave the best results, with a minimum of 0.21 kg/h in June and maximum of 10.80 kg/h in December. The average CPUE in other areas was 2.39 kg/h in 17-73, 3.31 kg/h in 18-72, 3.24 kg/h in 19-72 and 3.59 kg/h in 19-71.

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

K. Alagarswami, K. Satyanarayana Rao, H. Mohammed Kasim, Kuber Vidyasagar, G. Syda Rao, M. M. Meiyappan, K. Prabhakaran Nair, P. Natarajan, R. Sarvesan and G. Radhakrishnan.

With a view to improving and standardising the system of data collection to meet the specific objective of stock assessment, a new set of proformae for fishery and biological data was evolved and used from the year under report.

At *Veraval*, cephalopod catch by trawlers amounted to 840.8 t for a total effort of 42,765 trawler-days (t-d), giving an annual average CPUE of 19.66 kg/t-d. There was a decrease in catch from previous year by 503.7 t due to decrease in effort by 3890 t-d and perhaps poor abundance. April 82 (CPUE 45.3 kg/t-d) and December 82-March 83 (CPUE range 16.73 - 34.72 kg/t-d) were the best period for cephalopod fishery. There was no fishery during July-August. *Loligo duvaucelii* was the most dominant species (90.2%), followed the *Sepia aculeata* (6.6%) and *S. elliptica* (1.9%). The size-range was 25/29 - 215/299 mm for *L. duvaucelii*, 10/14 - 65/69 mm for *Sepiella inermis*, 50/54 – 210/214 mm for *S. aculeata* and 40/44 - 155/159 mm for *S. elliptica*.

At *Bombay*, the total cephalopod landings by the trawlers amounted to 4363 t, giving an increase of 118.5% over

that of 1981-82. About 60% of the catch was accounted for together by *Sepia aculeata* and *S. pharaonis*, and the rest by *L. duvaucelii*. *S. inermis* was negligible. At New Ferry Wharf, the increase in cephalopod production (2408 t) was 255.5% over the previous year. October-March proved the best season with monthly production ranging 206-349 t, and catch rates 2.50-8.83 kg/h. At Sassoon Dock, the cephalopod production (1955 t) was an increase of 48% over the previous year. The cuttlefishes formed 62.61% and squids 37.39% of the landings. Between October-March, monthly production ranged 102-471 t and the catch rates 2.44-8.64 kg/h. April 82 gave a higher catch rate of 10.69 kg/h. At Versova, cephalopod landings were practically nil.

At *Cochin*, the trawlers landed 140.7 t of cephalopods with an increase of 39% over the previous year, forming about 1.5% of the total landings at the fisheries harbour. The total effort was 48,515 trawler days which was an increase of 17% over the previous year, and the Cephalopod catch rate was 2.9 kg/t-d. The landings during April-September accounted for 75% of the annual production. The catch varied from 57 kg in October to 83,802 kg in August with corresponding CPUE of 0.3 kg/t-d and 22.4 kg/t-d. Though cuttlefishes were landed only during July-November, they accounted for 69.5%. Squid landings were observed in all months except during August-October. In general the cuttlefish landings during the year were greater than the previous year, the increase being 138% for *S. pharaonis* 71% for *S. aculeata* and 79% for *S. elliptica*. *Sepiella inermis* which used to be landed in good quantities previously was almost totally absent, may be due to the fact that this species is thrown overboard as there is no demand in the export market. *S. aculeata* (size range 60-190mm) accounted for 27.8% of cephalopod catch, *S. pharaonis* (60-250 mm) 23.3%, *S. elliptica* (50-120 mm) 18.4% and *L. duvaucelii* (40-220 mm) 30.5%.

At *Vizhinjam*, the estimated total landings of cephalopods were 125.2 t and showed a decrease of 10 t over the previous year. Hooks and lines contributed to about 80% of cephalopod landings and the boat-seines the rest. Shore-seines yielded negligible quantities (234 kg) of cephalopods. The CPUE for hooks and lines showed a 50% decrease, from 2.73 kg/unit in 1981-82 to 1.34 kg/unit in 1982-83, although the effort increased from 72,268 units to 74,372 units during the period. Among boat-seines, there was a slight reduction in the number of units, from 42,803 units in 1981-82 to 41.446 units in 1982-83, but the CPUE showed an increase from 0.57 kg to 0.62 kg per unit. Of the total cephalopod catch 62% was constituted by cuttlefishes and 38% by squids. The entire quantity of cuttlefishes was landed by hooks and lines. Of the squid landings, 54.0% came from boat-seines, 45.5% from hooks and lines and 0.5% from shoreseines. Cephalopods were landed in all months, except June. Higher monthly catches, ranging 12.7-24.6 t, were obtained in April, September, October, January and March. The mainstay of the squid fishery was *Doryteuthis* sp. contributing to 93.1% of the squid landings, followed by *L. duvaucelii* with 6.7%; *Sepioteuthis lessoniana* (0.2% was taken in the boat-seine only in April and this species does not form a fishery in this area. The cuttlefish landings were composed by a single species, *Sepia pharaonis*. The size ranges of the species in the fishery were: *Doryteuthis* sp: 60-209 mm; *L. duvaucelii:* 50 - 169 mm: *S. lessoniana*: 160-299 mm and *S. pharaonis:* 100-359 mm.

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

K. Alagarswami, P. V. Sreenivasan and M. M Meiyappan.

The progress in this project was slow as one of the associates (P. V. Sreenivasan) trained in techniques of karyology proceeded on study leave. Gaps in morphometric and

electrophoretic data of earlier years for samples of *Meretrix casta* from Mangalore on the west coast and Waltair on the east coast were filled up. Samples of *M. meretrix* were also examined.

Assessment of exploited mussel resources (MOL/RE/1·6)

The fishery of brown mussel *Perna indica* was monitored along the south-west coast and the total production from the major fishing centres of Vizhinjam, Enayam, Colachel and Kadiyapatnam was estimated to be 208.9 t. The fishery lasted from September to February at Vizhinjam, and from November to March at other centres. The peak landings were during November - January, when 67.2% of total brown mussel production was taken.

Following successful spawing of *P. indica* in July, good settlement of spat was observed at Muttom, Kadiyapatnam, Colachel, Enayam, Mulloor, Vizhinjam, Varkala and Sakthikulangara. The density of spat ranged 4500-5132 spat/m^2 in the Vizhinjam area. Due to successful production of 0-year class mussels, the fishery showed an improvement over that of the previous year.

The production of green mussel *P. viridis* from Malabar coast was estimated to be 3074 t which was about the same as in previous year. Except during the peak of monsoon (July-August), the fishery continued throughout the year at various centres. Estimated production from the major centres of Challium, Elathur, Moodadi, Thikkodi, Chombala, Mahe and Koduvally was respectively 777.15, 354.58, 608.81, 472.72, 402.44 and 458.45 tonnes. The fishery started in September. Production during different quarters was April-June: 881.90 t; July - September 117.37 t; October-December 1391.73 t (peak); and January-March: 683.15 t. The marketed size of mussel ranged 40-105 mm. The price range was Rs.48 - 175, depending on size, for 100 kg of whole mussel.

Along the Uttara Kannada coast, green mussel beds were noticed only at two centres, Tadri and Harwada. At other places, only scattered mussels were found. The Harwada bed, estimated to be of 4 ha in area, extends from intertidal rocky coast to the mud flat at 3 m depth. The density changed from 330/m² in April (mode 55-59 mm) to 159/m² in June (mode 65-69 mm). The potential stock of mussels in Harwada bed was estimated at 192 t in April. The fishery, confined to April-June season exploited 36.5 t of mussel of 40-100 mm range. Spat settlement was restricted to 80 m² but this was also lost by end of December due to accumulation of mud. At Tadri, the mussel bed on submerged granite was about 0.5 ha in area. With an average density of 60/m², the potential stock was estimated to be about 7.0 t in May 82. A minor fishery at this centre during May-June exploited 1.5 t of the stock. Spat settlement in October was on about 150 m² area of intertidal rocks but suffered mortality by end of December due to prolonged exposure. At Karwar spat (2-10 mm) were observed as isolated patches with a high density of 34,000/m² in November.

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

S. Mahadevan, K. Rangarajan, P. S. Kuriakose, M. E. Rajapandian, P. Muthiah and K. K. Appukuttan.

A few experiments were conducted on conditioning and transportation of spat of oyster *Crassostrea madrasensis*, brown mussel *Perna indica* and green mussel *P viridis*. Hardening of oyster spat with control showed difference in oxygen requirement; spat (30 - 40 mm) transported by bus from Tuticorin to Madras showed 99.6% survival after 17 hours. Temperature and salinity tolerance limits of brown mussel seed were studied; transport of seed by road within the region of its occurrence (Varkala to Kadiapatnam) was accomplished successfully. Green mussel seed from Ennur

established itself well in the salt water farm at Muttukadu near Madras.

Recruitment studies in clam population (MOL/RE/1.8)

K. A. Narasimham and N. Ramachandran

In Kakinada Bay, recruitment of the blood clam *Anadara granosa* was studied. As the species has a prolonged spawning period, seed clams of 4-8 mm were found throughout the year in the bay. The average density of population ranged from 5.3-20.0/m^2. In Kali estuary at Karwar, the smallest size group of *Meretrix casta* at 21-23 mm entered the fishery in April (forming 16% of exploited stock), June (4%), and July 82 (2%) and March 83 (28%). In May, November and January the smallest size group was 24-26 mm, and in December it was 27-29 mm group. Seed clams less than 10 mm were found during December-March. The population density ranged from 3/m^2 in March to 38/m^2 in December. Environmental parameters were monitored.

Culture of edible oyster (MOL/CUL/1.1)

K. Nagappan Nayar, S. Mahadevan, K. Satyanarayana Rao, K. Ramadoss, P. Muthiah and M. E. Rajapandian

While continuing the use of lime-coated tiles for the collection of spat of the oyster *Crassostrea madrasensis* in the Tuticorin Bay, experiments on new materials were intensified to develop cheaper spat collectors, also with a view to reducing the cost of production during the grow-out phase. A set of 100 rens each with 15-17 oyster shells, showed an average 7 spat per shell during April-May spawning season. Same type of shells, when bagged in nylon nets, gave a lower spat settlement rate at 5.3 spat/shell. Velon screen, g.i. wire mesh and p.v.c tubes (100 cm long, 2.5 cm dia.) also proved to be useful spat collectors. The experiments are to be repeated for proper evaluation. In all, 205,000 spat were collected and reared

further. At the end of one year, the oyster attained a mean length of 74.9 mm and weight of 56.7 g. Maximum length attained was 101 mm. Due to sudden increase of sulphites and nitrites in November 1982 resulting from the discharge of bittern from adjacent salt pans into Karapad creek, oysters reared in the creek suffered total mortality. The predatory gastropod *Cymatium cingulatum* appeared in the bay farm in July and a total of 224 gastropods were collected and destroyed.

Experiments on induced maturation of the oyster showed that fed with mixed phytoplankton, *Chlorella* and rice/bran powder, the glycogen content of oyster increased from initial 1.8% to 6.45%, 5.93% and 4.8% respectively. The reproductive cycle of farm oysters was studied, along with sex ratio and condition index. The C. I. values showed two peaks, during July-August and February-March.

Culture of mussels (MOL/CUL/1.2)

S. Mahadevan, K. Rangarajan, P. S. Kuriakose, K. K. Appukuttan and N. Ramachandran.

Open sea farming of green mussel *Perna viridis* off Kovalam, near Madras, could not be continued due to technical problems of maintaining rafts during periods of adverse sea conditions. A new experiment was taken up to investigate the feasibility of culturing mussel in the salt water farm at Muttukadu and this gave encouraging results. In the deeper parts of the farm (2 m depth), short poles for "bouchot" type culture and fixed rafts for "hanging" culture were erected. In the initial experiment on pole culture, mussel seed (10-15 mm) secured on poles in mid September '82 grew to mean size of 48 mm and weight of 7.8g by end of December '82, giving a growth rate of 9.8 mm/month. Intensifying the experiments further, juvenile mussels (20-25 mm) seeded in December '82 attained a mean size of 70 mm by end of March '83, showing a growth rate of 11 mm/month.

In the hanging culture, seed bagged and suspended in May '82 grew to 88 mm by end of December '82, the monthly growth increments varying from 9.28 mm to 11.38 mm. The growth rates attained by the green mussel in the salt water lagoon, are favourably comparable to the open sea culture. These experiments have opened up a new possibility of culturing mussels in the lagoon areas with shallow waters.

The green mussel culture at Karwar was carried out on a very low scale due to paucity of seed in the natural beds. Continuing the farm work initiated in November 1981 and terminated in May 1982, the harvest taken was 2520 kg from a net 2 rafts and 42 ropes. A third raft had been damaged due to rough sea conditions and a total of 61 ropes had been lost due to raft damage and poaching. The average production from the ropes harvested was 10 kg per metre length of rope. At harvest, the mussel was 75 - 80 mm in length, and average 32 g in weight, with a meat yield of 35 - 40%. The longline culture experiment during March - May 1982 period proved unsuccessful due to poor performance of floats used. In the 1982-83 season, again due to paucity of mussel seed, only one raft was moored in Karwar Bay. Six ropes were seeded in January 83 with juvenile mussels (15 - 25 mm), at the rate of 0.7 kg/m, collected from submerged rocks at Harwada. While progress was normal with this seed, those collected from the exposed rocks at Karwar, showed 80% slipping and attachment of the rest of the juveniles to the ropes was weak.

In the culture of brown mussel *Perna indica* at Vizhinjam, the emphasis was on culture biology and not on production. Attempts at spat collection inside the bay proved a failure. Juvenile mussels collected from natural beds were seeded on 104 ropes and suspended from 3 rafts in the bay in November - December 1982. Slipping of seed was observed in those ropes seeded in November, but not in those seeded in December. Predation by fishes *Tetradon* and *Diodon* was

common, besides poaching. Biological data on reproduction, growth and meat content were collected. April – August period showed high percentage edibility (39.0 - 41.3%).

Culture of clams and windowpane oyster (MOL/CUL/1.3)

K. A. Narasimham, P. V. Srinivasan, G. Syda Rao and N. Ramachandran.

An experiment was carried out on the culture of blood-clam *Anadara granosa* without enclosure in the Kakinada Bay. Stocking was done in March 1982 on a 0.5 ha subtidal flat with clam seed (mean size 21.8 mm; weight 5.68 g) at a density of 200 seed/m^2. Survival was 41.5% upto August and production rate was 10.51 t/0.5 ha/6 months at harvest in September 1982. The clam attained a mean size of 39.7 mm and weight of 25.33 g. With this experiment, the feasibility of culture of blood-clam with and without enclosure has been established.

Clam culture with *Meretrix casta* done in the State Government Fish Farm at Mulki met with failure due to heavy predation by the crab *Scylla serrata*. The crab was seen to consume an average of 9 clams/day. Experimental culture of the species in the intertidal bed of the estuary showed a slow growth from 12.4 mm in December 1982 to 17.4mm in March 1983, due perhaps to longer exposure (12h/day of the site. Another important species of clam *Paphia malabarica* was taken up for culture. Stocking the seed clams of 18.6 mm mean size and 1.51 g mean weight at a density of 250 seed/m^2 in January 1983, it was observed that the clams had grown to 23.9 mm in mean size and 3.55 g in weight in March. Crab predation was also noticed. These experiments have indicated the problems of clam culture in unprotected areas. Pre-culture biological studies were carried out on *M. casta* of Kali estuary.

Replenishment and monitoring of Villorita spp. production in estuarine system (MOL/CUL/1-3.1)

G. P. Kumaraswamy Achary.

The pattern of distribution of *Villorita* spp. in the different ecosystems of the estuary extending from Thevara in the north to Pulinkunnu in the south was studied. The study area was divided into 4 zones; Zone-I includes Thevara, Kumbalam, Thekkumbhagom, Manakkunnam, Chembur, Kulaseharam, Aroor and upto Vaduthalamattathilbhagom; Zone-II includes areas around Pallipuram east/west, Chenganda and Vayalar; Zone III includes Thanneermukkom north / south; Kokkothamangalam and Kumarakom; and Zone-IV includes Ponnad, Mannancherry, Aryad north/south. Alleppey, Pulinkunnu, Kavalam and Chennamkari. Zone-I has the highest salinity conditions and Zones-III and IV have more or less freshwater conditions. *Villorita* spp. production during January-December 1982 in the zones I to IV was, respectively 3520 t, 4938 t, 5275 t and 5344 t. The total production from these four zones in 1982 exceeded that of 1981 only by 50 t, and it appears that production is standstill. Analysing the size composition of clams, it was seen that more than 60% of production in Zones-III and IV are of quality I and II, whereas in Zone-I, the major exploitation is on quality IV which are seed clams of size even below 10 mm. This would call for mesh regulation to prevent exploitation of under-sized clams. Artificial breeding of *Villorita cyprinoides* var. *Cochinensis* in the laboratory made progress.

Pearl culture (MOL/CUL/1.4)

K. Alagarswami, A. Chellam, S. Dharmaraj and T. S. Velayudhan

The pearl oyster resource in the natural beds of Gulf of Mannar was continued to be monitored. During April-May 1982, three survey trips were made to Nagarai paar and a total of

8530 oysters were collected. The size range of oysters was 26.0-49.5 mm (mean 38 mm, 9.2 g). Predatory gastropods *Murex virgineus* and *Cymatium cingulatum*, though present in the beds, did not seem to cause any large-scale mortality of oysters as in the previous year. Flat oysters were very few. Between November 1982 and March 1983, 20 survey trips to Kurichan, Nagarai, Utti and Karai paars were made and a total of 34,165 oysters were collected. The size range was 36-62 mm, with majority in the range 46-55 mm. The oysters were farmed in the harbour basin. The total stock in the farm at the end of the year was about 125,000. By judicious management, mortality was kept low at an average 6.3%. Predatory gastropods, when noticed, were removed and destroyed.

Surgery work was on a low key as priority was placed on hatchery work. Environmental parameters, including temperature, salinity, pH, calcium, magnesium, phosphates and silicates were collected. The earlier observations on depth-dependent differential fouling intensity was confirmed by panel studies and oysters were reared on 5 m depth and also on breakwater slope. Biological monitoring was continued and it was observed that the reproductive potential of the farm oysters was affected as the process of maturation did not proceed in the normal manner as in the previous years. Environmental data were being examined to understand this failure.

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

A. Chellam, A.C. C. Victor, S. Dharmaraj and T. S. Velayudhan.

Progress in this project was again slow due to logistic problems. The navigational aspect of the programme remained to be solved. The buoy and anchor fabricated earlier could not be commissioned.

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

S. Dharmaraj, A. Chellam, A. C. C. Victor and T. S. Velayudhan.

Only modest progress could be made in this project and 1068 oysters were implanted with nuclei of 2-5 mm diameter. The hatchery-produced oysters were used for the first time in nucleus implantation.

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

K. Alagarswami and B. S. Ramachandrudu.

The project work was divided into three phases, namely shell cutting, shaping and sphere grinding and finishing and polishing. A shell cutting machine was designed and fabricated. It is a double ended circular cutter with three speed variations coupled to a A. C. motor of 1 H. P. through a belt pulley. A circulating pump is provided to couple with the cutter pulley to supply coolant liquid. Trials were taken to cut shell bits of *Xancus pyrum* and the machine proved useful. Steps for procurement of equipment and tools for other works were taken and it was decided to do the job in the workshop of the Regional Centre at Mandapam as such facilities are not available at the head-quarters.

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

K. Nagappan Nayar, K. Ramadoss and M. E. Rajapandian.

A breakthrough was achieved in this project and techniques for the production of spat of *Crassostrea madrasensis* in the laboratory were developed successfully in August 1982. Oysters in the maturing and mature stage were conditioned at 20-25°C and fed intensively with *Chlorella* or mixed phytoplankton for 10-15 days at the end of which spawning was observed. The larvae were reared on *Isochrysis galbana*

at 2000-8000 cells/larva depending on the growth stage. Sand filtered and U. V. treated sea water was used for larval rearing. Spat settlement took place between days 15-20 from fertilisation. The spat were detached from collecters and reared in close meshed boxes in the bay. A total of 64,000 oyster spat were produced in the laboratory in seven experimental rearings between August '82-March '83. Following the first success in artificial production of pearl oyster spat in the previous year, the second molluscan species of aquaculture importance was successfully bred in the laboratory during the year under report.

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

K. Rangarajan and K. K. Appukuttan.

Initial success was achieved in rearing the larvae of the green mussel *Perna viridis* upto spat stage but spat settlement was very low. Spawning was achieved in February-April period by thermal stimulation, using 10-12°C rise. The larvae were fed on *Isochrysis galbana*. Early umbo stage (215 μm) was reached on day 12 from fertilisation and pediveliger stage (485 μm) subsequently. A few mussel spat (0.5 mm) were observed on seaweeds *Chaetomorpha* and *Bryocladia* placed in the larval rearing tanks. Based on this preliminary success, the techniques of larval rearing were improved to achieve normal spat settlement.

Similar experiments were carried out on the brown mussel *P. indica*. Induced spawning with thermal stimulation in May-June did not result in viable gamates though spawning took place. But temperature rise from 25.6° C to 30.5° C in July, when natural spawning also took place in the sea, proved successful. The larvae could be reared upto umbo stage (day 6-8) with *I. galbana* and *Pavlova* sp. Although they survived for 36 days, further growth did not take place. Low feeding level was found to be the reason for failure of growth and this was corrected in subsequent experiments.

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

K. Alagarswami, A. Chellam, S. Dharmaraj and T. S. Velayudhan.

Having achieved a major breakthrough in technology of artificial breeding of pearl oyster *Pinctada fucata* in the previous year, the accent in the current year was on large-scale production of spat, on experimental variations to improve the larval rearing system, on induced maturation and juvenile rearing. In a spawning in August '82, 42,000 spat were obtained. In a subsequent rearing over 500,000 spat were produced firmly establishing the indigenous technology. In the experimental series, UV treatment of water was found to give higher rate of spat settlement compared to non-treated water. Rearing in black/blue tanks yielded better results than in white tanks. Larval density and algal cell concentrations were varied to obtain data on optimum density and critical cell concentration. Induced maturation studies were carried out by intensive feeding with microalgae and rice powder and mixed phytoplankton was found to give positive results.

Juvenile rearing experiments included shifting of hatchery spat to the farm on the fourth day from spat setting so that the great effort needed to maintain them in the laboratory could be minimised A special type of "lantern net" was fabricated to rear the spat and early juveniles in the farm. The growth of spat was monitored in the laboratory and in the farm after transplantation.

Training in pearl culture (TR/2). edible oyster culture (TR/3). underwater investigations (TR/4) and mussel culture (TR/8)

TR/2 : K. Alagarswami, A. Chellam, S. Dharmaraj and T. S. Velayudhan

TR/3 : K. Nagappan Nayar, S. Mahadevan, K. Ramadoss, P. Muthiah and M. E. Rajapandian

TR/4 : S. Mahadevan, K. Nagappan Nayar and K. Ramadoss

TR/8 : P. S. Kuriakose and N. Ramachandran

A four-week training programme in oyster culture was organised at Tuticorin from 19 January to 15 February 1983. This was the first such training in edible oyster culture to be organised in India. The curriculum included oyster biology, oyster culture techniques, harvest and post-harvest techniques. There was good response from the Department of Fisheries in the maritime States for sponsoring officers for this training. The following eight candidates completed the course successfully:

1. Shri N. G. Akolkar, Dept. of Fisheries, Gujarat.
2. ,, Francis Mascarenhas, Dept. of Fisheries, Karnataka.
3. ,, M. Abdul Jaleel, Dept. of Fisheries, Tamil Nadu
4. ,, P. Leonard Moral, Dept. of Fisheries, Tamil Nadu
5. ,, C. P. Chatterjee, State Fisheries Development Corporation, West Bengal.
6. ,, Jaysingh B. Chavan, Konkan Krishi Vidyapeeth Maharashtra.
7. Dr. N. Ramachandran, CMFRI
8. ,, P. K. Martin Thompson, CMFRI

Training in underwater investigations (SCUBA-diving) was organised at Tuticorin for 8 weeks from 21 February to 20 April 1983. The curriculum included surface swimming underwater swimming with mask and snorkel, skin-diving in shallow water SCUBA-diving in deeper water, safety precautions and underwater observations. The following five candidates completed the training course successfully:

1. Shri B. Pragasam, Dept. of Fisheries, Tamil Nadu
2. ,, M. Chinna Muthiah, Dept. of Fisheries, Tamil Nadu.
3. ,, S. M. Irulandy, Dept. of Fisheries, Tamil Nadu.
4. ,, A. Raju, CMFRI.
5. ,, V. Gandhi, CMFRI.

A training course in mussel culture was organised at Karwar in three phases. (i) 14-26 December 1981, (ii) 22 February-6 March 1982 and (iii) 3-14 May 1982, totalling to six weeks of training. The curriculum included mussel biology, mussel farming, environment of mussel beds and farms, harvest and post-harvest techniques. The following seven candidates completed the training course.

1. Shri B. Harish, Dep. of Fisheries Karnataka.
2. ,, C. Somasekhar, Dept. of Fisheries, Karnataka
3. Dr. H. B. Dave, Dept. of Fisheries, Gujarat.
4. Shri R. R. Pathak, Dept. of Fisheries, Gujarat.
5. ,, Y. Bala Ramaiah, Dept. of Fisheries, Andhra Pradesh
6. ,, V. V. S. P. R. V. Prasad, Dept. of Fisheries, Andhra Pradesh.
7. ,, D. Nagaraja, CMFRI.

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Dr. K. Alagarswami, Scientist S-3	:	—do—
Shri K. Venkatanarayana Rao, Scientist S-3	:	—do—
Dr. M. J. George, Scientist S-3	:	—do—
Shri. G. Venkataraman, Scientist S-3	:	—do—

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Shri. K. H. Mohamed, Scientist S-3	:	—do—
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Dr. K. Alagaraswami, Scientist S-3	:	—do—
Shri T. Jacob, Scientist S-3	:	—do—
Shri G. Venkataraman, Scientist S-3	:	—do—
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Jr. LIBRARY ASST. (T-2) (Rs. 330-560)

1. Shri V. Edvin Joseph

DRIVER (BOAT) (T. I. 3) (Rs. 425-700)

1. Shri M. Mustaffa
2. ,, A. Pathrose
3. ,, S. G. Kalgutkar

DRIVER (BOAT) (T-2) (Rs. 330-560)

1. Shri M. A. Vincent

DRIVER (BOAT) (T-1) (Rs. 260-430)

1. Shri M. Mohideen Abdul Kader
2. ,, K. Anbalagan
3. ,, D. Padmanabhan
4. ,, James George

SERANG (T-2) (Rs. 330-560)

1. Shri C. K. Dhandapani
2. ,, O. M. Jainulabdeen

SERANG (T-1) (Rs. 260-430)

1. Shri H. Vasu

BOSUN (T. II. 3) (Rs. 425-700)

1. Shri P. Ferozkhan
2. ,, T. E. George Augustine
3. ,, Thomas Teles
4. ,, Nirmal Mathews

SENIOR ARTIST (T. II. 3) (Rs. 425-700)

1 Shri K. L. K. Kesavan

ARTIST (T. I. 3) (Rs. 425-700)

1. Shri A. Muniyandi

ARTIST (T-1) (Rs. 260-430)

1. Shri K. K. Sankaran

PHOTOGRAPHER (T-5) (Rs. 650-1200)

1. Shri P. Raghavan

MECHANIC (T-2) (Rs. 330-560)

1. Shri M. Alagar

PAINTER-CUM-POLISHER (T. I. 3) (Rs. 425-700)

1. Shri R. Marimuthu

COOK (BOAT) (T-1) (Rs. 260-430)

1. Shri E. Sivanandan
2. ,, M. Rengan
3. ,, Vali Mahamed
4. ,, Yerinindra Rao
5. ,, K. C. Gopalan

CARPENTER (T-1) (Rs. 260-430)

1. Shri T. P. Haridasan

SKIN DIVER (T. I. 3) (Rs. 425-700)

1. Shri J. Antony Pitchai
2. ,, A. Dasman Fernando
3. ,, F. Soosai V. Rayan

HINDI TRANSLATOR (T-4) (Rs. 550-900)

1. Miss A. Rajeswari Menon

PROJECT OPERATOR (T-1) (Rs. 260-430)

1. Shri K. Chacko

DECKHAND (T-1) (Rs. 260-430)

1. Shri M. Ibrahim
2. ,, M. K. Gopalakrishnan
3. ,, K. S. Leon
4. ,, V. Vedanayagam
5. ,, P. Muniasamy
6. ,, D. Bosco Fernando
7. ,, D. Anandan
8. ,, S. Enasteen
9. ,, R. Arokiaswamy
10. ,, K. Parasuraman
11. ,, C. Manibal
12. ,, S. Kesavan
13. ,, S. Ganesan
14. ,, P. Md. Abdul Moheedu
15. ,, R. Sekar
16. ,, U. Alagamalai
17. ,, K. C. Devassy
18. ,, P. M. Hariharan
19. ,, V. P. Benziger
20. ,, P. Hillary

SKIPPER (T-7) 9 Rs. 1100-1600)

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CHIEF ENGINEER (T. 6) (Rs. 700-1300)

1. Shri P. J. Josy Jacob

MATE (T-6) (Rs. 700-1300)

1. Shri P. K. Velayudhan

BOSUN (T-4) (Rs. 550-900)

1. Shri B. Ramesh

ENGINE DRIVER (T. II. 3) (Rs. 425-700)

1. Shri Johnson K. Kuriakose

DECKHAND Sr. (T-2) (Rs. 330-560)

1. Shri P. Bhaskaran
2. ,, T. K. Sudhakaran
3. ,, S. Mohideen Meerasa
4. ,, V. Maria Alwaris
5. ,, K. P. Vijayan

OILMAN (T—2) (Rs. 330—560)

1. Shri T. R. Sreekumaran

OILMAN-CUM-DECKHAND (T-2) (Rs. 330-560)

1. Shri P. D. Chidambaran
2. ,, L. Jobai Fernando

COOK BOAT (T—2) (Rs. 330—560)

1. Shri A. K. Unnikrishnan
2. ,, K. K. Prabhakaran

FOREMAN (T. II. 3) (Rs. 425—700)

1. Shri P. Thankappan

TECHNICAL OFFICER (T—7) — CAS (Rs. 1100—1600)

1. Shri K. V. George

FARM ENGINEER (T—7) — CAS

1. Shri B S. Ramachandrudu

Krishi Vigyan Kendra, Narakkal

Sr. TRAINING ASST. (T—6) (Rs. 700—1300)

1. Shri P. Karunakaran Nair
2. ,, K. Asokakumaran Unnithan
3. ,, Dr. P. K. Martin Thompson
4. ,, Shri K. N. Resachandra Kartha

TRG. ASSISTANT (T—4) (Rs. 550—900)

1. Shri A. N. Mohanan
2. ,, P. Radhakrishnan
3. ,, K. Purushothaman Kani

MOTOR DRIVER (T—1) (Rs. 260—430)

1. Shri P. J. Sebastian

BOSUN (T. II. 3) Rs. 525—700)

1. Shri N. B. Gopalakrishna Menon

DRIVER (BOAT) (T—1) (Rs. 260—430)

1. Shri K. K. Bose

COOK (BOAT) (T—1) (Rs. 260-430)

1. Shri K. Raju

Operational Research Project, Kovalam

Jr. TECH. ASST. (T—2) (Rs. 330—560)

1. Shri V. Selvaraj

MOTOR DRIVER (T—1) (Rs. 260—430)

1. Shri K. Pandi

Administrative Staff as on 31 - 3 - 1983

SENIOR ADMINISTRATIVE OFFICER

Shri C. P. Thomas

ADMINISTRATIVE OFFICER

Shri V. K. Sridhar

ASSISTANT ADMINISTRATIVE OFFICER

Shri R. Doraraj

ASSISTANT ACCOUNTS OFFICER

Shri M. P. Chandrasekharan

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Shri S. PL. Sethu
Shri S. Subramanian
Shri M. P. Lakshmanan
Shri A. Sethubhaskaran
Shri P. Aithappa Naick
Shri M. Subbiah
Shri G. V. Pednekar
Shri A. K. Balakrishna Pillai

P. As TO DIRECTOR

Shri. L. Krishnaswamy
Shri. K. M. Surendran