



# *Annual Report*



**1978**

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

*Issued by*

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## DIRECTOR'S INTRODUCTION

During 1978 the Institute has undertaken 67 research projects/problems under the five existing Divisions; 10 Inter-Divisional projects; 3 inter Institutional projects; 4 demonstration projects; 6 training programmes and 1 sponsored project. The objectives of the various projects have taken into consideration, the priority areas proposed for the Sixth Plan, the specific needs and problems of the Maritime States and the fishing industry for their development plans. Wherever possible, the problems and projects have been made time-bound, applied, adaptive and need-based and implemented through Inter - disciplinary and Inter - Institutional action programme.

Mariculture investigations were intensified at all the centres and based on the technologies already developed by the Institute, suitable demonstration projects and training programmes were undertaken so as to transfer the technologies to various levels.

The highlights of the work done during the year are summarised as follows:

### *Trend in exploited marine fishery resources*

The total marine fish catch during 1978 was estimated at 1.4 million tonnes as against 1.26 million tonnes in 1977 thus showing higher landings by 1.7 lakh tonnes. This 11.42% increase in the catch was contributed mainly by higher landings in Karnataka, Tamil Nadu and Kerala. There was a significant rise in the catches of ribbon fish, Bombay duck, penaeid prawns, mackerel, perches, oil sardine, anchovies, silver bellies and cephalopods. However, there was a decline in the landings of non-penaeid prawns, cat fishes, carangids, sciaenids, other sardines, other clupeids, other crustaceans, crabs and eels. Purse seine operations in Karnataka resulted in almost doubling of mackerel catch in Karnataka, compared with previous year's catch.

## *Indo-Polish Industrial Fisheries Survey*

Having actively participated in all the 6 cruises of the Indo-Polish Industrial Fisheries Survey conducted off Maharashtra-Gujarat coasts, the scientists of the Institute have prepared a detailed report, which is being processed and edited for publication.

### *A case study on operation of traditional fishing units*

A case study made by the Institute on the economics of operation of traditional indigenous fishing units at Cochin has revealed that the fishing operations by indigenous units gave better economic returns than those by mechanised fishing vessels. In the case of 'Thangu vala', a traditional boat seine, the per-capita income of a fisherman employed in the unit was found to be Rs. 26.57 per working day and the percentage of net profit over initial investment on a new unit was 171.7% per annum. In the case of mechanised units operating at Cochin (36'-43' boats) this profit rate is about 30% as per the available information.

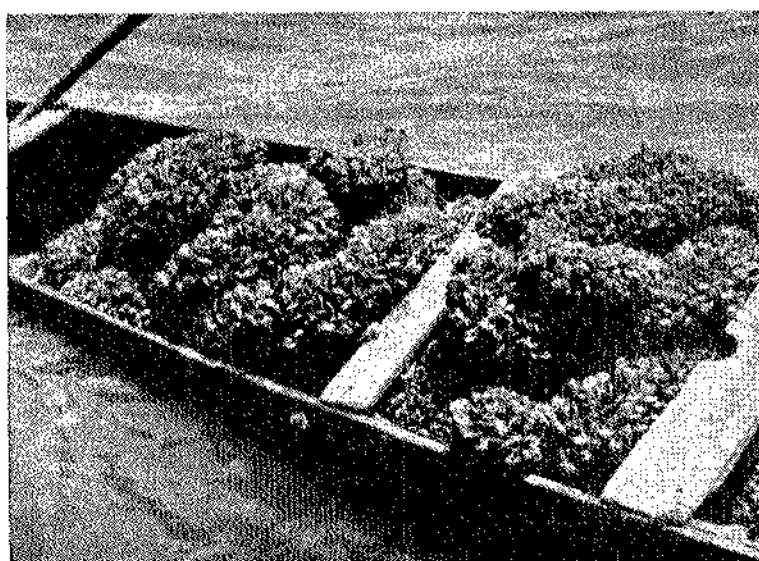
### *Mariculture*

The Institute has been constantly striving to improve the techniques in mariculture for arriving at better production rates per unit area. Based on the experiments carried out by the Institute, the following production rates were obtained for various culturable organisms:

Marine prawns	— 1000-1500 kg/ha/annum
Brown mussel	— 150 tonnes/ha/annum
Green mussels	— 235 tonnes/ha/annum
Edible oysters	— 100 tonnes/ha/annum
Eels	— 3.8 tonnes/ha/2 years
<i>Sillago sihama</i>	— 20 cm/7 months (Growth)
Seaweeds	— 4-6 kg per metre sq. of coir netting in 80 days
Cultured pearls	— Success of 60-70% of implanted nuclei



Open sea mussel culture at Calicut



Harvested mussels

### *Breakthrough in prawn culture*

The Institute has achieved a major breakthrough in the induced breeding of the marine prawn, *Penaeus indicus* which is ideally suited for intensive culture. For the first time in the country, this species was induced to maturity by the eye-ablation technique at Narakkal. Within 12 days after cauterization of one of the eyes, the female prawn released about 60,000 eggs, which were reared further to post larval stages. Similar success was also achieved in respect of *Metapenaeus dobsoni* and also *Parapenaeopsis styliifera* which breeds in the sea and completes its entire life cycle in the marine environment.

### *Lobster culture*

In the field laboratory at Kovalam, the young ones of lobsters collected from the inshore region by special collectors were reared in the laboratory in large plastic pools. These young lobsters after growing in the laboratory for one year, matured mated and, got berried. Subsequently the eggs hatched out into free swimming Phyllosoma larvae.

It is also found that the pueruli reared in the laboratory attain marketable size within a period of about 18 months.

### *Air lifting of live-prawn seeds*

The Institute has developed improved methods of packing and air-lifting of live-prawn seeds to different parts of the country for stocking in various fields.

### *Survey of seed resources*

The Institute has conducted along the coasts of Tamil Nadu, Kerala and part of Andhra Pradesh, extensive surveys for the location of suitable sites for the collection from natural sources, seeds of fishes, prawns and molluscs. The information on the seasonal abundance, quality and quantity and other ecological parameters have been consolidated to bring out a detailed Bulletin containing coloured charts. This information is vital for any accelerated programmes in the development of mariculture.

### *Special surveys*

A comprehensive mariculture survey of the Andaman and Nicobar Islands was completed during the year and this revealed that many areas in the islands are potentially good for mariculture of prawns, fishes and molluscs. In another survey, the mangrove ecosystems and coral reef resources in the Gulf of Kutch have been investigated. A survey has been undertaken in the Cochin back-water and adjacent low-lying areas to evaluate the productivity of the perennial and seasonal fields and potential areas for mariculture.



Quantative sampling of seeds

### *Extension, Education and Training*

Endeavours were made to transfer the technologies developed by the Institute on various aspects of mariculture to the field of the actual fish farmers. During the year, demonstrations on intensive culture of fast growing species of prawns such as, *Penaeus indicus* and *P. monodon* were carried out in three different farms around Cochin. Both the perennial fields as well as the fallow canals among coconut groves were chosen for the demonstrations. The Institute also participated by providing technical expertise in the



Co-operative Prawn Farming Project at Narakkal. The Institute has thus taken steps to demonstrate the scientific methods of intensive prawn culture and its economic viability in the farmer's own field. Such demonstrations have helped the Institute in securing much valuable feed-back information vital for improving and perfecting the techniques in mariculture. As a result of these demonstrations, several fish farmers have now taken up intensive culture of prawns in the Pokali fields and perennial water areas of Central Kerala.

#### *Krishi Vigyan Kendra*

The Krishi Vigyan Kendra at Narakkal, attached to the Institute, has successfully imparted training in prawn and fish culture with practical demonstrations in the field to different batches of farmers and farm-women. 268 fish farmers including about 100 women were trained during 1978. Short term special courses on collection, identification and transportation of fish/prawn seeds was organised for the benefit of mostly women, the trainees. This has paved the way for the development of a seed collection and distribution systems as an industry in the Ernakulam District.

#### *Operational Research Project*

The Operational Research Project at Kovalam (near Madras) on 'an Integrated approach to blending sea farming with traditional capture fisheries' has made a good beginning. The Institute has achieved a breakthrough in establishing good liaison with the fishermen of the village who have voluntarily involved themselves in the project work as a part time or full time avocation. About 150 poles have been fixed in the sea and seed mussels attached. These have been showing good and healthy growth despite adverse sea conditions due to North East monsoon.

#### *Seminar at Madras*

During December 6-9, 1978 the Institute successfully organised a Seminar at Madras on 'The role of small scale fisheries and coastal aquaculture in integrated rural development.' It is for the first time that a Seminar on such an integrated theme bringing together a broad cross section of people as fishermen, fishermen representatives/leaders, social scientists, economists, scientists, administrators, planners and representatives of international organisations, is being organised. The Seminar deliberated in detail various

problems relating to small scale fisheries and coastal aquaculture and their role in integrated rural development. Many significant recommendations have been made in the Seminar and these are being placed before concerned authorities for consideration and implementation.

#### *Brief history of the Institute*

The Central Marine Fisheries Research Institute was established in February 1947 under the Union Ministry of Food and Agriculture. In October 1967 the administrative control of the Institute was transferred to the Indian Council of Agricultural Research, New Delhi.

#### *Objectives of the Institute*

- i) To estimate the catches of marine fishes and other animals from the seas around India throughout the year by different types of vessels and gears and the effort expended,
- ii) to conduct researches on marine fisheries resources in order to step up their production to the maximum possible extent,
- iii) to locate new fishing grounds and untapped resources; to conduct environmental studies in relation to fisheries,
- iv) to recommend measures for the rational exploitation of the various resources,
- v) to develop techniques for the culture of suitable species of marine animals and plants for augmenting natural production, and
- vi) to organise suitable education, extension and training programmes so as to transfer the technology to the masses.

#### *Organisational set up*

The Institute has five Divisions, viz., Fishery Resources Assessment, Fishery Biology, Crustacean Fisheries, Molluscan Fisheries and Fishery Environment. The subordinate establishments include

a Regional Centre at Mandapam Camp and Research Centres at Veraval, Bombay, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Madras, Waltair, Kakinada and Minicoy and 29 Field Centres along the east and west coasts of India.

#### *Library*

During the year, The *Indian Journal of Fisheries* Vol. 23 Nos. 1 & 2, CMFRI News letter Nos. 7, *CMFRI Special Publication* Nos. 3, 4 & 5 and the *Marine Fisheries Information Service* Nos. 1 to 4 were published.

About 738 books and 930 new numbers of periodicals were added to the library. As usual the library facilities were utilized by different Universities, Institutes, Central and State Departments and interested individuals.

#### *Deputation abroad*

1. Dr. E. G. Silas, Director was deputed to Philippines to attend the Regional workshop on aquaculture Development Strategies for Asia held at Manila from 6th to 13th August 1978.
2. Dr. M. D. K. Kuthalingam, Scientist S-2 was deputed to U. K. to attend the Symposium on Biological basis of Pelagic Fish Stocks held at Scotland from 3-7-79 to 7-7-79.
3. Dr. C. S. Gopinadha Pillai, Scientist S-1 was deputed to West Germany for a study tour of 4 months from 14-10-78 at the invitation of the Alexander von Humboldt Foundation.
4. Dr. P. Parameswaran Pillai, Scientist S-1 attended on deputation, a Training Course in Biological Oceanography under the UNESCO/IOC held at Karachi from 4-11-78 to 30-11-78.
5. Shri V. Kunjukrishna Pillai, Scientist S-1 has been deputed to U. K. for training in marine chemistry at the University of Southampton for a period of one year from 27-9-78.

6. Shri D. Vincent, Junior Technical Assistant was deputed to U. K. for training in marine chemistry at the University of Southampton from January to July 1978.

*Training received/provided*

Details of the training programmes under different Divisions are reported under 'Progress of Research.'

At the Krishi Vigyan Kendra of the Institute at Narakkal 268 fish farmers including farm women were imparted training during 1978 on various aspects of mariculture of fishes and prawn and in seed collection from the wild. Since its inception the KVK has trained so far 478 individuals which include 143 women and 154 members of the Scheduled Caste Community. Total number of training courses conducted was 28.

Dr. S. V. Bapat, joint Director and Shri S. Rajagopalan underwent training in Vigilance at New Delhi.

Shri P. V. Sreenivasan, V. Sriramachandra Murty, G. Sudhakara Rao, A. Chellam, V. T. Subramanian, M. Vijayakumaran, Syed Ahamed Ali, K. K. P. Panikkar, Dr. L. Krishnan, Shri. G. Mohamed Kasim, A. R. Thirunavakarasu, Smt. S. Lalitha Devi, Shri Alexander Kurian and C. Muthiah, Scientists of the Institute have successfully completed Foundation Course Training at the National Academy for Agricultural Research Management.

S/Shri K. Narayana Kurup, Varughese Jacob, K. Balan and Smt. V. P. Annam have received training at the Indian Agricultural Statistics Research Institute, New Delhi on computer programming/professional statisticians' course.

The Administrative staff comprising a number of Superintendents, Senior Clerks and Junior Clerks received training in Administrative Procedure & Financial Rules, organised and conducted at CTCRI, Trivandrum, CTRL, Bombay, Staff College, Hyderabad and NDRI, Bangalore.

Two Technical Assistants received Diploma after completion of the course in Fisheries Science at CIFE, Bombay.

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

1. ICAR representative on the General Council and Executive Committee of the Kerala Agricultural University, Mannuthy, Trichur.
2. Member on the joint ICAR-ICSSR Scientific Panel for Social Sciences and Agricultural Extension.
3. Member, Programme Priorities and Cruise Committee for the National Institute of Oceanography, Goa.
4. Member, Research Advisory Committee of the Kerala Agricultural University, Trichur.
5. Member, Kerala State Fisheries Research Committee.
6. Member, Central Advisory Committee on Exploratory Survey of Marine Fisheries.
7. Member, Tamil Nadu State Fisheries Research Council.
8. Member, Regional Committee No. 8 (constituted by the Governing Body, ICAR).
9. Member, Scientific Panel for Fisheries Research, ICAR.
10. Member, Kerala State Fishery Advisory Board.
11. Member, High Level Aquarium Committee—Construction of a Marine Aquarium at Cochin.
12. Member, in the Committee on Fisheries and other Aquatic Resources of the State Committee on Science and Technology, Kerala.
13. Member, Central Government Employees Co-ordination Committee, Cochin.
14. Member, Faculty of Marine Sciences, University of Cochin.

15. Member, Executive Council and Vice-President, Indian Society of Ichthyologists, Madras.
16. Member, the Board of Management of Konkan Krishi Vidyapeeth, Dapoli, Maharashtra.
17. Member, Technical Committee of the Marine Products Export Development Authority, Cochin.
18. Member, Board of Studies in Zoology (Post-Graduate) and Zoology (General and Pass) of the University of Madras for a period of three years from 20-3-76.
19. Member, Expert Committee of the Madurai University, Madurai, constituted for framing the rules, regulations and syllabus for B.Sc., Marine Science.
20. Member, Editorial Committee for 'Indian Seafoods' of the Marine Products Export Development Authority.
21. Member, Professional Board of Studies for developing Curriculam on "Post-Graduate Diploma Course in Aquaculture, Fisheries Management and Fisheries Technology.
22. Member, Committee appointed by the Board of Management of Tamil Nadu Agricultural University to select a suitable location for establishing a Fisheries College.
23. Member, Working Group for preparing a Co-ordinated Project for the collection, conservation and utilisation of fish genetic resources.
24. Member on the Export Committee/Advisory Committee constituted to advise the Kerala Agricultural University on the organisation of a full fledged Department of Fisheries.
25. Member (ICAR representative), Management Committee, Krishi Vigyan Kendra, Pondicherry.
26. Chairman, Task Force on Inland and Estuarine Fisheries including culture programmes, Kerala State Planning Board and also served as Member, (i) Task Force on

drawn from different institutions connected with various sectors of fisheries participated in the proceedings of the seminar. For the first time, representatives of fishermen and fish farmers, administrators, planners, scientists and representatives of financial institutions met together at a common forum.

Apart from lectures on specified topics by distinguished leaders in different fields of fisheries research, development and management, 26 topical research papers were presented and discussed. The special lectures and the papers were presented under eight technical sessions, namely present status of small-scale fisheries and coastal aquaculture, socio-economic conditions for the coastal rural sector, resource potential for capture and culture fisheries in the coastal region, technological base for integrated rural development, post-harvest technology, manpower requirements and training, financing of integrated projects and public policies and planning of rural fisheries. The lectures and presentation of papers were followed by lively discussions in which the view points of the different sectors including the fishermen were freely expressed.

In the concluding session chaired by Dr. E. G. Silas, Director, Central Marine Fisheries Research Institute, based on the suggestions of the participants several recommendations were recorded. Concluding this session Dr. M. S. Swaminathan, Director General of Indian Council of Agricultural Research and the President of the seminar exhorted the participants to expedite the implementation of the recommendations of the seminar. He pointed out that the proper development of coastal aquaculture would open new frontiers of production ushering a new economic order in the coastal rural sector. He further stressed that an integrated approach is essential for the productive utilisation of all the ecosystems and the resources.

#### *Finance*

During the financial year 1978-79 the budget allotment for the Institute has been Rs. 63.11 lakhs under Non-Plan and Rs. 100.00 lakhs under Plan. The actual expenditure has been Rs. 63.11 lakhs under Non-Plan and Rs. 97.28 lakhs under Plan.

*Budget allotment and Expenditure during 1978-79. (In Rupees)*

Heads	NON-PLAN		PLAN	
	Allotment	Expenditure	Allotment	Expenditure
1. Salary & Allowances	53,00,200	52,972,06.84	14,21,000	12,71,104.35
2. Travelling Allowance	1,85,800	1,85,864.90	4,45,000	4,44,941.09
3. Other charges Assets Acquired	42,900	42,870.99	48,65,000	48,24,757.21
4. Office contingencies	3,83,500	3,83,456.85	4,47,000	4,06,662.39
5. Other Expenditure	3,96,600	3,99,495.20	28,00,000	27,60,241.48
6. Recruitment Expenditure	2,000	1,776.80	22,000	20,148.76
Total	63,11,000	63,10,671.58	100,00,000	97,27,855.28



*Common abbreviations used in the report*

<b>CMFRI</b>	<b>Central Marine Fisheries Research Institute</b>
<b>CIFT</b>	<b>Central Institute of Fisheries Technology</b>
<b>IFP</b>	<b>Integrated Fisheries project</b>
<b>EFP</b>	<b>Exploratory Fishery Project</b>
<b>PFP</b>	<b>Pelagic Fishery Project</b>
<b>MPEDA</b>	<b>Marine Products Export Development Authority</b>
<b>ICAR</b>	<b>Indian Council of Agricultural Research</b>
<b>FAO</b>	<b>Food and Agricultural Organisation</b>
<b>KVK</b>	<b>Krishi Vigyan Kendra</b>
<b>UNDP</b>	<b>United Nations Development Programme</b>
<b>CPUE</b>	<b>Catch per unit effort</b>

## PROGRESS OF RESEARCH

### FISHERY RESOURCES ASSESSMENT DIVISION

#### *Salient features*

The estimate of marine fish landings in India in 1978 was 1.40 million tonnes against 1.26 million tonnes in 1977 showing an increase of about 11.42%.

Landings by purse seines in Karnataka State increased by about 62,000 tonnes.

The first six week training course in statistical methods as applied to fisheries research and development commenced in December 1978.

As per the recommendations of National Commission on Agriculture, meetings were held with the representatives of Fisheries/Statistics Departments of maritime States for arriving at unified sampling scheme for estimation of marine fish catch to be followed both by CMFRI and State Fisheries Departments. Accordingly a unified procedure has been finalised for Tamil Nadu to be followed from January 1979 onwards.

#### **Sample survey for estimation of marine fish production and the effort expended (FSS/FRA/1.1)**

G. Venkataraman, T. Jacob, K. Alagaraja, S. K. Dharmaraja, A. S. Kaikini, C. R. Shanmughavelu, M. G. Dayanandan, Syed Basheeruddin, S. S. Dan, K. Narayana Kurup, K. Balan, M. Srinath, K. K. P. Panikkar, R. Sathiadhas, B. Prasanna Kumari, K. Vijayalakshmi, G. Balakrishnan, Varghese Philipose, U. K. Sathyavan, P. K. Mahadevan Pillai, Varghese Jacob, G. Krishnakutty Nair, P. Sivaraman, V. Rajendran, V. P. Annam, A. Kanakkan, S. Haja Najeemudeen, K. Santhakumary, P. L. Ammini, C. J. Prasad, T. A. Sankaran Kutty and field staff.

### Annual production of marine fish

The total marine fish catch during the year 1978 is estimated at 1.40 million tonnes as compared to 1.26 million tonnes in 1977, thus showing higher landings by 0.14 million tonnes. This works out to an increase of 11.42% in the total catch during the year as compared with that of the previous year. Except Andhra Pradesh, all the maritime States registered an increase in their total annual landings during the year. The bulk of the increase was contributed by Karnataka and Kerala to the extent of about 56,000 and 28,000 tonnes respectively.

The significant feature observed during the year was the rise in the catches of Bombay duck, ribbon fish and penaeid prawns to the tune of about 40,000, 35,000 and 30,000 tonnes respectively. The other important fisheries that contributed to the rise in the total catch were mackerel, oil sardines and perches accounting for 23,000, 18,000 and 17,000 tonnes respectively. However, there was a significant decline in the landings of non-penaeid prawns, cat fishes, *Caranx* spp. and other sardines the decrease being 23,000, 15,000, 14,000 and 13,000 tonnes respectively.

There was a further fillip in the purse seine operations in Karnataka which resulted in almost doubling of the mackerel catch in that State when compared to that of the last year.

Details of the State-wise annual marine fish landings for the years 1978 and 1977 are shown in Table. 1.

**Table 1.** *Statewise marine fish landings in India for 1977 and 1978 (in tonnes)*

State	1978	1977
1. West Bengal	12,754	6,689
2. Orissa	39,670	15,072
3. Andhra Pradesh	82,116	100,756
4. Tamil Nadu	212,899	206,046
5. Pondicherry	6,828	6,462
6. Kerala	373,339	345,037
7. Karnataka	152,860	97,152
8. Goa	27,111	24,731
9. Maharashtra	284,244	264,452
10. Gujarat	201,929	189,638
11. Andamans	7,077	1,532
12. Lakshadweep	2,780	2,215
Total	1,403,607	1,259,782

#### *West Bengal*

The total catch increased sharply by about 6,000 tonnes (Table 1) registering a 90% rise over that of the previous year.

Sciaenids, other clupeids, non-penaeid prawns, ribbon fish and Bombay duck mainly contributed to the higher landings, the increase being about 950, 470, 390, 380 and 300 tonnes respectively.

#### *Orissa*

There was a sharp rise in the total catch amounting to about 24,600 tonnes as compared to that of last year (Table 1). Landings from Paradeep partly contributed to this increase. Higher landings of sciaenids, *Hilsa ilisha*, pomfrets, penaeid prawns, elasmobranchs and other sardines to the extent of about 4,900, 4,800, 4,700, 1,800, 1,700 and 1,300 tonnes respectively were observed.

#### *Andhra Pradesh*

The total marine fish landings in Andhra Pradesh recorded a decline of about 19,000 tonnes (19%) when compared with that of the previous year (Table 1). This was mainly due to the set back in the fisheries of sciaenids, silver bellies, non-penaeid prawns, other sardines, ribbon fish, cat fishes and *Caranx* spp. to the tune of 4,600, 3,700, 3,600, 3,300, 3,000, 2,400 and 2,000 tonnes respectively. However an increase was observed in the landings of elasmobranchs, penaeid prawns and mackerel, the increased catches being about 2,200, 1,800 and 1,500 tonnes respectively.

#### *Tamil Nadu*

A marginal increase of about 7,000 tonnes was noticed in the total landings in this State (Table 1). An interesting feature observed was the heavy landings of ribbon fish and silver bellies resulting in an increase in the catch by about 24,000 tonnes and 12,000 tonnes respectively. It may be noted that these two groups had shown a decline in the previous year. The other groups that contributed to the increase in the landings were penaeid prawns. *Thrissoles* spp. perches and red mullets to the extent of about 5,100, 1,700, 1,300 and 1,100 tonnes respectively. However a decline was noticed in the landings of cat fishes, white baits, other sardines, mackerel, elasmobranchs, *Caranx* spp. tunnies, crabs & other crustaceans and seer fish to the tune of about 10,000, 5900, 5200, 4200, 3,200, 3000, 2100, 1700 and 1700 tonnes respectively. Heavy catches of ribbon fish in Cape Comorin area and of silver bellies in the Palk Bay region were responsible for the improved landings during this year.

#### *Pondicherry*

There was a slight increase of about 400 tonnes in 1978 in the total marine fish landings in this Union Territory excluding Mahe and Yenam when compared to that of 1977 (Table 1). The catches of flying fish, other clupeids, penaeid prawns and sciaenids showed an increase of 480, 280, 140 and 120 tonnes respectively. The species that showed decline in their landings were *Caranx* spp.

Mackerel and *Lactarius lactarius* to the tune of about 270, 220 and 180 tonnes respectively.

#### Kerala

An increase in the total landings during 1978 by about 28,000 tonnes over that of 1977 was noticed. (Table 1). Ribbon fish, white baits, perches, mackerel, penaeid prawns and elasmobranchs mainly contributed to this increase which amounted to about 17,000, 11,000, 11,000, 6,000, 5,000 and 3,500 tonnes respectively. Lower landings, notably in the case of other sardines, *Caranx* spp., silver bellies, crabs and pomfrets were also observed, the decreases being about 9,000, 8,500, 5,000, 2,500 and 2,000 tonnes respectively.

#### Karnataka

The highest increase of about 56,000 tonnes in the marine fish catch was recorded in this State (Table 1). Mackerel contributed maximum to this increase by about 24,000 tonnes constituting about 45% of the increase. The next important contributor was oil sardine whose increase in the catch amounted to about 15,600 tonnes (28%). The increased landings were chiefly brought about by the greater number of purse seines operated in the Karnataka coast. The other groups that added to the higher landings were penaeid prawns, silver bellies, other sardines and pomfrets to the tune of about 5,000; 2,600; 2,400 and 1,700 tonnes respectively. However, the catches of cat fishes, perches, elasmobranchs and sciaenids went down by about 2,300; 1,300; 1,200 and 1,000 tonnes respectively.

#### Goa

An increase of about 2,400 tonnes in the landings was observed during the year as compared to that of 1977. (Table 1). The catches of other sardines, *Thrissocles* spp. *Caranx* spp. oil sardine and seer fish have registered an increase amounting to about 1,100, 1,000, 650, 600 and 500 tonnes respectively. However a substantial decline in the landings of mackerel to the tune of about 4,300 tonnes was also noticed.

#### Maharashtra

Marine fish landings during 1978 registered an increase of about 20,000 tonnes over that of 1977 in this state (Table 1). This was mainly brought about by the higher landings of Bombay duck to the extent of about 18,000 tonnes. The other important groups that contributed to the rise in the landings were penaeid prawns (14,000 t), ribbon fish (4,000 t), cephalopods (4,000 t), perches (4,000 t), cat fishes (3,000 t) and elasmobranchs (2,000 t). A decline was also noticed in the landings of non-penaeid prawns (23,000 t), other clupeids (9,000 t) and pomfrets (4,000 t).

## Gujarat

The marine fish catch in this State showed a marginal increase of about 12,000 tonnes over that of the previous year (Table 1). The landings of Bombay duck rose by about 22,000 tonnes. Some of the other groups that also showed an increase were pomfrets (6,000 tonnes) other clupeids (4,000 tonnes), perches (3,000 tonnes), non-penaeid prawns (2,000 tonnes) and seer fish (2,000 tonnes). However the landings of ribbon fish (7,000 tonnes), eels (6,600 tonnes), elasmobranchs (6,000 tonnes), Sciaenids (6,000 tonnes), cat fish (5,000 tonnes), *Lactarius* (4,000 tonnes) and crabs (2,000 tonnes) showed a decrease.

## Andamans & Nicobar

The total marine fish landings in Andamans & Nicobar Islands amounted to about 7100 tonnes showing an increase of about 5500t. (Table 1). This increase was mainly due to the landings by the trawlers operating in the area. The catches mainly comprised penaeid prawns, perches, *Caranx* spp. *Mugil* spp, seer fish, mackerel, anchovies, other sardines, silver bellies and elasmobranchs.

## Lakshadweep

In Lakshadweep, the total landings increased by 565 tonnes during 1978 as compared to 1977. The landings of tunnies showed an increase of about 700 tonnes. The catch of elasmobranchs and perches, however, declined by about 100 tonnes and 50 tonnes respectively.

## Species composition

In the table given below is shown the composition of marine fish catch landed in India during 1978 and 1977.

**Table 2.** *The Composition of total marine fish landings in India during 1978 and 1977 (in tonnes)*

Sl. No.	Name of fish	1978	1977
1.	Elasmobranchs	61,621	62,216
2.	Eels	8,781	12,997
3.	Cat fishes	39,231	53,504
4.	<i>Chirocentrus</i>	10,990	11,909
5. (a)	Oil sardine	1,68,078	1,50,130
(b)	Other sardines	52,838	65,724
(c)	<i>Hilsa ilisha</i>	9,894	4,189
(d)	Other <i>Hilsa</i>	12,800	14,651
(e)	<i>Anchoviella</i>	39,054	34,033

**Table 2 (Contd.)**

Sl.No.	Name of fish	1978	1977
(f)	<i>Thrissocles</i>	14,304	9,929
(g)	Other clupeids	37,020	41,458
6 (a)	<i>Harpodon nehereus</i>	1,25,481	85,236
(b)	<i>Saurida &amp; Saurus</i>	10,808	8,525
7.	<i>Hemirhamphus &amp; Belone</i>	1,478	2,311
8.	Flying fish	1,681	643
9.	Perches	49,312	31,799
10.	Red mullets	2,984	2,422
11.	Polynemids	5,469	3,929
12.	Sciaenids	96,379	99,887
13.	Ribbon fish	77,785	42,407
14 (a)	<i>Caranx</i>	16,956	30,666
(b)	<i>Chorimenus</i>	3,359	4,119
(c)	<i>Trachynotus</i>	106	80
(d)	Other carangids	423	219
(e)	<i>Coryphaena</i>	64	226
(f)	<i>Elacate</i>	568	429
15 (a)	<i>Leiognathus</i>	41,777	34,504
(b)	<i>Gazza</i>	104	61
16	<i>Lactarius</i>	7,906	10,961
17	Pomfrets	41,434	35,127
18	Mackerel	85,233	62,136
19	Seer fish	20,779	21,119
20	Tunnies	13,893	13,005
21	<i>Sphyræna</i>	3,709	2,423
22	<i>Mugil</i>	2,626	2,269
23	<i>Bregmaceros</i>	184	30
24	Soles	13,620	10,810
25 (a)	Penaeid prawns	129,204	96,472
(b)	Non-penaeid prawns	50,652	73,992
(c)	Lobsters	1,307	1,217
(d)	Crabs & other crustaceans	14,202	20,068
26	Cephalopods	15,931	10,005
27	Miscellaneous	113,582	91,945
Total		14,03,607	12,59,782

## Pelagic and Demersal groups of fishes

During 1978, the pelagic fishes contributed to 767,986 tonnes as against 646,528 tonnes in 1977, thus showing an increase of about 1.21 lakh tonnes. The major part of this improved catch came from Bombay duck and ribbon fish. In the case of demersal fishes, the increase was about 22,000 tonnes the estimated catches being 635,621 and 613,254 tonnes for 1978 and 1977 respectively.

### *Pelagic groups of fishes*

#### *oil sardine*

The total landings of oil sardines increased by about 18,000 tonnes during 1978 when compared with that of previous year (Table 2). Karnataka (15,600 tonnes) and Kerala (26,00 tonnes) were the two states that contributed to this increase.

#### *Mackerel*

In contrast to a decline by about 34,00 tonnes observed last year, the catches of this fish improved by about 23,000 tonnes in 1978 as compared to that of 1977. The landings in the States

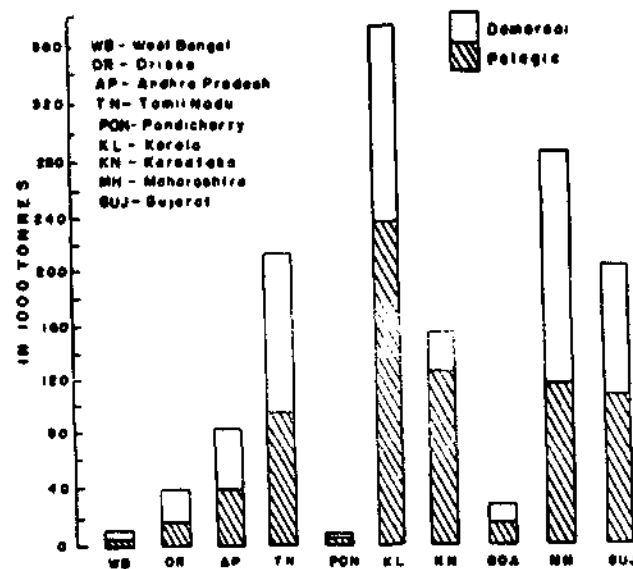


Fig. 1-Pelagic and demersal catch in different States during 1978



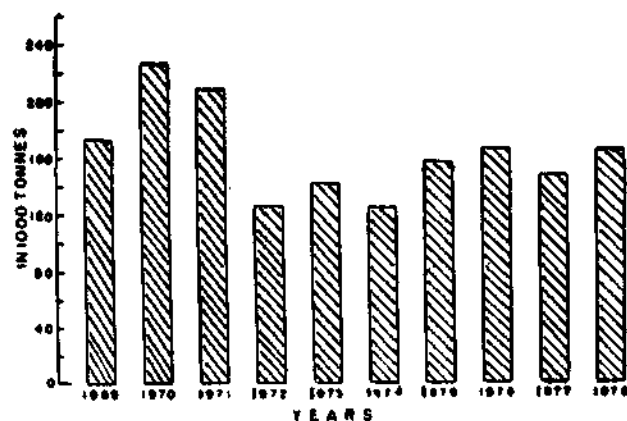


Fig. 2—Landings of oil sardine during 1969 to 1978

of Karnataka (24,000 tonnes), Kerala (6,000 tonnes) and Andhra Pradesh (1,500 tonnes) were responsible for this increase, even though a decline in the catches was noticed in the States of Goa and Tamil Nadu (4,000 tonnes).

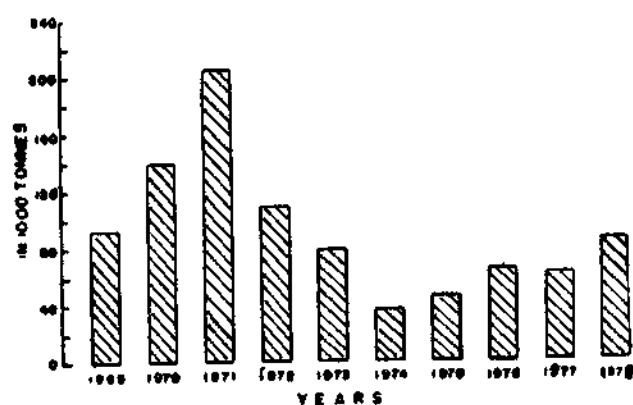


Fig. 3—Landings of mackerel during 1969 to 1978

#### *Bombay duck*

An increase of about 40,000 tonnes was noticed (Table 2) in the landings of this fish during 1978 over that of 1977. Maximum contribution to this increase came from Gujarat (22,000 tonnes), followed by Maharashtra (18,000 tonnes).

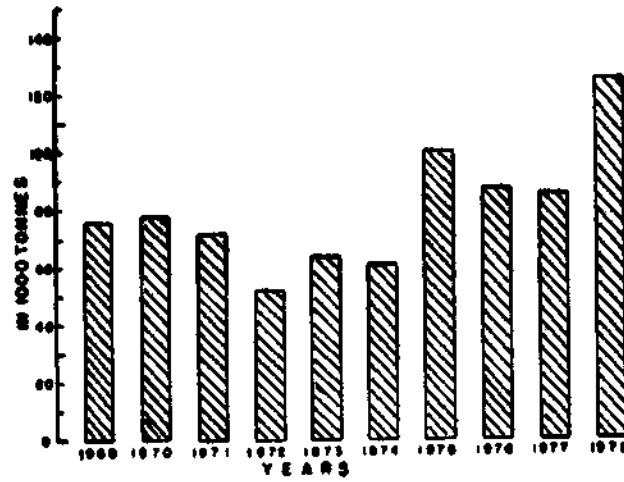


Fig. 4—Landings of Bombay duck during 1969 to 1978

#### *Other sardines*

In this year also a decline to the tune of 13,000 tonnes was noticed in the landings of other sardines (Table 2) when compared to that of the previous year. The bulk of the decrease was accounted for by Kerala (9,000 tonnes), followed by Andhra Pradesh (3,300 tonnes). However, Karnataka (2,400 tonnes), Orissa (1,300 tonnes) and Goa (1,100 tonnes) showed an increase in their landings.

#### *Other clupeids*

This group suffered a decline of about 4,400 tonnes this year (Table 2) over that of 1977. This was mainly brought about by the sharp decline of about 9,200 tonnes in Maharashtra, though this was to some extent offset by the increase in the landings of Gujarat (3,800 tonnes).

#### *Ribbon fish*

The total landings of ribbon fish during the year showed a sharp increase by 35,000 tonnes, (83%) as compared to that of last year (Table 2). Tamil Nadu and Kerala contributed the maximum to this increase to the extent of 24,000 and 17,000 tonnes respectively.

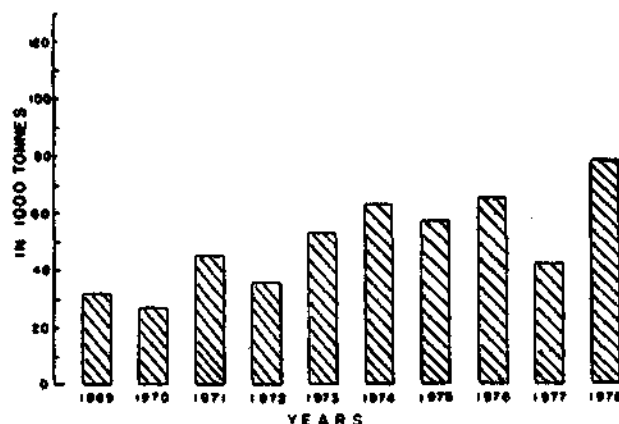


Fig. 5—Landings of ribbon fish during 1969 to 1978

#### *Caranx* spp.

This group suffered a decline of 14,000 tonnes (Table 2) during this year when compared to that of the previous year. The bulk of this decline was accounted for in the states of Kerala (8,500 tonnes), Tamil Nadu (3,000 tonnes) and Andhra Pradesh (2,000 tonnes).

Among other important pelagic group of fishes that showed an improvement in the fisheries are *Hilsa ilisha*, white-baits and *Thrissocles* spp. the increase in the catches being about 5,000, 5,000 and 4,300 tonnes respectively (Table 2).

#### *Demersal group of fishes*

##### *Penaeid prawns*

An increase of about 33,000 tonnes was observed in the landings of penaeid prawns during 1978 when compared to that of 1977. Most of the States contributed to this increase the more important ones being Maharashtra (14,000 tonnes). Tamil Nadu, Kerala and Karnataka (5,000 tonnes each).

##### *Non-penaeid prawns*

A decline of about 23,000 tonnes in the landings of non-penaeid prawns was noticed during the year as compared with

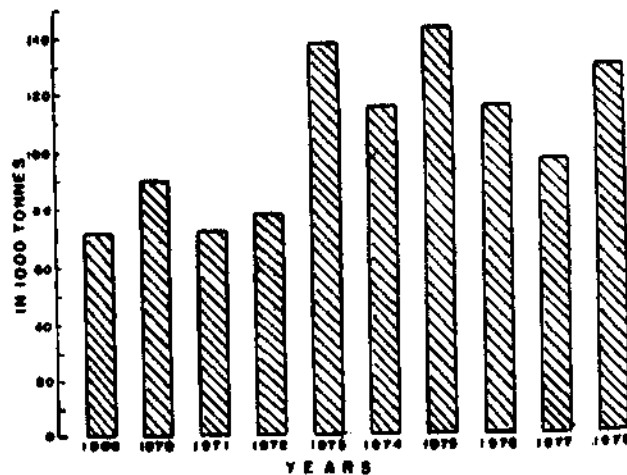


Fig. 6—Landings of penaeid prawns during 1969 to 1978

that of last year. This fall was mainly due to the lower landings of this group by about 23,000 tonnes in Maharashtra. To some extent Andhra Pradesh also contributed to this decline (3,600 tonnes). However Gujarat recorded an increase of about 2,000 tonnes.

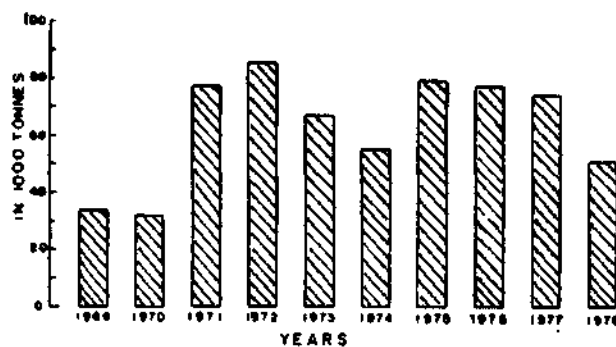


Fig. 7—Landings of non-penaeid prawns during 1969 to 1978

#### Perches

The increasing trend noticed in the landings of perches last year continued this year also, the improvement in the catches over that of last year being 17,000 tonnes. Among the states

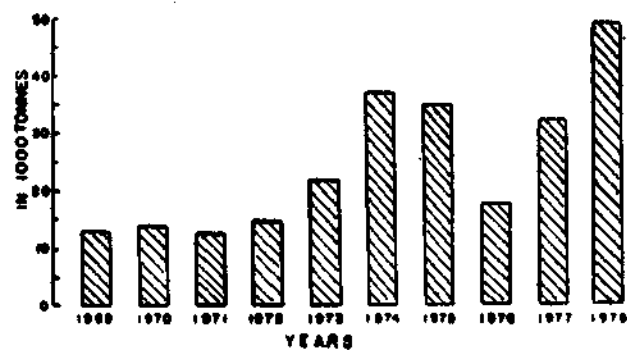


Fig. 8—Landings of perches during 1969 to 1978

which registered improved landings, Kerala came foremost the increase amounting to 11,000 tonnes, followed by Maharashtra (4,000 tonnes) and Tamil Nadu (1,300 tonnes). The catch in Karnataka, however, showed a decline of about 1,300 tonnes.

#### *Sciaenids*

In contrast to the increase observed last year over that of 1976, there was decline this year in the landings of sciaenids to the tune of 3,500 tonnes (Table 2) as compared with 1977. The states that were mainly responsible for this decrease were Gujarat (6,000 tonnes) and Andhra Pradesh (4,600 tonnes). However an increase of about 4,900 and 1,100 tonnes was observed in the landings of this group in Orissa and Kerala respectively.

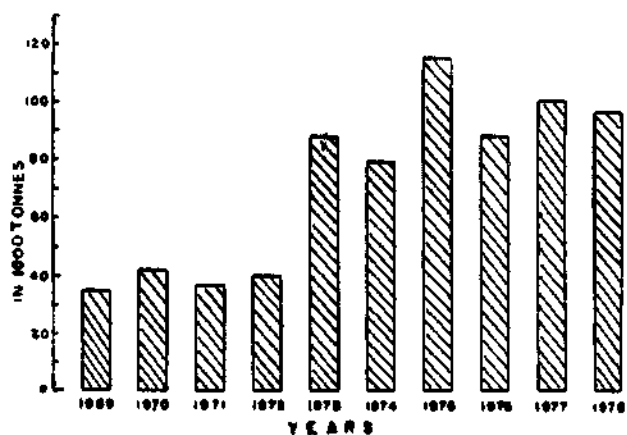


Fig. 9—Landings of sciaenids during 1969 to 1978

### *Silver bellies*

The landings of silver bellies showed an increase of about 7,000 tonnes when compared to that observed in 1977 (Table 2). Increased catches came from Tamil Nadu (12,500 tonnes) followed by Karnataka (2,600 tonnes). However there was a decline in their landings in Kerala (4,700 tonnes) and Andhra Pradesh (3,700 tonnes).

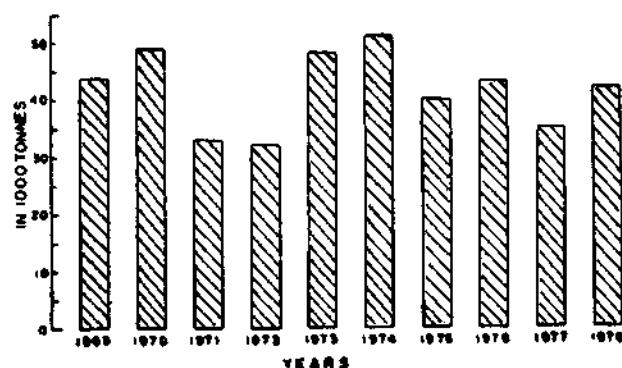


Fig. 10—Landings of silver bellies during 1969 to 1978

### *Pomfrets*

An improvement by 6,300 tonnes was registered in the landings of pomfrets during 1978 over that of 1977. The increased landings came from the States of Gujarat (6,000 tonnes), Orissa 4,700 tonnes) and Karnataka (1,700 tonnes).

### *Lobsters*

The landings of lobsters during this year amounted to 1,307 tonnes against 1,217 tonnes in 1977. They were mainly caught in the states of Maharashtra (607 tonnes), Gujarat (339 tonnes) and Tamil Nadu (249 tonnes).

### *Crabs & other crustaceans*

The landings of Crabs and other crustaceans showed a decline of 5,900 tonnes in 1978 when compared with that of 1977 (Table 2). The decline in the catches was mainly due to the fall in their landings in the states of Kerala (2,500 tonnes), Gujarat (2,000 tonnes) and Tamil Nadu (1,700 tonnes).

### *Cephalopods*

There was a sizable increase in the landings of cephalopods (6,000 tonnes) this year over that of last year (Table 2). Maharashtra (4,000 tonnes) and Kerala (1,500 tonnes) mainly contributed to this increase.

### **Input of fishing effort**

291,562 thousand man hours were expended during 1978 as compared to 249,759 thousand man hours in 1977, thus showing an increase of 41,803 thousand man hours. (Table 3)

**Table 3.**

	Fishing effort in 1000 man hours		Catch/effort (kg)	
	1978	1977	1978	1977
1. West Bengal	4,428	2,520	2.88	2.65
2. Orissa	21,362	12,200	1.86	1.23
3. Andhra Pradesh	48,883	38,379	1.68	2.62
4. Tamil Nadu	73,804	59,714	2.88	3.45
5. Pondicherry	2,292	2,360	2.98	2.74
6. Kerala	50,725	54,579	7.36	6.32
7. Karnataka	17,659	12,940	8.66	7.51
8. Goa	2,921	2,645	9.28	9.35
9. Maharashtra	38,605	31,908	7.36	8.29
10. Gujarat	30,883	32,514	6.54	5.83
Total excluding Andamans & Lakshadweep)	291,562	249,759	4.78	5.03

Except Gujarat, Kerala and Pondicherry all the maritime States of India recorded higher input of effort during the year under review. However, in respect of catch per unit of effort Andhra Pradesh, Tamil Nadu, Goa and Maharashtra registered lower rates while all other maritime States of India recorded higher rates as compared in 1977.

Table 4a - Offshore catch data

(40 M and below)

1978

Bases	Effort	Total catch (in Kg)	Prawns	Elasmobranchs	Catfish	Others
Bombay	200.75	22,148	—	6,545	7,880	7,723
Goa	595.56	89,526	359	3,543	48,725	36,899
Mangalore	972.55	78,149	738	924	12,258	64,229
Cochin	1,344.85	4,93,918	17	13,234	8,735	4,71,932
Tuticorin	1,430.65	1,31,349	—	35,978	1,005	94,366
Madras	Not operated in this depth range					
Visakhapatnam	45.58	2,719	—	455	220	2,044
Calcutta	123.51	14,396	553	2,129	1,030	10,684
Port Blair	Not operated in this depth range					
	4,713.45	8,32,205	1,667	62,808	79,853	6,87,877



Table 4b - Offshore catch data

(40 M and above)  
1978

Bases	Effort	Total catch (in Kg)	Prawns	Elasmobranchs	Catfish	Others
Bombay	876.39	74,733	46	18,535	19,950	36,202
Goa	148.67	43,961	88	1,825	9,793	32,255
Mangalore	118.50	12,473	—	248	1,717	10,508
Cochin	2,993.41	4,21,989	3,070	67,086	76,227	2,75,606
Tuticorin	46.17	5,167	—	1,103	7	4,057
Madras	683.87	60,923	26	5,287	1,650	53,960
Visakhapatnam	1,096.83	92,982	265	9,001	8,266	75,450
Calcutta	57.25	2,907	153	140	92	2,522
Port Blair	499.20	42,607	—	8,554	405	33,648
	6,520.29	7,57,742	3,648	1,11,779	1,18,107	5,24,208

## Exploratory Survey

The offshore catch data of the Exploratory Fishery Project and Integrated Fishery Project vessels were processed for the nine bases at Bombay, Goa, Mangalore, Cochin, Tuticorin, Madras, Vishakapatnam, Calcutta and Port Blair. The catch details are shown in (Tables 4a & 4b) for the two category of depths one showing upto 40 m depth and the other 40 m and beyond.

### 1. *Upto 40 m depth*

The total fish catch for all the bases in this depth range worked out to 832 tonnes during 1978 as against 2,176 tonnes during 1977 showing a reduction of 1,344 tonnes. Cochin base contributed the highest catch of 494 tonnes forming about 59% of the total offshore catch during 1978, followed by Tuticorin base with 131 tonnes (16%), Goa base with 90 tonnes (11%) and Mangalore base with 78 tonnes (9%). The catches of cat fishes and elasmobranchs amounted to 80 tonnes and 63 tonnes respectively. The total fishing effort expended by the trawlers during 1978 was much less than what was observed in 1977, the respective figures being 4,713 and 11,864 hours. However the C.P.U.E. did not vary much in these two years.

### 2. *40 m and above depth*

The total fish catch for all the bases during 1978 was 758 tonnes as compared to 180 tonnes during 1977 showing an increase of 578 tonnes. Cochin base again contributed the maximum of 422 tonnes its share being 56% of the total offshore catch during 1978 followed by Vishakapatnam base with 93 tonnes (12%), Bombay with 75 tonnes (10%), Madras with 61 tonnes (8%), and Goa with 44 tonnes (6%). Catfishes and elasmobranchs contributed 118 tonnes and 112 tonnes respectively to the total catch. Higher input of effort was made during 1978 as compared to 1977, the trawling hours being 6,520 and 2,184 respectively. Better C.P.U.E. was realised during the year under review than in the previous year.

## Frame survey (FSS/FRA/1.2)

S.K. Dharmaraja, G. Venkataraman and other associates.

Data on census and other particulars pertaining to marine fishing community collected in the last quinquennial survey were

processed and published in the *Marine Fisheries Information Service* No. 3, October 1978. A fresh survey is contemplated for which action is being taken.

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

B. Krishna moorthi, K. Alagaraja and associates

For the study of stock assessment of commercially important fishes namely oil sardine, mackerel, Bombay duck and penaeid prawns, gear-wise length measurements of the same were collected, processed and analysed.

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

T. Jacob, K. Alagaraja and associates

The work of coding and punching of fishery data continued during the year at the National Fishery Data Centre of the Institute. The off-shore data pertaining to the fish catches by vessels of the Exploratory Fishery Project during 1977 were coded and punched at the centre and were partly processed with the help of the electronic computer at Cochin Shipyard.

**Standardisation of fishing effort (FSS/FRA/1.4)**

S. K. Dharmaraja, K. Alagaraja and associates

In the case of oil sardine, boat seine (Thangu vala) in Kerala which is the most commonly used gear for its exploitation was taken as the standard gear and the total fishing effort expended by other gears which are also used for its exploitation have been standardised in terms of boat seine effort.

**Survey of estuarine fisheries (FSS/FRA/1.5)**

K. Narayana Kurup, K. Balan and associates.

Modalities for carrying out the survey was worked out during the year.

**Exploited marine fisheries resources of the maritime States (FSS/  
FRA/1.6)**

K. Narayana Kurup, K. Balan and associates

The work is under progress.

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

K. K. P. Panikkar and associates.

Schedules have been prepared for the collection of required data and action has been initiated to recruit two field enumerators to start the first phase of the programme.

## **FISHERY BIOLOGY DIVISION**

### **The fishery and resources characteristics of the Oil sardine (FB/MF/1.1)**

V. Balan, N. Gopinatha Menon, M. H. Dhulkhed, G. G. Annigeri and R. Reghu.

#### **Salient findings**

There was a tremendous improvement in the oil sardine fishery during the year at most centres except at Cochin. This improvement was due to heavy catches by purse seines at Mangalore which, in an estimated total catch of 72,075 m. tonnes, accounted for a catch of 52,663 tonnes. Even otherwise, there was an improvement in the catches by about 28% during the year over those of last year when 19,412 and 13,964 m. tonnes respectively of oil sardines were landed.

#### *Work done*

In all the three regions viz., Cochin, Mangalore and Karwar, where the investigations are in progress, the oil sardines measured, ranged in sizes from 50 to 215 mm. While 0+, 1+, and 2+ year groups were more abundant at Quilandy, Calicut and Karwar; above 2+ year group was abundant at Calicut and Ullal in the gill-net catches. The 0+ year class dominated in purse seine catches at Karwar. The dominance of indeterminates at Quilandy, females at Cochin, Calicut and Karwar and the males at Mangalore was evident.

#### *Work contemplated*

Work on the above lines to continue with stress on stock assessment of oil sardines in the regions under exploitation.

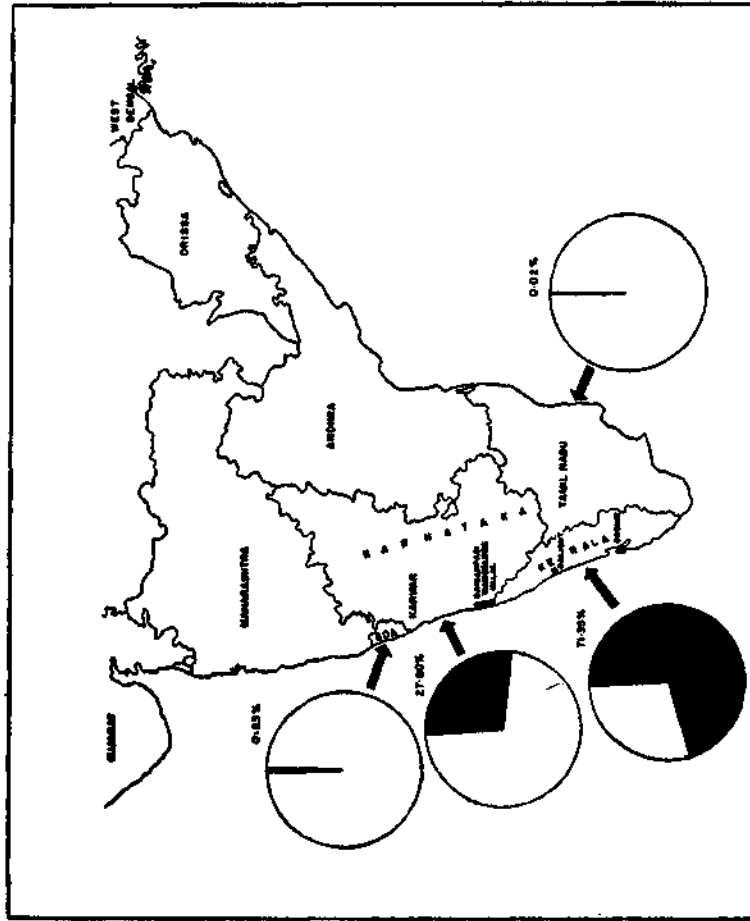


Fig. 11 Statewise annual oil sardine landings during 1978 (Percentage)

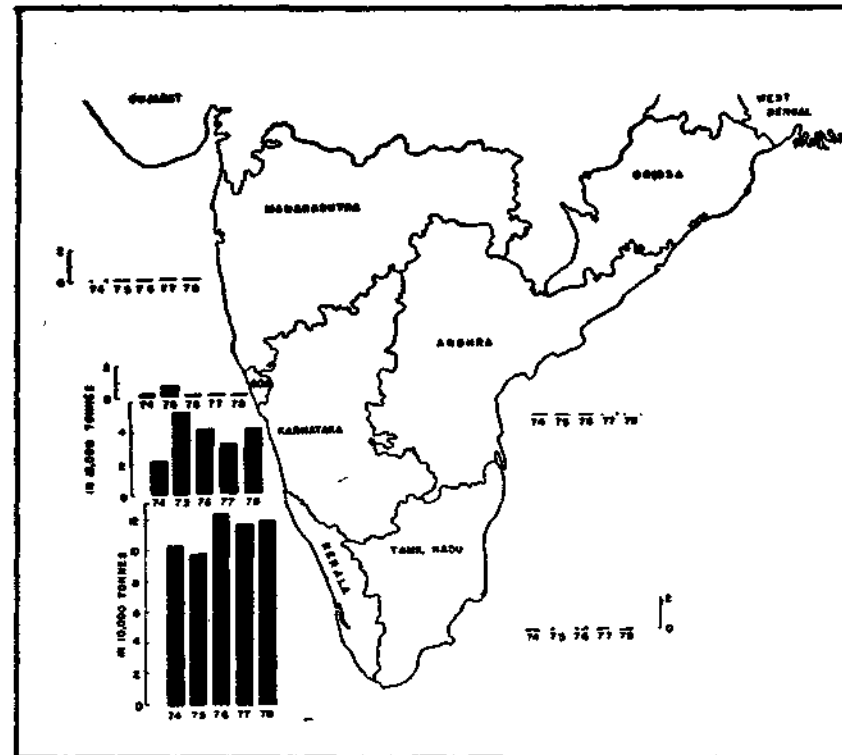


Fig. 12 - Statewise annual oil sardine landings during 1974 & 1978

**Unit stocks of oil sardine. (FB/MF/1.2)**

M. H. Dhulkhed, G. G. Annigeri, N. Gopinatha Menon and R. Reghu.

*Salient findings*

Excepting at Calicut, majority of the oil sardines at other centres had 47 vertebrae.

*Work done*

At Cochin, Calicut and Karwar, the number of vertebrae ranged from 45 to 48 whereas at Mangalore it was from 46 to 48.

*Work contemplated*

Besides studies on vertebral counts, electrophoretic studies would be attempted.

**Evaluation of the resources of lesser sardines, anchovies and other clupeoids. (FB/MF/1.3)**

G. Luther, P. Sam Bennet, J. C. Gnanamuthu, S. Lazarus, R. Thiagarajan, P. Radhakrishnan Nair, K. V. Narayana Rao and C. Muthiah.

*Salient findings*

Compared with those of last year, the catches of lesser sardines were better in most places excepting at Mandapam. The fisheries for anchovies also showed an improvement, similar to those of other clupeoids at Bombay.

*Work done*

Under this project, investigations on lesser sardines at Vizhinjam, Tuticorin, Mandapam and Madras; on anchovies at Cochin, Vizhinjam, Mandapam, Madras and Waltair; and on other clupeoids at Bombay were carried out during the year under review. At Vizhinjam, the catches of lesser sardines were twice the quantity landed last year. At Tuticorin as against a catch of 1,993 tonnes of 1977, the catches during 1978 was 2,425 tonnes. The total estimated catch at Madras amounted to 238



tonnes. *S. gibbosa* and *S. sirm* at Vizhinjam; *S. albella* and *S. gibbosa* at Tuticorin and *S. dayi* and *S. gibbosa* at Madras were the important contributors to the fishery in the order of abundance mentioned. At Mandapam the catches were only a third of what was obtained during last year. While *S. gibbosa* was abundant in the Palk Bay; the dominant species in the Gulf of Mannar was *S. albella*.

At Vizhinjam, *S. gibbosa* ranged in sizes from 20-190 mm; from 105-165 mm at Tuticorin; from 40-160 mm at Mandapam; and from 83-158 mm at Madras. The dominant species *S. albella* at Mandapam also ranged in sizes from 40-160 mm.

At Vizhinjam, a four fold increase was noticed in the fisheries for anchovies. This was due to improved contribution of *S. buccaneeri* as compared to *S. devisi* and *S. bataviensis*. *S. bataviensis* was the dominant species both at Madras and Waltair. But in the trawler catches at Waltair, *S. commersoni* was predominant. Forming about 43%, *S. heterolobus* was the chief contributor in the catches of PFP and IFP vessels at Cochin.

*Coilia dussumieri* ranging in sizes from 23-196 mm was the main supporter of the other clupeoid fisheries at Bombay. Males were generally more than the females in the samples examined. The clupeoid fisheries in general showed an improvement during the year (490m. tonnes) as against those of last year (418m. tonnes).

#### *Work contemplated*

This is a continuing project.

#### **The present status of the fishery of anchovies (FB/MF/1.6)**

K. V. Narayana Rao, G. Luther, V. Rajendran and M. N. Kesavan Elayathu.

#### *Work done*

A critical appraisal of the present status of the fisheries of anchovies was made based on the catch data of the fishery during the period 1950-1977. With an average yield of about 50,000 m. tonnes, during the last decade (1968-77), the anchovy fishery in India is very productive off Kerala (26%) along the West coast and Tamil Nadu (27%) along the East coast. Species belonging

to the genera *Stolephorus*, *Thryssa*, *Coilia*, *Setipinna* and *Thrissina* are the main contributors in the order of abundance mentioned. The distribution patterns of the fisheries for *Stolephorus* and *Thryssa* are similar. The fisheries for *Coilia* and *Setipinna* are localised in regions off major river systems. The fishery for *Thrissina* represented by a single species *T. baelama* is confined to the Andaman waters. About 7, 5, 2, 3 species respectively compose the fisheries for *Stolephorus*, *Thryssa*, *Coilia* and *Setipinna*, the former two being predominantly marine while the latter estuarine in habitat. Most of the species have protracted breeding periods and the sizes at which they spawn differ among various genera. The anchovies in general are fast growing fishes and either the '0' year or the '1' year groups supports the fishery. The reports of the PFP show that in the Ratnagiri—Gulf of Mannar region, an average annual standing stock of 480,000 m. tonnes of *Stolephorus* could be expected. Based on productivity data and yield formula  $Y=0.5 M \times B_0$ , a potential yield of 585,000 m. tonnes of anchovies was estimated for Indian waters. Of the total potential yield, the share of West coast, East coast and Andaman-Nicobar waters is in the order of 403,169 and 13 thousand tonnes respectively. Since the present catch is very meagre, substantial expansion of the fishery could be recommended.

This expansion of the anchovy fishery will be more rewarding along the coasts of Kerala, Tamil Nadu and Andhra Pradesh for *Stolephorus* and *Thryssa*; along Northern Maharashtra-Gujarat sector for *Coilia* and along Northern Orissa-West Bengal sector for *Setipinna*. Similar possibilities also exist for the increased exploitation of *Stolephorus* and *Thrissina* from Andaman Waters.

#### *Work contemplated*

This project is completed and a Status paper is under preparation.

#### **The fishery resources characteristics of mackerel. (FB/MF/2.1)**

G. Seshappa, A. Noble, M. V. Pai N. S. Radhakrishnan, R. S. Lal Mohan, T. M. Yohannan, P. Nammalwar, D. B. James, K. Rajasekharan Nair, G. Mohanraj.

#### *Salient findings*

Just as in the case of oil sardine, the fisheries for mackerel at all the centres in the southern sector was marked with impro-

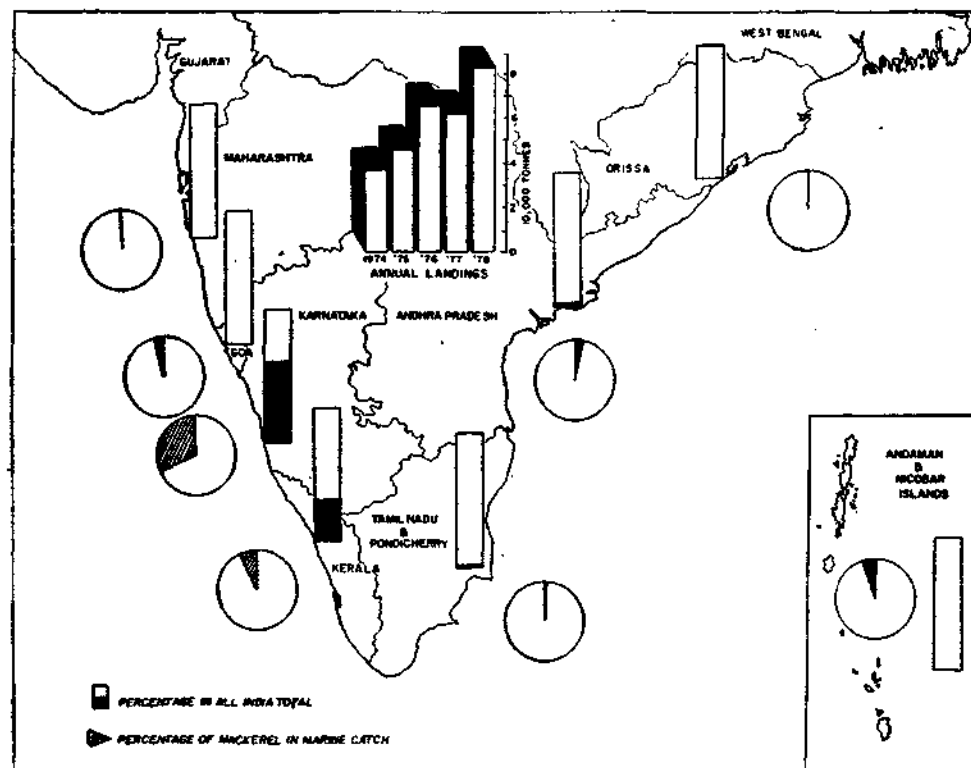


Fig. 13 - Annual landings of mackerel during the years 1974 to 1978 and Statewise percentage compositions

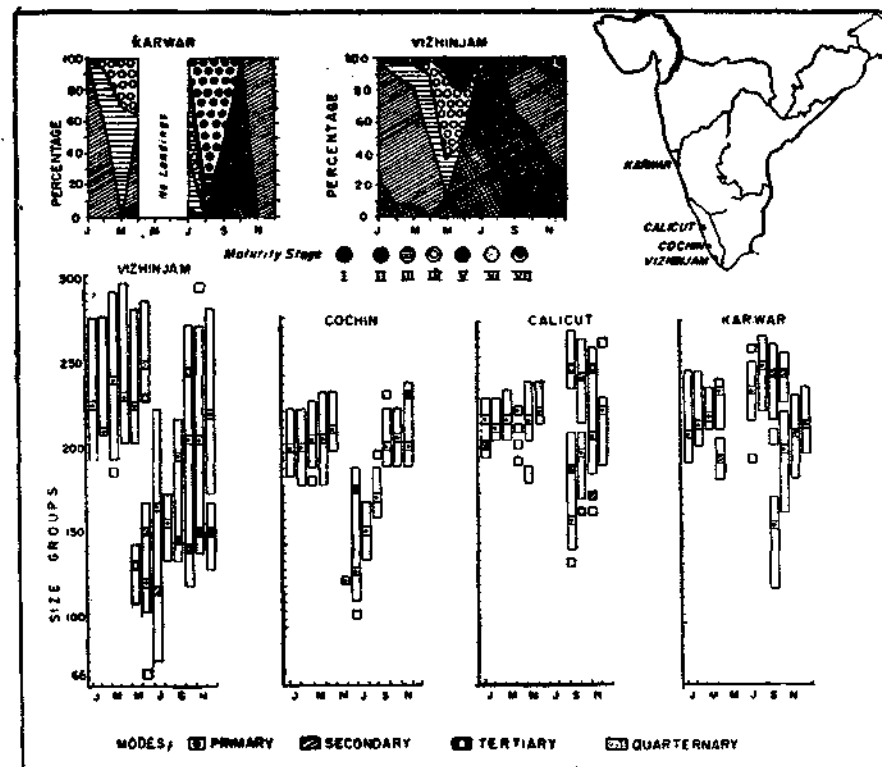


Fig. 14 - Length distribution and maturity of mackerel in 1978

vement over that of last year, whereas at centres in the northern sector, the fishery was poor. Maximum improvement was noticed at Vizhinjam.

#### *Work done*

Investigations were carried out at Vizhinjam, Cochin and Calicut in the southern sector and at Ullal, Baikampady and Karwar in the northern sector along the west coast. Along the east coast, centres at Keelakarai, Pamban and Panaikulam were covered. The boat-seines at Vizhinjam, Thangu vala at Cochin; Pattenkolli at Quilandy, Patta bala at Ullal and the rampan at Karwar accounted for the bulk of the mackerel landings. The purse seine landings at Mangalore, Malpe, Gangoli, Bhatkal and Karwar were considerable and noteworthy. Mackerel are landed mainly by the drift nets in Mandapam area. The size range of mackerel along the west coast was wider (65-295 mm) than that of the east coast (200-285 mm). Recruitment was noticed in June at Cochin, August at Quilandy and September at Karwar and was normal. The commercial catch composed mainly of 1-year old fish at most centres along the west coast except at Vizhinjam where it was supported by 0-year old fish. But along the east coast around Mandapam area, 1-year old fish were predominant. Sex ratio was in equal proportion. Spent and spent-recovering fish were obtained in May at Vizhinjam and after May at Cochin and in August at Karwar. Moderate feeding was noticed.

#### *Work contemplated*

Work on the above lines would be continued.

#### **Unit stocks of mackerel. (FB/MF/2.2)**

V. Balakrishnan, M.V. Pai, T. M. Yohannan and A. A. Jayaprakash.

#### *Salient findings*

Analysis of morphometric data in respect of nine characters showed a straight line relationship.

#### *Work done*

Morphometric studies and vertebral counts were undertaken to investigate unit stocks of mackerel collected from Cochin, Karwar

and Calicut. Studies on the vertebrae at Karwar, revealed that fishes having 11-14 haemal braces exhibited some variations. At Calicut no variation in the number of vertebrae were noticed. Based on the examination of 607 samples of vertebrae, it was observed that the pattern of occurrence of haemal braces viz., 14/15 haemal braces starting from 14-18/14-19 vertebrae, was similar to that noticed during last year.

#### *Work contemplated*

Resolution by the method of analysis of covariance is contemplated. Electrophoretic studies also would be undertaken.

#### **Mackerel fishery atlas. (FB/MF/2.3)**

A. Noble, V. Balakrishnan, K. Narayana Kurup and A. A. Jayaprakash.

#### *Work done*

About 94 drawings depicting distribution of both adults and larvae of mackerel in space and time and in relation to various environmental parameters are planned for inclusion in the atlas. A few have been inked also and others are in progress.

#### **Resources of tunas and bill fishes (FB/MF/3.1)**

E. G. Silas, V. Balan, M. D. K. Kuthalingam, M. S. Rajagopalan, P. Parameswaran Pillai, Pon Siraimetan, M. Devaraj, P. Livingston, P. S. S. Sarma.

#### *Salient findings*

The all India total catch of tunas during 1978 was estimated at 13,893 tonnes showing a slight increase in the catch as compared to 13,005 tonnes in 1977. The increase in the catches were noticeable in the States of Orissa, Goa, Maharashtra, Gujarat and Lakshadweep. Kerala contributed 47.13% of the total tuna catch. The state-wise landings of tunas are as follows:

Orissa	-	609	Goa	-	300
Andhra Pradesh	-	328	Maharashtra	-	1,939
Tamil Nadu	-	1,169	Gujarat	-	451
Pondicherry	-	3	Andamans	-	57
Kerala	-	6,548	Lakshadweep	-	1,875
Karnataka	-	614	Total	-	<u>13,893</u>
(all in tonnes)					

Gradual increase in the tuna catch was observed in the drift gill net operations at different centres, especially at Karnataka, Goa and Tamil Nadu. However, the tuna landings in 1978 when compared to that of 1977, recorded a 4.5% decrease at Vizhinjam and an overall decline of about 24% at Calicut. Young specimens of *Euthynnus affinis* of the size groups 120–210 mm and 250–260 mm were recorded from Vizhinjam and Tuticorin respectively. The occurrence of such young specimens was found to be repeated every year at Tuticorin.

#### *Progress of work*

##### *Mangalore:*

At Mangalore, 20,078 Kg of tunas comprising of *Euthynnus affinis* (97.26%), *Auxis thazard* (1.41%) and *Thunnus tonggol* (1.33%) were landed in the South-Kanara Coast by units operating drift gill nets of 7.5 to 10.0 cm mesh size, during January through April. CPUE for tunas was estimated at 2.2 Kg. Size composition of *E. affinis* ranged from 600–800 mm in total length. (Table 5).

A total quantity of 6,837 Kg of billfishes constituted by *Istiophorus platypterus* (96%) and *Makaira tenuirostratus* (4%) were landed during January and February. CPUE for billfishes (estimated value: 0.62 Kg) was relatively high in the mechanised units when compared to that in the non-mechanised vessels. Eye-fork length of sail fish ranged from 1501–1850 mm (Table 5)

##### *Calicut:*

Total yield of tunas at Calicut was 69,505 Kg which registered an overall decline of about 24% as against the 91,491 Kg of 1977. Drift net was the only gear that was operated for tuna fishery in the depth zone 25–55 m. *E. affinis* ranked first in abundance throughout the year, constituting about 98% of the total annual tuna catch and the catch per effort was 23.6 Kg. Yellowfin tuna was present in November only and constituted about 1,700 Kg of the total catch. *Sarda orientalis* and *Auxis thazard* yielded smaller quantities during September–October period. *T. tonggol* occurred in stray numbers during the first and last quarters of the year.

Biological investigations showed that the dominant modes of *E. affinis* were at 550 and 600 mm during first half of the year and was at 550 mm during the second half period; partly spent and spent stages dominated the catch during the latter period. Dominant modal sizes of different species are shown in Table 5.

#### *Cochin:*

The IFP Vessels based at Cochin and operating purse seine in the area off Cochin (Zones: 9-75, 10-75 and 10-76) landed a total catch of 3,284 Kg. of tunas, which mostly comprised of *E. affinis*.

Observations on tuna fishery made at Fort Cochin indicate that 890 tonnes of tunas were landed (at Fort Cochin) by drift gill nets of mesh size 10-15 cm., operated in the depth zone 35-40 m. *E. affinis* dominated the catches followed by *A. thazard*, *T. tonggol* and *K. pelamis*. *Coryphaena* sp., *Chorinemus* sp., black tipped and grey sharks and catfishes chiefly co-occurred with tuna in the gill net catches. The dominant modes of *E. affinis* and *A. thazard* were 540 and 400 mm respectively. Stray catches of sailfish (*I. platypterus*) were recorded during July and September (Table 5)

Species-wise catch statistics of tunas published by the FAO during 1965-1976 has been compiled. Catch of yellowfin tuna (*Thunnus albacares*) in the recent years ranged from 35,000-45,000 tonnes and was characterised by a gradual decline in the longline catch and rapid increase in of surface fishery. Total catch of skipjack (*Katsuwonus pelamis*) by longline and surface gears was around 24,500 tonnes. Analyses of the Japanese longline fishery data for yellowfin tuna in the Indian Ocean during 1972-'75 indicate that hook-rates of 1.0 to 1.9% occur in the north eastern Bay of Bengal and equatorial Indian Ocean during January to May. Average hook-rates for skipjack tuna for the period 1965-1975 was 0.2% in the tropical and western Indian Ocean, during the period October to February.

#### *Minicoy:*

The estimated catch for the year was 523.5 tonnes. The percentage composition of skipjack, yellowfin and big eye tuna were respectively 72.5, 25.3 and 1.5. The second and fourth quarters yielded better catches.

Detailed information on the impacts of mechanization on the tuna fishery has been collected and are being processed. Field studies on the effect of cyclonic calamities on the tunas in the Lakshadweep waters were conducted and detailed information collected.

#### *Vizhinjam:*

Total catch of tunas at Vizhinjam was estimated at 397.31 tonnes which showed a decrease of 4.5% from the landings of tunas in



1977 (416.6 tonnes). Of the total catch, 82.3% was landed by the drift gill nets, 17.6% by hooks and lines and 0.1% by boat seines and other gears. June was the peak period of the tuna catch. *E. affinis* and *A. thazard* contributed 73% and 24% of the total catch, respectively. *S. orientalis*, *T. albacares* and *K. pelamis* together contributed to 3% of the total catch.

The size ranges of different species are given in Table 5, *E. affinis* was mostly in the maturity stages III and IV. Young ones of this species measuring 120-210 mm were recorded from the area north of Vizhinjam. *Stolephorus* spp. and lesser sardines constituted the major forage items of tunas examined.

#### *Tuticorin:*

Tuna landings were relatively high in the third quarter of the year when compared to that in the other periods. Drift nets, troll lines and sardine gill nets were widely used in the fishing.

20.5% of *E. affinis* landed belonged to the size-group 550-575 mm. Young specimens (in the size-range 250-260 mm and weighing 140-160 gms) were recorded during August, a phenomenon recurring every year in this zone. Landings of *A. thazard* were relatively high during August-September period and 39.6% of the specimens belonged to the 300-325 mm group (Table 5). Stray catches of *Istiophorus* were made by troll lines, particularly during February, June and September.

#### *Work contemplated:*

Studies on the population, fishery and resource characteristics of tunas and bill fishes will be carried out at the major centres. Thrust will be given to the racial and migratory studies. Abundance and availability of different species of tunas and bill fishes taken by the longline in the Indian Ocean will be estimated based on the available catch statistics.

#### **Resources of seer fishes. (FB/MF/3.3)**

M. V. Pai, T. M. Yohannan and M. Devaraj.

#### *Salient findings*

The seer fish landings at all places of observation viz., Calicut, Mangalore and Karwar registered an improvement during the year over those of last year. As during last year, the fishery was supported by *S. commersoni*, *S. guttatus* and *S. lineolatus* in the order of abundance mentioned.

**Table 5.** Size Ranges and Modal Size (s) (mm) of Tunas and Billfishes observed at different centres

Species/Centres	Mangalore	Calicut	Cochin	Vizhinjam	Tuticorin
<i>Euthynnus</i>	*R : 601-820		R: 420-650	R: 224-680	R: 440-642
<i>affinis</i>	**M: 670-710	M: 550,600	M: 540-600		M: 550-575
<i>Auxis</i>	—		R: 360-450	R: 344-379	R: 180-395
<i>Thazard</i>		M: 200,250	M: 400		M: 300-325
<i>Sarda</i>					
<i>orientalis</i>	M: 350	M: 350	—	R: 400-760	—
<i>Thunnus</i>					
<i>albacares</i>	—	M: 600	—	M: 590-840	—
<i>Thunnus</i>					
<i>tonggol</i>	—	M: 550,600	R: 630-650	—	—
<i>Katsuwonus</i>					
<i>pelamis</i>	—	—	R: 450-520	—	—
<i>I. platypterus</i>	R: 1501-1850				
	M: 1725	—	R: 2020-2820	—	R: 1127-2205

\* Range; \*\* Mode (s)

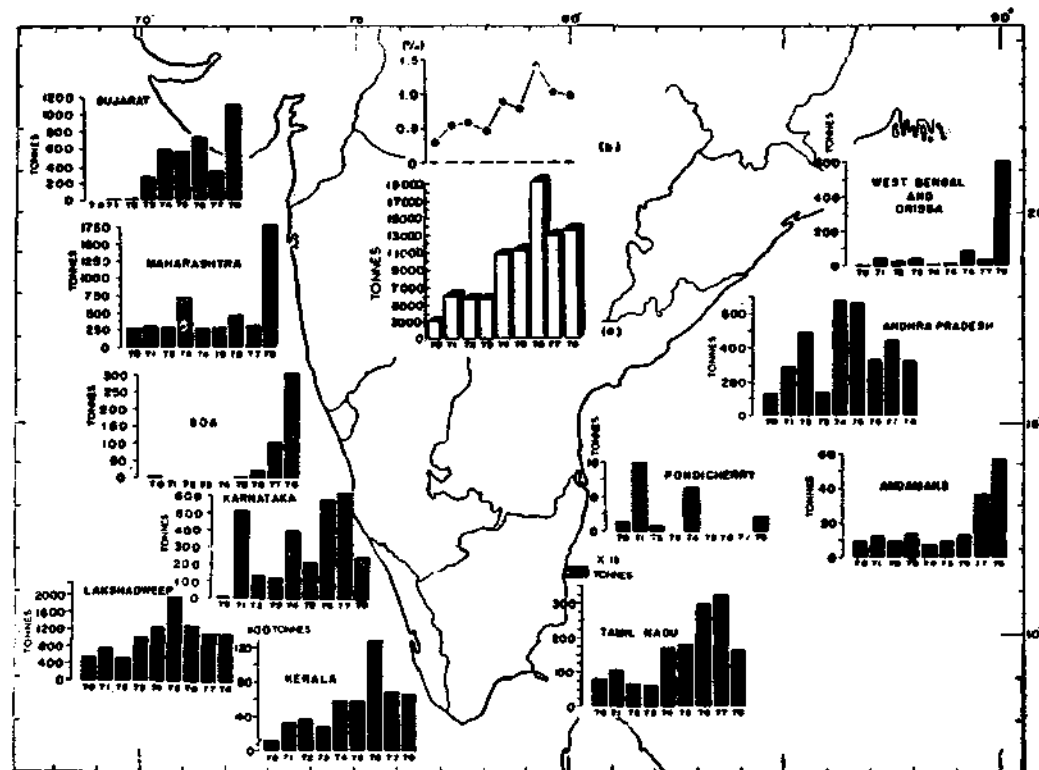


Fig. 15 - Trend in the tuna landings during 1970-78—Annual total landings of tunas, percentage composition in total marine fish landings and statewise landings are shown.

### *Work done*

At Calicut, an estimated catch of 1,130 tonnes of seer fish was obtained from the operations of drift nets, boat seines and hooks and line. As during earlier years, drift nets continued to be the most effective gear which accounted for 93% of the catches. The last quarter witnessed peak catches, 61% of the landings having been realised during this period. At Mangalore, the bulk of the catch was obtained in the I quarter. The dominant fishery was for *S. commersoni* which was supported mainly by the 2 year old fish. The annual total mortality rates for the king seer, spotted seer and streaked seer were 0.6, 0.7, and 0.8 respectively. The annual exploitation rates were, thus, low. It follows, therefore, that the stocks of seer fishes along the South Canara coast are under-exploited. At Karwar, as against an estimated catch of 3,116 tonnes of last year, 3,996 tonnes of seer fishes were obtained during the year. As at Calicut, major landings were recorded in the last quarter at Karwar. *S. commersoni* had the widest size range (300-1,250 mm) followed by *S. guttatus* (220-950 mm) and *S. lineolatus* (300-855 mm) at Karwar. But at Calicut, *S. commersoni* ranged in sizes from 125-1,249 mm.

### *Work contemplated*

Investigations envisaged in the project are of a continuing nature since the seer fishes are one of the esteemed and valuable pelagic resources of the country.

### **Culture of anchovies as live-bait for tunas. (FB/MF/3.4)**

G. Luther, G. Gopakumar and Madan Mohan.

### *Salient findings*

Survival of anchovies was better: (1) when no fish other than the anchovies were transported; (2) if water was changed frequently; (3) when the optimum density was 250 fish per 50 ltrs. of water; and (4) when the duration was less than an hour. *S. buccaneeri* was hardier than *S. bataviensis*.

### *Work done*

Experiments to develop suitable low cost technology for capture, handling, transport and rearing of anchovies in cages suspended from floating rafts were carried out.

#### *Work contemplated*

Development of better handling techniques of bait fish; experimental fishing for skipjack and other tunas with live bait; and economics of culture of bait fishes.

#### **The fishery and resources characteristics of Bombay duck and lizard fish (FB/MF/4.1)**

S. V. Bapat, A. S. Kaikini, A. Kurian, R. R. Nandakumar, V. S. Somavarshi, M. Z. Khan, M. Jayachandran and S. Bashiruddin

#### *Salient findings*

A marginal improvement in the fisheries for Bombay duck was noticed in Maharashtra as a whole.

#### *Work done*

Although the fisheries of Bombay duck showed an improvement from an estimated catch of 50,863 tonnes of 1977 to 68,781 tonnes of 1978 in Maharashtra as a whole, observations at Versova and Arnala did not, however, support this trend since at both centres a declining trend was noticed. There was, nevertheless, an increase in the average size from 178 mm in 1977 to 183 mm in 1978. At Arnala, the fishery was mainly supported by juveniles with an average size of 140 mm. At Navabunder in Gujarat also a decreasing trend was noticed, the estimated catch being 2,901 tonnes as against 3,758 tonnes in 1977. However, an increase in the average size from 107 mm to 132 mm was a noteworthy feature.

#### *Work contemplated*

Work on the above lines to continue.

#### **Unit stocks of Bombay duck. (FB/MF/4.2)**

S. V. Bapat, M. V. Deshmukh, M. K. George and A. Kurian.

#### *Work done*

Morphometric and meristic data of 496 specimens of Bombay duck collected from Versova, Jaffrabad, and Dahanu were taken

and analyses of covariance carried out. Methods of electrophoresis were standardised. Preliminary tests on oil sardine and black pomfret showed that LDH and ES could be resolved in these fishes also.

#### *Work contemplated*

Work on the above lines to continue.

#### **The resources of Cat-fishes, perches and carangids. (FR/DR/1.1)**

B. Krishnamoorthi, P. Mojumder, S. S. Dan, V. S. Rengaswami, V. Sriramachandramurthy, P. Sam Bennet, Gracy Mathew and T. Prabhakaran Nair.

#### *Salient findings*

The Cat-fish fisheries at Waltair and the nemipterid fisheries at Kakinada showed a decline. But at Mandapam the Cat-fish fisheries registered an improvement. So also the carangid fisheries at Vizhinjam.

#### *Work done*

At Waltair, catches of 8,487 kg and 30,455 kg of Cat-fishes were realised in the offshore and inshore regions respectively during the year as against 19,332 kg and 65,245 kg respectively of last year. There was, therefore, a fall in the relative abundance of Cat-fish fisheries in both the regions. The Cat-fish fisheries during both the years and in both the regions were supported by two species viz., *T. thalassinus* and *T. tenuispinis*. Unlike in the offshore region, the contribution of *T. tenuispinis* was higher than that of *T. thalassinus*. While *T. thalassinus* ranged in sizes from 120-450 mm; the size range of *T. tenuispinis* was from 119-422 mm. The fisheries for *T. thalassinus* was mainly supported by immature groups of fishes of one year age. But at Mandapam, an improvement in the Cat-fishes was noticed. *T. dussumieri* was the principal contributor.

A 71% decrease in the fisheries for nemipterids was recorded at Kakinada. *N. japonicus* ranging in sizes from 75-245 mm continued to be dominant species and the fishery was supported by '0' and '1' year groups.

The results of experimental fishing for perches with traps at Tuticorin were not encouraging.

An estimated quantity of 172 tonnes of perches was landed at Tuticorin both by the indigenous craft and the Government of India trawlers. The perch fishery was supported by 6 species. *L. lineolatus* ranged in sizes from 90-265 mm.

The estimated landings of carangids at Vizhinjam being 1,235 tonnes as against 250 tonnes of last year, there was considerable improvement in the fisheries for carangids. The main supporter was the *Decapterus* sp. *M. cordyla* ranged in sizes from 90-389 mm.

#### *Work contemplated*

Stock assessment of Cat-fish fisheries at Waltair would be attempted. Experimental fishing at Tuticorin with perch traps to be intensified.

#### **Sciaenid and Polynemid resources of the east and west coast of India (FB/DR/1.2)**

T. Tholasilingam, E. Vivekanandan, V. Sriramachandra Murty,  
K. V. Somasekharan Nair and S. K. Chakraborty.

#### *Salient findings*

Generally landings of sciaenids during 1978 excepting at Calicut, was poor and declining when compared with those of the previous year.

#### *Work done*

An estimated catch of 397 tonnes was landed at Kakinada during the year. Although a total of 17 species occurred in the catches, no species in particular was available in all the months as observed during the previous years. *J. carutta* was however, the most important contributor.

At Madras an estimated catch of 207 tonnes of sciaenids was obtained from the trawler catches and was supported by 14 species.

An increase of 25% over the sciaenid catches of last year was recorded during the year at Calicut. About 11 species contributed to the fishery. The fisheries for *O. ruber* constituted mostly of '0' and '1' year old fishes.

Estimated catches of 281, 673 and 1,012 tonnes of sciaenids were respectively obtained from Bombay, Kasara Bundar and Sason Docks, during the period from March to December 1978. The polynemid fishery exclusively consisted of *P. heptadactylus* and an estimated catch of 281 tonnes was landed at Kasara Bundar.

#### *Work contemplated*

Work on lines similar to the present would be continued.

#### **Resources of silver bellies and ribbon fishes. (FB/DR/1.3)**

G. Venkataraman, P. T. Meenakshi Sundaram, J. C. Gnanamuthu, Y. Appannasastry, M. Bhashiruddin, S. K. Chakraborty.

#### *Salient findings*

A revival in the fisheries for silver bellies at Mandapam and Rameswaram in 1978 was a noteworthy feature. While the fisheries for ribbon fishes at Madras was good, a declining trend was noticed at Kakinada.

#### *Work done*

The investigations on silver bellies were carried out at three centres viz., Mandapam, Rameswaram and Madras. Data not only on the catches but also on the biology of the important species supporting the fishery at each place of investigation, were collected. At Mandapam, an estimated total catch of 6,763 tonnes of silver bellies were landed during the year as against 3,602 tonnes of last year, bulk of which was obtained during day time. The trend in the catches of the most dominant species, *L. jonesi* was similar to that of the total silver belly catches. Ranging in sizes from 30 to 115 mm, the fisheries for *L. jonesi* was mainly supported by the 0+ and 1+ year old fishes. Maximum spawning in this species was noticed from January to April. At Rameswaram also, an improvement from an estimated catch of 4,943 tonnes of 1977 to 6,798 tonnes during this year was noticed in the fisheries of silver bellies



mainly supported by *L. jonesi*. The size range and spawning of this species was also as observed at Mandapam. At Madras, the silver belly landings by the mechanised vessels were poorer than those of last year. Of the four species supporting the fishery, *L. bindus* with a contribution ranging from 53 to 83 % was the dominant species. *L. bindus* ranged in sizes from 33 to 124 mm and those measuring below 70 mm appear to belong to below 1 + year class and those above 70 mm to 1 year class. Mature fish occurred throughout the year with peak in the period from February to April.

The fisheries for ribbon fishes was good at Madras but poor at Kakinada. But at both places *T. lepturus* was the dominant species, though five other species occurred occasionally at Kakinada. While at Madras, it ranged in sizes from 180 to 550 mm, at Kakinada it was from 195 to 765 mm. At Bombay work on ribbon fishes was started in March '78 only. Here also the main contributor was *T. lepturus*. While in the trawler catches, the length ranged from 580 to 1,149 mm; at Versova in the catches of indigenous craft it was from 330 to 664 mm.

#### *Work contemplated*

The project being continuing in nature, observations on the fisheries and the biology of the most important species supporting the fishery would be continued.

#### **Evaluation of demersal resources of some selected areas (FB/DR/1.4)**

C. Mukundan, V. M. Deshmukh, M. K. George, C. Muthiah, G. S. Daniel Selvaraj, M. M. Meiyappan, M. Vijayakumar, P. Sam Bennet, M. Devaraj, P. Natarajan, V. S. Rangaswamy, P. T. Meenakshisundaram, R. Sarvesan, M. Rajagopal, Y. Appanna Sastry, W. Venugopalan, B. Krishnamoorthi, V. Ramamohana Rao, S. Reuben, S. S. Dan, P. Mojumdar, T. Appa Rao, D. B. James and others.

#### *Salient findings*

The trawling operations of EFP vessels off Bombay have yielded highest catch rates (115.8 kg/hr) during first quarter, compared to second and third quarters, indicating greater abundance of the resources in the trawl grounds during the period. Category-wise, elasmobranchs and catfishes dominated the catches. Eels were caught in good proportion from June/July onwards.

Similar operations of the EFP vessels in the deeper waters and those of IFP vessels in the shallow waters off Cochin have yielded highest catch rates of 170.7 kg/hr and 216.9 kg/hr respectively during the second quarter, unlike in the Northern shelf. The perch trap operations by IFP vessel 'Kalava' during February have yielded a catch rate of 42.2 kg/hr which is better than the handline operations in the same grounds and period.

The operations of EFP vessels from Tuticorin employing 24 M trawl and 20 M trawl during the year and from the same grounds have obtained better catch rates by 24 M trawl. The main components of catches were perches and rays.

At Madras the trawling operations of the EFP vessels have shown that in the areas covered, the highest catch rate of 240 kg/hr was from 14-80/3B in February. The major components of the catches were silverbellies, sciaenids, rays, carangids, catfishes and lizard fishes.

There was a marked decline in the trawl catches off Kakinada during the year with an estimated catch of 8.423 tonnes (including 2,026 tonnes of prawns) as compared to previous year's catch of 24,572 tonnes (including 6,061 tonnes of prawns). This is possibly due, in part, to the lesser effort put in this year as well as due to lower catch rates of different types of trawlers. The various components of fish resources appear to be at a lower level of abundance during the year compared to the previous year. Prawns, ribbon fishes, lizard fishes, sciaenids, silver bellies and threadfin bream were the dominant elements in the catches.

There was also slight decline both in the total catch and catch rates of the EFP vessels off Waltair during the current year. 'Meena jawahar' brought higher catch rate than 'Mena shodhak'. Both the vessels landed highest catches and catch rates during the first quarter. The miscellaneous groups dominated the catches making up over 73% of the landing. Next in abundance were catfishes and elasmobranchs. At Port Blair limited operations of trawling, trolling and tuna long-lining showed C/E rates of 149.92, 0.56 and 33.84 respectively. Dominant catches were, sharks and marlins by long lines; and tunas and barracudas by trolling. In the trawl catches silver bellies, sciaenids and elasmobranchs predominated.

### *Work done*

The catch and effort data of the Government of India vessels and the private mechanised boats have been analysed from Bombay, Cochin, Vizhinjam, Tuticorin, Mandapam Camp, Madras, Kakinada Waltair and Port Blair.

### *Work contemplated*

Exploratory fishery data from the above centres will be collected, analysed and disseminated.

### **The resources of flat fishes and pomfrets. (FB/DR/1.5)**

G. Seshappa, G. Nandakumar, J. P. Karbhari, and K. V. Narayana Rao.

### *Salient findings*

A marginal decrease in the fisheries for pomfrets at Veraval and a steady fisheries for flat fishes at Mandapam were the noteworthy features.

### *Work done*

Supported mainly by the black pomfret, *Stromateus niger*, an estimated catch of 398 tonnes was landed at Cochin obtained in depths less than 45 m. The bulk of the catch was realised from the operations of the drift nets (64%). Two peaks of abundance during November/December and April/June periods were observed. At Veraval, the fisheries for pomfret during the year (1,046 m. tonnes) was not as good as it was during last year (1,282 m. tonnes). With about 80% contribution, the gill-nets were more effective than the trawl nets.

*Pampus argenteus* was the main contributor at Veraval. The 800 specimens measured ranged in average lengths from 261 to 290 mm recorded in January and May respectively. Females were dominant and most of them were with mature ovary.

Comparable catches of 24 m. tonnes of *C. macrolepidotus* were landed during the present and last years at Mandapam. The first quarter was the best season for the fishery for soles. The size ranges of males and females were respectively from 101 to 440

and 101 to 350 mm. Young fish with modal sizes of 125 mm (males) and 135 mm (females) were recorded in March. Observations on maturation indicated a prolonged breeding in the species.

#### *Work contemplated*

Work on the fishery and biological characteristics of the resources of pomfrets will be intensified.

#### **Evaluation of the commercially important elasmobranch resources. (FB/OF/1.1)**

M. D. K. Kuthalingam, R. Soundarajan, P. Natarajan, D. Kandaswamy, M. E. Rajapandian, S. G. Vincent.

#### *Salient findings*

While the fisheries for elasmobranchs at Calicut showed a decline, those at Tuticorin were better.

#### *Work done*

At Vizhinjam and Sakthikulangara landing centres, estimated catches of 205 and 14,300 m. tonnes of elasmobranchs were landed during the year. At both the places, the landings of sharks were better than those of skates and rays. The indigenous craft and gear at the former centres and the trawl nets at the latter yielded better catches. Seven to eight species of sharks and 6 species of rays supported the fishery. *S. lewini* which formed 50% of the shark landings at Sakthikulangara ranged in size from 240 to 410 mm.

There was a slight fall in the fisheries for elasmobranchs from 162 m. tonnes of 1977 to 155 m. tonnes of 1978 at Calicut. However, sharks such as *C. limbatus*, *S. sorrah* and *C. dussumieri*, were the main contributors as at Vizhinjam. Also, the drift nets were the most efficient gear. Females in the drift net catches and males in trawl nets dominated.

The estimated catches of 298 m. tonnes of elasmobranchs landed at Tuticorin were better at Tuticorin than at Calicut, the sharks alone contributing as much as 207 m. tonnes. The important species of sharks viz., *R. acutus*, *L. macrorhinus*, *C. maculipinnis* and *R. oligolinx* ranged in sizes 830-860, 630-810, 740-810 and 720-730 mm respectively.

A total catch of 63 m. tonnes of rays was obtained at Mandapam which was considerably less than that obtained in 1977 (185 m. tonnes). *H. alcockii* with a contribution of 192 m. tonnes was the chief species.

#### *Work contemplated*

This being a continuing project, work on similar lines would be continued.

#### **Culture of marine fishes. (FB/CUL/1.1)**

G. Venkataraman, T. Appa Rao, S. Reuben, M. H. Dhulkhed, R. Marichamy, K. M. S. Ameer Hamsa, R. S. Lal Mohan.

#### *Salient findings*

The survey of the cultivable species in Bhiminipatnam (Waltair) backwaters indicated that mullets and prawns predominated in the area. In the culture experiments using pen at Mandapam average growth rate of 30 mm/month was obtained for mullets and chanos. In the salt pan area cultured prawns (*P. indicus*) showed increase in total length from 51 to 82 mm in a period of 2½ months. At Calicut the culture of fishes in polythene lined ponds showed that prawns, mullets, *Chanos*, *Lates calcarifer*, *Megalops cyprinoides* could be reared to marketable size and even oil sardine could be kept in captivity for a period of 4 months. Hatchlings of the marine turtle, *Lepidochelys olivacea* are also being reared. At the Mulki farm (Mangalore) culture experiments on *Sillago* is continuing.

#### *Work done*

Experiments on culture of marine fishes were continued during the year at Mangalore, Calicut, Tuticorin, Waltair and Mandapam Camp.

#### *Work contemplated*

Research on induced breeding of fishes such as *Chanos*, mullets and *Sillago* will be intensified and experiments on polyculture of compatible species of fishes and prawns will be strengthened.

#### **Culture of eels. (FB/CUL/1.2)**

K. Dorairaj, R. Soundararajan and D. Kandasami.

### *Salient findings*

Eels cultured in outdoor tanks registered an increase in weight by 92% in the first six months and by 339% at the end of one year.

### *Work done*

Investigations were carried out to culture eels both in the laboratory tanks (indoor) and outdoor tanks. While the increase in weight was of the order of 170% in the former; in the latter an increase of about 239% was registered. Recycled water was used and the feed was a paste of minced silver bellies, rice bran and oil cake in 2:1:1 proportion with 0.2% multi-vitamins. The net production rate was 2.15 kg/sq.m. in 5 months. In October 78, an elver resources survey was started.

### *Work contemplated*

Besides continuing the work, it is proposed to formulate dry food.

### **Studies on induced breeding and culture of grey mullets. (FB/CUL/1.3)**

P. S. B. R. James, V. S. Rengaswamy, and G. Mohanraj.

### *Salient findings*

A preliminary survey was conducted along the coast of the Palk Bay and the Gulf of Mannar for obtaining breeders.

### *Work done*

This is a new project which was started in September 1978. Specimens of *M. cephalus*, *L. macrolepis*, *V. seheli* and *E. vaigiensis* ranging respectively in sizes 250-470 mm, 110-372 mm, 180-390 mm and 230-622 mm were available from Pamban, Pillaimadan and Manauli island. Among all the species, females dominated. No breeders, however, could be obtained. Mullet fry particularly those of *E. vaigiensis* were abundant in early morning and late night hours in the catches near the bar mouth.

### *Work contemplated*

Intensive and extensive surveys would be carried out for breeders with a view to attempting induced breeding.

### *Salient findings*

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### *Work done*

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### *Work contemplated*

Intensive and extensive surveys would be carried out for breeders with a view to attempting induced breeding.

## CRUSTACEAN FISHERIES DIVISION

The research activities of the Crustacean Fisheries Division during 1978 were included under seven research projects on the resources aspect and four projects on the culture of marine prawns, spiny lobsters and edible crabs. Two new research projects, one on the 'Genetic resources of the commercially important prawns' and the other on the 'Assessment of stomatopod resources', were initiated during the year.

The noteworthy features of the crustacean fisheries and its resources during the year were: (1) the penaeid prawn fishery in most of the major fishing centres along the coast, except those in the Karnataka and Tamil Nadu states, was relatively of lesser magnitude than that of the previous year; (2) the shallow water lobster fisheries constituted by *Panulirus polyphagus* on the north-west coast and *P. homarus* on the southwest and southeast coasts were better except at Veraval; (3) the *Macrobrachium* fisheries in the Pampa river system and in the Cochin Backwater showed a revival with improved landings; (4) the fishery of *Metapenaeus dobsoni* on the southwest coast, which was a failure in the last year, showed improvement; and (5) at Kakinada, the non-penaeid prawns continued to contribute significantly in the prawn catches as in the previous year.

The important research results achieved in the field of culture fisheries were (1) induced maturation of the cultivable prawns such as *Penaeus indicus*, *Metapenaeus dobsoni* and *Parapenaeopsis stylifera* was successfully achieved by unilateral eye stalk ablation technique, and they spawned viable eggs under controlled conditions; it was observed that the ovaries of the species when subjected to unilateral eye-stalk ablation matured rapidly and reached the final stage of maturity within 12 to 20 days. Rematuration of spent females within 10 to 12 days in the case of *P. indicus* and *P. stylifera* and 15 days in that of *M. dobsoni* was also



recorded; (2) juveniles of *P. homarus* reared in the laboratory attained maturity and subsequently spawned. The viable eggs thus liberated on to the pleopods underwent further development and hatched out into free swimming phyllosoma larvae under controlled conditions.

Several prawn farmers and entrepreneurs approached the Institute for information on the techniques, feasibility, inputs required and economics of intensive prawn farming. Besides providing technical advice to these farmers, demonstration of intensive prawn farming was also undertaken in some of the farmer's fields. The Division also actively participated in the "Co-operative Intensive Prawn Farming Project" at Narakkal.

#### Assessment of penaeid prawn resources (CF/RE/1.1a)

S. Ramamurthy; J. P. Karbhari; M. Aravindakshan; P. A. Thomas; K. Y. Telang; K. K. Sukumaran; G. Krishnaiah; M. M. Kunju; M. M. Thomas; N. S. Kurup; Thangaraj Subramanian; G. Nandakumar; K. Devarajan; G. Sudhakar Rao; S. Lalitha Devi; P. E. Sampson Manickam; K. N. Rajan; Mary K. Manissery; K. Chellappan; Jacob D. Eapen and P. V. K. Rao.

#### Salient findings

The penaeid prawn fishery in the observation centres at Veraval, Bombay, Panaji, Calicut, and Cochin was of lesser magnitude than that of the previous year. At Karwar and Mangalore the fishery, however, showed improvement. On the east coast, better fishery prevailed only at Mandapam and Tuticorin, while in the other centres, the catch was relatively poor, particularly at Kakinada. The mean size of *P. indicus* showed an improvement in the fishery at Mangalore and Calicut, whereas that of *M. monoceros* decreased slightly. A significant increase of mean size was recorded for *M. dobsoni* at Mangalore, while a downward trend in size was noticed in the fishery of the species at Calicut. The percentage contribution of *P. stylifera* in the fishery of the south-west coast of India was relatively less unlike in the previous year when it was the principal species exploited.

#### Work done

The estimated landings of penaeid prawns by the mechanised fishing vessels, non-mechanised indigenous crafts, catch per unit

of effort, important species and peak fishing season at different observation centres on both the coasts are given in Table 6.

The fishery suffered a heavy decline on the west coast except at the centres of Karnataka, where however, the improvement was only marginal. On the east coast, the fishery was better at Tuticorin, Mandapam and Waltair.

At Bombay, *M. affinis* and *M. monoceros* predominated in the trawler catches whereas in the southern centres of the west coast, *P. stylifera* and *M. dobsoni* formed the mainstay of the fishery. Moderate landings of *P. japonicus* was reported at Bombay. The decline in the landings at Cochin was due to the failure of the fishery for *P. stylifera*. Improved catches of *M. dobsoni* were observed at Cochin and Mangalore. On the other hand, the fishery in respect of *M. monoceros* at Mangalore was considerably reduced unlike in 1977 when it ranked second in abundance.

On the east coast, *P. semisulcatus* constituted the mainstay of the fishery at Mandapam and to a lesser extent at Tuticorin. *P. indicus* comprised the bulk of the catch of Manapad (Tuticorin). *M. dobsoni*, the chief species at Madras and Kakinada, suffered a heavy decline in the catch particularly at the latter centre. The species components, especially *M. monoceros* and *P. indicus* registered an increasing trend at Waltair.

The catches by indigenous gear were better at Calicut and Cochin during the year as compared to 1977, *M. dobsoni* being the principal species. At Puri, the fishery had a marginal fall, *P. indicus* and *P. merguensis* constituting the bulk of the landings. A new centre of observation—Uppada was taken up in the Kakinada area from October.

#### Biological details

*P. indicus*: This was the chief species at Tuticorin and Puri and formed a sizable fishery at Cochin and Waltair. There was an overall increase in the mean length of the species exploited at Mangalore and Calicut as given below:

Centre	Mean size (mm)			
	1978		1977	
	Male	Female	Male	Female
Calicut	140.8	142.1	139.0	141.5
Mangalore	131.9	139.6	132.9	135.8
Puri	156.9	162.1	—	—

Table 6. *Penaeid* prawn fishery at various centres

Centres	Offshore fishery				Inshore fishery			
	Catch in tonnes	Catch/effort in Kg.	Important species*	Productive months**	Catch in tonnes	Catch/effort in Kg.	Important species*	Productive months**
Veraval (a)	854.9	—	—	11, 10, 12	—	—	—	—
Bombay	1605.0	126.7 (Boat day)	b, c, i	2, 9, 8	—	—	—	—
Goa	186.3	6.3 (hour)	a, i, c	3, 1, 2	—	—	—	—
Karwar	271.5	8.2 (hour)	a, i, b	12, 4, 3	5.1	7.2 (shore seine)	i, f	6, 7
Mangalore	1589.1	40.9 (Boat day)	i, a, c	1, 2, 4	17.3	21.7 (Cast net)	a, e	8, 7
Calicut	231.0	35.0 (Boat day)	a, i, e	4, 1, 12	5.8	—	a, e	7, 9
Cochin	2212.1	5.5 (hour)	i, a, c	6, 5, 4	97.6	—	a	6
Tuticorin	738.8	2.3 (hour)	e, h	7, 8, 9	—	—	—	—
Mandapam	280.1	14.5 (Boat day)	h, b, f	12, 6, 8	—	—	—	—
Madras	216.0	3.0 (hour)	a, e, g	9, 8, 10	—	—	—	—
Kakinada (aa)	860.0	3.3 (hour)	a, c, d	8, 9, 11	231.7	—	d, c, a	—
Waltair	659.7	3.5 (hour)	c, e, g	9, 11, 8	—	—	—	—
Puri	—	—	—	—	107.9	0.3 (Gill net)	a, f, b	9, 1, 10

\* a = *M. dobsoni* d = *M. brevicornis* g = *P. monodon*  
 b = *M. affinis* c = *P. indicus* h = *P. semisulcatus*  
 e = *M. monoceros* f = *P. merguensis* i = *P. stylifera*

\*\* Calendar Months

(a) January-September only

(aa) Offshore catch excluding January-February & May. Inshore Catch-October-December only.

8 Table 7. Estuarine prawn fishery at different centres during 1978

	Goa (Zuari es- tuary) At Dongri	Calicut (Korapuzha estuary)	Cochin (Cochin Backwaters)	Madras (Ennore estuary)	Kakinada (Godavari estuary) at B.V. Palem	Waltair (Champavati estuary) at Konada	Puri (Chilka Lake) at Arkakuda
Estimated catch in tonnes	1.9	76.8	1039.6	17.2	523.2	16.1	19.5
Catch/effort in Kg.	23.2*	12.6*	1.5**	—	5.4@ 5.5**	6.3*	0.6+
Fishing gears	Stake nets	Stake nets	Stake nets, cast nets, gill nets	Cast nets	Drag nets Stake nets	Drag nets	Drag nets
Important species	<i>M. mono- ceros</i> <i>M. dobsoni</i>	<i>M. dobsoni</i> , <i>M. mono- ceros</i> <i>P. indicus</i>	<i>M. dobsoni</i> , <i>P. indicus</i> <i>M. monoceros</i> <i>P. semisulcatus</i>	<i>P. indicus</i>	<i>M. monoceros</i> <i>P. indicus</i> , <i>P. monodon</i> <i>M. brevicornis</i>	<i>M. mono- ceros</i> <i>M. dobsoni</i> <i>P. indicus</i>	<i>P. indicus</i> <i>P. monodon</i> <i>M. monoceros</i>

\* Catch/net

\*\* Catch/net for stake nets

@ Catch/net for drag nets

+ Catch/hour

Females outnumbered males at Mangalore and Puri. Percentage of mature females was high during February-April and October-December.

*P. merguensis*: The species formed one of the important components of the prawn catch at Puri especially during September-October. The mean length was 154.8 mm and 167.00 mm for males and females respectively. Peak spawning was noticed during February and October-November. The species was reported to occur in appreciable quantity at Mandapam Camp during the first quarter and at Goa during March and December.

*P. monodon*: This was of commercial importance on the east coast particularly at Madras, Kakinada and Waltair. The mean length of the species exploited by gill nets at Puri was 180.8 mm and 203.8 mm for males and females respectively.

*M. dobsoni*: This species was chiefly exploited between Goa and Cochin on the west coast and at Madras and Kakinada on the east coast. The mean length showed a significant increase at Mangalore whereas a downward trend was indicated at Calicut particularly, for males as seen below. At Goa, the average size was comparatively small. Peak spawning was during November-December.

Centre	Mean size (mm)			
	1978		1977	
	Male	Female	Male	Female
Calicut	75.0	91.6	77.4	92.4
Mangalore	74.2	87.8	71.9	82.6
Goa	70.1	81.6	—	—

*M. affinis*: The fishery for the species at Mangalore showed an improvement. The mean length for males and females was respectively at 101.4 mm and 113.5 mm at Mangalore and at 123.3 mm and 132.9 mm at Puri. Percentage of mature females was high during December and January at the above respective centres.

*M. monoceros*: Though the fishery suffered a decline at Mangalore and Calicut, the mean length increased at the former centre, whereas it decreased at Calicut as shown in the following table.

Centre	Mean size (mm)			
	1978		1977	
	Male	Female	Male	Female
Calicut	116.1	132.8	116.8	137.5
Mangalore	118.4	138.0	113.9	131.6

Peak period of breeding was during February-April.

*P. stylifera*: This was an important species exploited all along the west coast. It was also caught in appreciable quantities at Kakinada. The fishery dwindled at Cochin, Calicut and Goa during the year as compared to 1977. However, there was no difference in the mean length at Calicut. At Mangalore, the species supported a good fishery and recorded significant increase in the average size. Percentage of mature females was high during April-June and November-December.

Centre	Mean size (mm)			
	1978		1977	
	Male	Female	Male	Female
Calicut	80.3	85.1	80.1	85.0
Mangalore	79.9	95.1	77.8	89.2
Goa	77.7	93.4	—	—

#### *Work contemplated*

This is a continuing project. It is proposed to make a comprehensive evaluation of the fishery with special reference to fishing effort, size distribution and dynamics of the resources at selected centres under a new project.

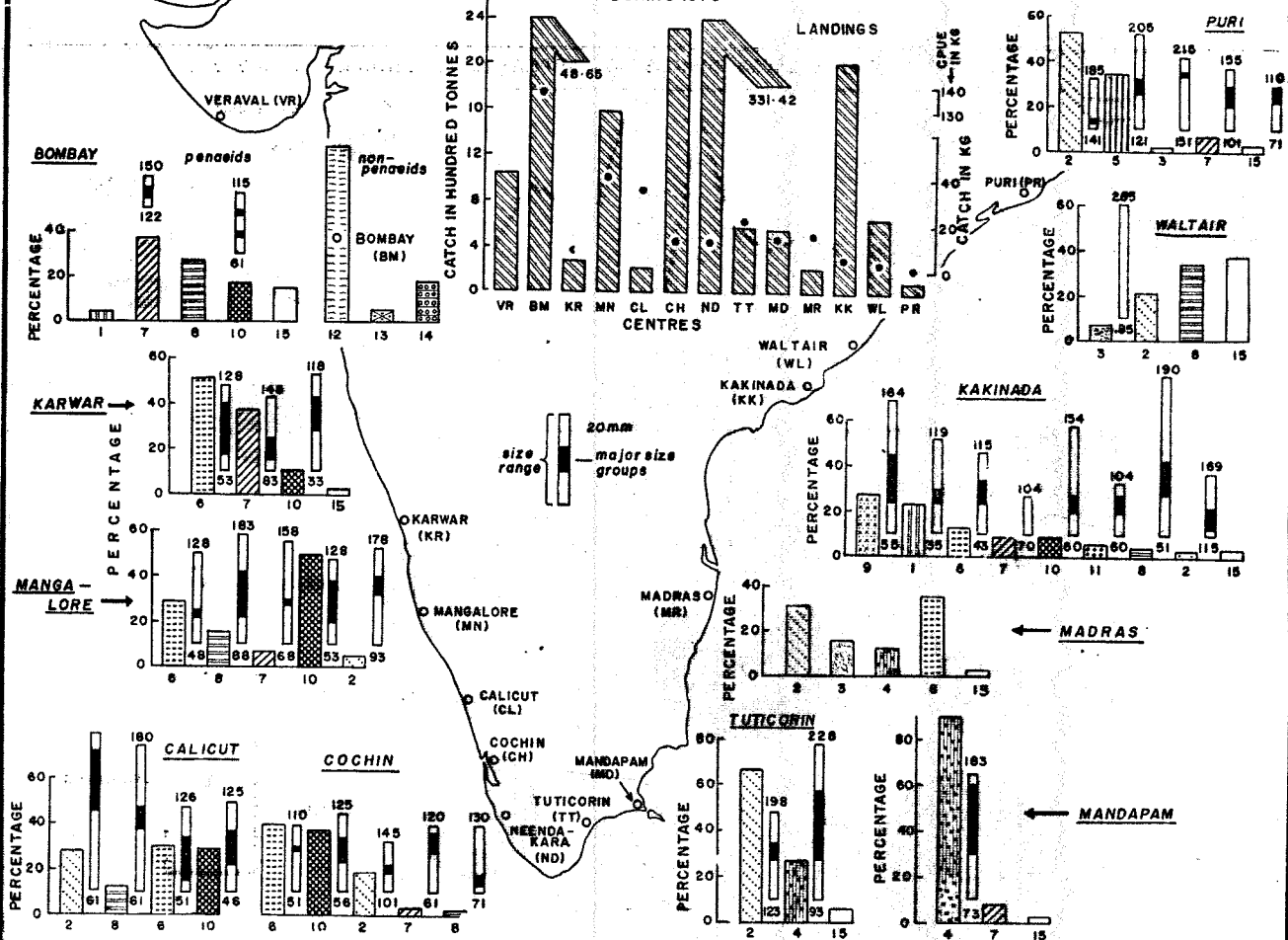
#### **Assessment of non-penaeid prawn resources (CF/RE/1.1b)**

M. Mydeen Kunju; J. P. Karbhari; V. D. Deshmukh; V. S. Kakati; G. Sudhakar Rao; S. Lalitha Devi; and K. N. Rajan.

#### *Salient findings*

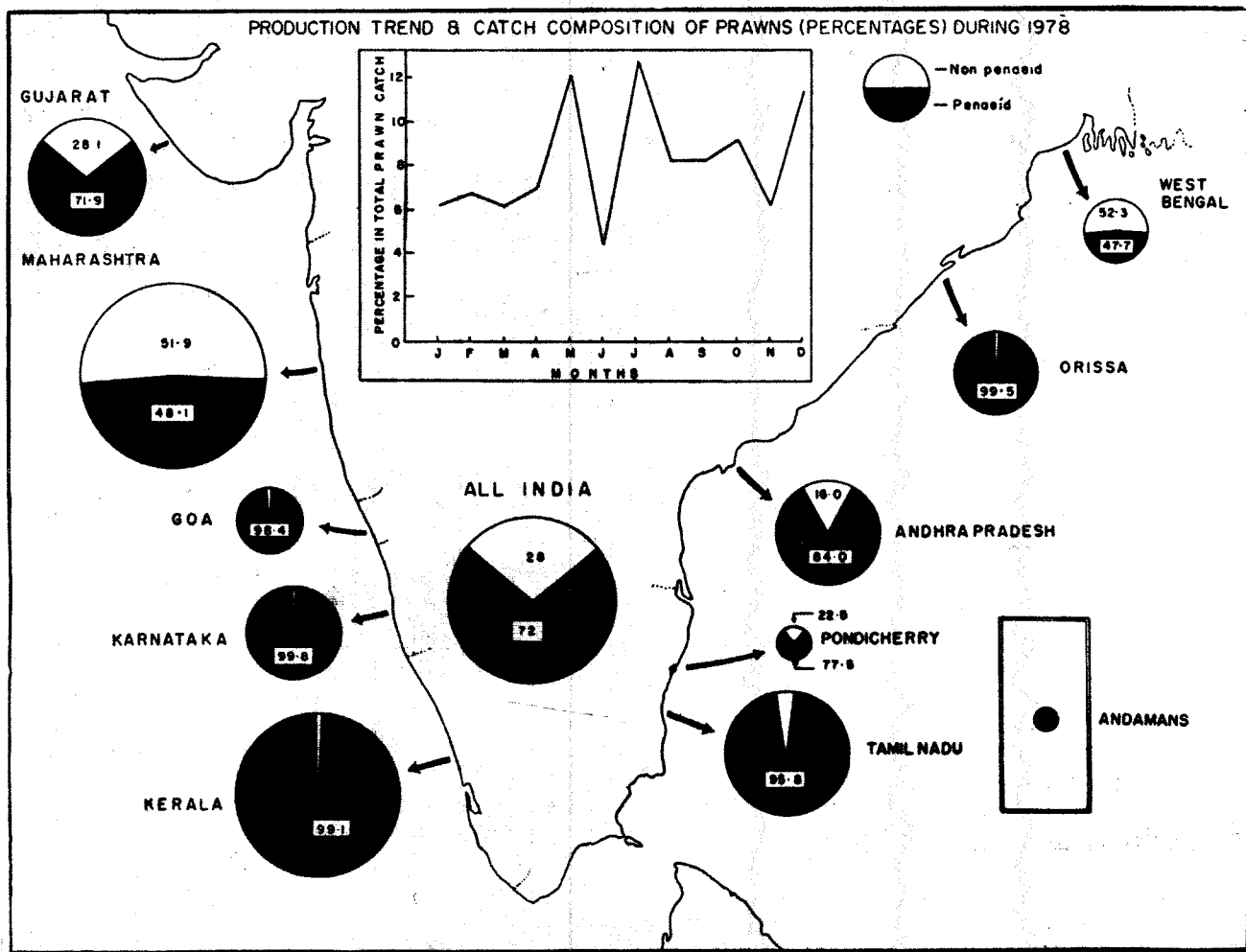
A noteworthy feature of the non-penaeid prawn fishery of the west coast of India was the revival of the fishery for the giant

LANDINGS, SPECIES COMPOSITION & SIZE DISTRIBUTION OF PRAWNS AT SELECTED CENTRES DURING 1978



1. *S. crassicornis*, 2. *P. indicus*, 3. *P. monodon*, 4. *P. semisulcatus*, 5. *P. merguensis*, 6. *M. dobsoni*, 7. *M. affinis*, 8. *M. monoceros*, 9. *M. brevicornis*, 10. *P. stylifera*, 11. *P. hardwickii*, 12. *A. indicus*, 13. *H. ensirostris*, 14. *P. tenuipes*, 15. others

Fig. 16 Annual landings species composition and size distribution of prawns at selected centres during 1978



*Fig. 17 Monthly production trend and catch composition of prawns during 1978*



brackish water prawn, *Macrobrachium rosenbergii* in the Pampa river system and Cochin Backwaters. During April-June, the catch rate varied between 20 kg and 300 kg per day. At Kakinada, on the east coast, the non-penaeids, particularly *Palaemon tenuipes* and *Acetes indicus* contributed to considerable portion of the prawn catch landed by the mechanised fishing vessels. Reduction of mesh size of the cod end of trawl nets operated in this region was found to be one of the contributing reasons for the dominance of non-penaeids in the catch.

#### *Work done*

The total estimated non-penaeid prawn landings at Veraval were 190 tonnes, entirely caught by a type of trawl net, locally known as 'Hull'. November recorded the highest catch.

At Bombay, the biology and fishery of the non-penaeid prawns were studied from Versova and Sassoon Docks. Fixed bag net ("Dol") was the gear operated at both the centres. The total landings were estimated at 2,142 and 1,218 tonnes at Versova and Sassoon Docks respectively. *A. indicus* was the dominant species contributing to the fishery at these centres. Juveniles of *P. tenuipes* were caught along with *A. indicus* at Sassoon Docks. Similarly, juveniles of *Hippolytina ensirostris* were landed only at Sassoon Docks in November. Food and feeding habits of *P. tenuipes* and *H. ensirostris* were studied by examining the stomach contents. The food items in the gut contents of *H. ensirostris* consisted of remains of *A. indicus*, crustacean larvae, polychaetes, and fish remains, whereas, in *P. tenuipes*, they were composed of detritus, and fish and crustacean remains. *H. ensirostris* was found to be hermaphrodite and the number of eggs carried by the female was found to vary from 924 to 3,134 in specimens ranging from 49 mm to 83mm in size.

There was practically no fishery for non-penaeid prawns in the Cochin Backwaters in the first quarter (January-March). However, the second quarter registered an appreciable fishery for *Macrobrachium rosenbergii*. In the centres north of Thanneermukkom Bund, the total catch during the season, was of the order of 20 kg/day, while in the south of the bund, the catch rate ranged from 200 to 300 kg/day. The fishing gradually declined as the season advanced to the third quarter. The size of the species ranged from 104 to 295 mm. Berried females were absent in the last quarter. *M. idella* subscribed substantially to the non-penaeid

prawn fishery of the Cochin Backwaters in the third quarter, the catch rate being 20-100 kg/day. As the season advanced from July to September, the percentage of berried females increased to reach as much as 85% by September.

At Kakinada the non-penaeid prawn landings by the mechanised fishing vessels were estimated at 224 tonnes. Heavy catches were recorded during July-October, when they contributed to 48 to 74% of the total prawn catch. *A. indicus*, followed by *P. tenuipes* and *H. ensirostris* constituted the main species contributing to the fishery. One of the main reasons for the increased catches of such small-sized non-penaeid prawns in the trawl nets observed during the last two years could be due to the reduction of cod end mesh size of the nets. However, detailed studies on the subject is progressing.

In the backwaters of Kakinada, the non-penaeids formed a small fishery in June-July and in November-December. A minor fishery for *M. idae* and *M. malcolmsonii* was also reported from the Chilka Lake.

#### *Work contemplated:*

The Research Project would be continued in 1979 from Veraval, Bombay, Cochin and Kakinada. As the non-penaeid prawns form only a sustenance fishery at Puri, the project would be discontinued from this centre. It is proposed to include Junput and Jamnagar centres under the project as and when the research and technical staff are made available.

#### **Assessment of prawn resources in the nursery grounds (CF/RE/1.1c)**

C. Suseelan; P. A. Thomas; K. Y. Telang; S. Ramamurthy; K. K. Sukumaran; K. Koumudi Menon; M. Kathirvel; V. S. Kakati; K. N. Gopalakrishnan; S. Lakshmi; K. Chellappan; Jacob D. Eapen; A. C. Sekhar; P. E. Sampson Manickam; M. V. Somaraju; G. Sudhakar Rao; S. Lalitha Devi; K. N. Rajan and P. V. K. Rao.

#### *Salient findings*

The year witnessed better prawn fishery in the major nursery grounds except at Cochin where the stake net fishery declined to the tune of 36% from that of the previous year. *M. monoceros*

was the principal species supporting the fishery at Goa, Kakinada and Waltair, *M. dobsoni* at Calicut and Cochin and *P. indicus* at Madras and Puri. While the size composition of these species in all the nursery grounds on the west coast and of Madras and Puri was more or less similar, it was composed of relatively small sized prawns in the nursery grounds of Andhra Pradesh coast.

### *Work done*

Studies on the resources and biology of penaeid prawns in the nursery areas were carried out at Goa, Mangalore, Calicut, Cochin, Madras, Kakinada, Waltair and Puri. The commercial prawn fishery was generally active and the catches showed improvement at all centres except at Cochin. The catch estimates and important species exploited at different centres are shown in Table 7

**Goa:** With an estimated catch of 1.9 tonnes by stake nets at Dongri, the prawn fishery of Zuari estuary extended from June to December. The peak catch was recorded during August-September. *M. monoceros* (56%) and *M. dobsoni* (42%) constituted the fishery with peak abundance of the former during June-July and the latter in August and December.

**Mangalore:** The experimental shore-seine operations conducted at Mangalore revealed lesser abundance of prawns in the estuarine environments when compared with the previous year. *M. dobsoni*, mostly in the size range 33-48 mm, predominated in the catches (56.2%) followed by *P. indicus* (17.7%) and *M. monoceros* (9.7%). Fresh recruitment of *M. dobsoni* (28 mm) was observed in May and *P. indicus* (23 mm) in October.

**Calicut:** In Korapuzha estuary the overall prawn production was slightly better this year (76.8 t.) although the catch per effort decreased from 13.3 kg/stake net in 1977 to 12.6 kg in 1978. As usual, juveniles of *M. dobsoni* (42%) dominated in the fishery, followed by *M. monoceros*, *P. indicus* and *P. monodon*. Relatively higher landings were recorded for all these species in the first half of the year. Experimental fishing conducted by specially designed drag nets in December revealed the occurrence of early juveniles of *P. indicus* more abundantly near the shore than in the channel areas of the estuary.

**Cochin:** The prawn production from Cochin backwaters amounted to 1,039.6 tonnes combinedly by stake nets (88%), cast nets (10%)

and gill nets (2%). The stake net catch showed a declining trend with a reduction to the tune of 36% from that of the previous year. A similar failure was also noticed for the gill net fishery, while the catches of cast nets remained moderate during major part of the season. The peak landings for all the gears were recorded during February-April. *M. dobsoni* (68%) was the mainstay of the stake net fishery, followed by *M. monoceros* (14%), *P. indicus* (13%) and others. Larger juveniles of *P. indicus* contributed to 75% of the cast net and 99% of the gill net catches. The occurrence of *P. semisulcatus* and *P. canaliculatus* in fair quantities in the fishery during premonsoon period is noteworthy.

Recruitment of postlarval prawns (mostly *M. dobsoni*) into the backwater remained weak except during January and November-December. Veilon screen net sampling of the juvenile population indicated good concentration of *P. indicus* during March-May and November-December with peak in the former period.

**Madras:** From Ennore estuary, it was estimated that 17.2 tonnes of prawns were fished mainly by cast nets with peak landings during the fourth quarter. *P. indicus* was the principal species throughout the year, followed by *M. monoceros* and *M. dobsoni*.

**Kakinada:** In the backwaters connected to Godavari estuary the total prawn production was better this year although the first three quarters registered lower landings over the previous years catch. At B. V. Palem, the total landings were estimated at 523.2 t, as against 236 t. of the previous year. The catch/effort, however, showed a remarkable decline. Over 63% of the catch was obtained during the fourth quarter. Drag nets accounted for 56% and stake nets 44%. *M. monoceros* formed the major component of the fishery contributing to about 52% and 43% of the drag net and stake net catches respectively. *P. indicus*, *P. monodon* and *M. brevicornis* were the other important species caught.

Experimental fishing conducted during different tidal phases indicated maximum abundance of prawns during night low tide.

**Waltair:** In Champavati estuary drag net fishing was fairly active throughout the year and landed an estimated catch of 16.1 tonnes with maximum production during August-November. As at the previous centre, *M. monoceros* (40%) was the principal

species with peak abundance during September. Other major species were *M. dobsoni* (38%) and *P. indicus* (22%).

*Puri:* With an estimated catch of 19.5 tonnes landed at Arkakuda, the prawn production in Chilka lake showed considerable improvement. The fishing season extended from April to August with peak landings in June. *P. indicus* (55.4%) and *P. monodon* (28.4%) formed the mainstay of the fishery and were caught mostly during May-July. *M. monoceros* accounted for a sizeable portion from June to August.

*Size distribution and recruitment:*

*M. monoceros* was predominantly represented by the size group 51-95 mm at most of the centres except at Kakinada and Waltair where still smaller size groups 31-65 mm dominated in the fishery. Recruitment of smaller individuals into the fishery was noticed during June and November-January on the west coast centres, while it was during April, July-September and December in Andhra Pradesh, and May-June and December at Puri. The major exploited size of *M. dobsoni* was 36-75 mm. In the stake net catches of Cochin Backwaters its mean sizes ranged from 44.0 mm to 54.5 mm with fresh recruitment during April-June. The dominant sizes of this species in Korapuzha estuary was slightly higher (51-70 mm) than in Cochin Backwaters particularly during August-November, while at Waltair the modal size in drag net catch belonged to 21-45 mm. The principal size of *P. indicus* in the fishery was generally at 91-120 mm. At Kakinada and Waltair, however, smaller individuals of the species (21-80 mm) constituted the bulk of the landings during the major part of the year. The principal size group of the other important species exploited were 110-165 mm for *P. monodon*, 81-105 mm for *P. semisulcatus* and 45-63 mm for *M. brevicornis*.

*Work contemplated*

This is a continuing project and the data will be collected as per the approved technical programme.

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

P. V. Kagwade; J. P. Karbhari; K. K. Balasubramanian;  
M. Kathirvel; S. Shanmugam; K. M. S. Ameer Hamsa;  
E. V. Radhakrishnan and W. Venugopalam.

### *Salient findings*

The lobster fishery of the Saurashtra coast was relatively of lesser magnitude during the year as compared to that of the previous year. Similar trend was also recorded at the Mandapam area on the south-east coast. However, at Bombay, Calicut, Tuticorin and in the Kanyakumari District, the fishery was better with improved landings. The species composition of the catch and the biological characteristics of the important species at different centres did not show any appreciable deviations from those observed in the earlier years.

The crab fishery at Veraval, Mandapam Camp and Kakinada was generally better in 1978 than of 1977.

### *Work done*

#### *a) Lobster fishery*

Estimated lobster landings at different observation centres are given in Table 8.

**Table 8:** *Lobster landings at different observation centres in 1978 and 1977.*

Centre	Estimated lobster catch (tonnes)	
	1978	1977
Veraval	160.8	360.7
Bombay	163.8	146.7
Calicut	2.1	1.5
Kanyakumari District	40.9	26.1
Mandapam Camp	2.5	15.9
Tuticorin	15.9	3.8
Madras	6.2	—

As in the previous year, the Saurashtra and the Bombay coasts continued to be the major lobster fishing area, relegating the Kanyakumari District to a secondary position. Nevertheless, the lobster catch at Veraval registered a fall of about 55% from that of 1977. On the contrary, the fishery in the Kanyakumari District showed an improvement of about 58% over the landings of the previous year. While a fourfold increase in the lobster catch was recorded in Tuticorin, it was lower by about 6 times of the last year's catch at Mandapam Camp.

*Panulirus polyphagus* was the dominant species in the fishery of the Gujarat and Maharashtra coasts; at Calicut, Kanyakumari District, Tuticorin and Madras, *P. homarus* was principal species, while at Mandapam *P. ornatus* contributed to the fishery.

The size of *P. polyphagus* ranged from 93 mm to 360 mm. There was no marked difference in the size range of *P. homarus* from centre to centre, the range being from 100 mm to 288 mm. *P. ornatus* measuring between 135 mm and 375 mm supported the fishery at Mandapam.

Berried females of *P. polyphagus* and *P. homarus* were encountered throughout the fishing seasons. At Bombay, the percentage of berried females of *P. polyphagus* was varying between 25 and 51. At Calicut, berried females of *P. homarus* were scarce in November and thereafter their percentage increased. Maximum number of berried females were encountered at Tuticorin in October. The size of the smallest specimen of berried *P. homarus* encountered in the catch at Madras was 135 mm.

The sex ratio distribution showed the dominance of males of *P. polyphagus* in the fishery of the early part of the year at Bombay while it was 1:1 in *P. homarus* at Madras and Tuticorin.

The deep-sea spiny lobster, *Puerulus sewelli*, was landed at Cochin only in February, when one of the vessels of the Integrated Fisheries Project was operated for the purpose. The total catch realised was 5.9 tonnes as against 12.4 tonnes in 1977. The size of the lobster ranged from 98 mm to 187 mm in total length. The dominant size mode for female and male was noticed at 141-145 mm and 116-120 mm respectively. Females were predominant with about 63% in berried condition. The important food items as revealed from the gut content analysis were the remains of prawns and fishes, foraminiferans and molluscan shells.

#### b) Crab fishery

The estimated crab landings at Veraval was 61.9 tonnes, at Kakinada 71.8 tonnes, and at Mandapam 157.9 tonnes. *Portunus pelagicus* was the principal species supporting the fishery at Kakinada and Mandapam Camp. Small quantities of *Scylla serrata* were also caught in the former centre.

The size of *P. pelagicus* at Mandapam ranged from 85 mm to 190 mm. Although the berried females were encountered

almost throughout the fishing season, higher percentage was observed in February (46.9%), April (50.5%) and June (44.3%).

*Work contemplated*

The project would be continued in 1979. As Mangalore is one of the important crab fishing centres, it is proposed to take up the work from this centre also by strengthening the staff.

**Prawn fishery Atlas (CF/RE/1.4)**

E. G. Silas; S. K. Dharmaraja; K. Rangarajan; I. David Raj and others.

*Work done*

Relevant data on prawn resources and their fisheries were collected, analysed and maps and charts were drawn and added to the model copy prepared earlier.

*Work contemplated*

The model copy will be finalised.

**Genetic resources of the commercially important prawns**

M. M. Thomas; N. S. Kurup; C. Suseelan and M. Kathirvel

*Work done*

This research project was started during the year under report to identify the natural unit stocks, if any, in the populations of the commercially important species of prawns and to determine whether there is any intermixing of the units in the fishery at different regions of the coast.

Two commercial prawns, namely, *P. indicus* and *M. dobsoni* were selected for detailed studies on the various morphological features. Arrangements were made to obtain monthly samples of 25 prawns of each of the species from Bombay, Panaji, Karwar, Mangalore, Calicut, Tuticorin, Kakinada, and Puri. Twentyfive samples thus received from the different centres during June-December were analysed for 15 characters of body measurements and weight and the data were maintained.



### *Work contemplated*

The project would be continued. In addition to the collection of morphometric data, electrophoretic studies will also be initiated to identify the unit stocks.

### **Assessment of Stomatopod resources (CF/RE/1.7)**

P. V. Rao, P. K. Martin Thompson; M. Ayyappan Pillai and K. Koumudi Menon.

### *Salient findings*

Estimated landings of the stomatopod, *Oratosquilla nepa* by the small mechanised fishing vessels operating bottom trawl nets at Cochin was 392.2 tonnes. The size of the species ranged from 26 mm to 120 mm in males and from 31 mm to 120 mm in females. Except in February, April and December, males dominated the catch. Mature females were encountered throughout the year, but the peak spawning season was observed during April-May.

### *Work done*

Stomatopods form an important constituent of the catch of the small mechanised fishing vessels operating in the inshore waters. The total catch of the stomatopods landed at Cochin in 1978 was estimated at 392.2 tonnes. At Calicut, about 40.5 tonnes of these crustaceans were caught between March and December. The highest catch recorded at Cochin was in January, (93.2 tonnes, 10.0 kg/hr) and in the subsequent months up to June, its abundance varied between 39.3 to 57.8 tonnes. From the second half of August to the end of October, the stomatopod catch was negligible and it appeared again in appreciable quantities from November onwards. The catch was principally composed of *Oratosquilla nepa* ranging in size from 26 mm to 120 mm in males and 31 to 120 mm in females. The sex-ratio distribution of the species in different months showed predominance of males in February, April and December and of females in the other months. Mature females were encountered throughout the year, but the peak spawning season was found to be during April-May.

### *Work contemplated*

The project would be continued to collect adequate data to study the biological population characteristics of the stomatopod and its resources.

### **Intensive culture of marine prawns (CF/CUL/1.1a)**

P. V. Rao; S. Ramamurthy; M. M. Kunju; M. S. Muthu; N. N. Pillai; S. K. Pandian; M. Rajamani; A. Laxminarayana; C. M. James; K.A. Narasimham; G. Sudhakar Rao; V. Sriramachandra Murty; S. Shanmugam; G. Nandakumar; K. K. Sukumaran; M. Kathirvel; C. P. Ramamirtham; Syed Ahamed Ali; M. Ayyappan Pillai; C. Thankappan Pillai and K. K. Balasubramanian.

### *Salient findings*

Results of a series of experiments carried out on intensive culture of *P. indicus* during the monsoon and the rest of the season in the Cochin region indicated that the growth, production and quality of prawns were better in those cultured in the post and pre-monsoon months, when the environmental conditions particularly the salinity of the pond water were stable. In the monsoon months, when the ecology of the prawn farms was disturbed due to lowering of salinity, and consequent changes, the prawn became "soft". This condition adversely affected the growth, production and survival of the prawns in the field. Some physiological imbalance leading to non-protein nitrogen (NPN) accumulation, non-availability of proper food and susceptibility of prawns to disease caused by a species of *Vibrio* in such an environmental and biological stress were put forward as probable reasons for the "soft" condition.

### *Work done*

Seven field culture experiments with *P. indicus*, two with *P. monodon* and one each with *P. semisulcatus* and *M. dobsoni* were carried out in the experimental ponds at Narakkal during January 1978 through September 1978. Seeds collected from the wild as well as those obtained through laboratory rearing experiments were stocked in the fields and their growth and well being were regularly monitored. Up to the end of March, the stocked prawns showed normal growth and were in healthy condition.

In April, some of the prawns in the experimental fields were found to be "soft". As the season advanced the number of "soft" prawns increased, particularly when the salinity of the pond water started decreasing due to monsoon precipitation. Following this, high mortality rate, low growth in the stocked prawns and poor yield were recorded in all the fields. The salinity, and dissolved oxygen content of the pond water, and the mud chloride values in different seasons were as follows:

Season	Salinity (‰)	Dissolved oxygen (ml/L)	Mud chloride (gm/1000 gm)
Mid June	3.5-3.8	9-12	3.5-10.4
Late August	1.4-1.9	3.7-5.1	1.0- 4.8
Mid September	1.0-1.4	3.4-5.5	1.0- 3.8
November	2.0-2.2	3.5-5.5	1.8- 3.2

Comparative analysis of total nitrogen (TN), nonprotein nitrogen (NPN) and protein nitrogen (PN) of the "soft" and "healthy" prawns were undertaken. While no appreciable difference in TN and PN in "soft" and "healthy" prawns was observed, the NPN was found to vary from 3.18 to 3.43% in "soft" prawns as against 2.59 to 2.74% in "healthy" prawns. This indicated that some physiological imbalance leading to NPN accumulation occurred when the prawns became "soft". Further studies on this aspect are progressing.

Pathological investigations undertaken on the "soft" prawns revealed that this condition was mainly brought out by the attack of a species of *Vibrio* which affected both the muscle and the exoskeleton of the prawns. In the healthy prawns, the indigenous bacterial flora of *P. indicus* and *P. monodon* were found to contain a bacterial load of  $1.2-4.5 \times 10^5$  in the exoskeleton;  $1.1-8.6 \times 10^4$  in muscle;  $2.2 \times 10^5-1.5 \times 10^6$  in stomach and  $1.2-5.6 \times 10^5$  in the gut. Further, luminescent bacteria were predominant in these species in August.

The demonstration project on intensive culture of prawns initiated in October last year in a perennial field at Kannamaly near Cochin was completed in March 1978. The demonstration was carried out in a field 0.23 ha. After eradication of undesirable and predatory organisms from the field, the seeds of *Penaeus indicus* and *Metapenaeus dobsoni* collected from the brackish water canals in the Vypeen Island were stocked at the rate of 1,15,000

per ha, between 15th and 16th November, 1977. The size of prawn seed at the time of stocking ranged from 10 mm to 30 mm total length. Observations on the salinity, temperature and dissolved oxygen of the farm water were made throughout the period of culture operation (Table 9). Regular sampling of prawns was carried out after a month of stocking to follow the feeding activities and growth of the stocked prawns.

**Table 9.** *Monthly range of salinity, temperature and dissolved oxygen of the farm water during the period of culture operation (26.11.'77 to 27.3.'78)*

Month	Salinity (‰)	Temperature (°C)	Dissolved oxygen (ml/L)
November	0.45- 4.50	33.2-34.5	2.96-5.19
December	4.89- 6.82	32.5-33.4	5.21-8.10
January	7.2 -12.32	32.3-32.8	4.32-6.40
February	15.31-21.38	32.6-33.1	4.50-5.12
March	21.12-21.39	33.2-33.5	4.00-5.60

Since the farm water was found to be very productive, the entire culture operation was carried out without giving any artificial feed.

Harvest of stocked prawns was carried out on 28.3.'78 (i.e. after 122 days of initial stocking). The total yield was 89.9 kg, constituted by 14.1 kg of *P. indicus* of above 10 cm size, and 33.0 kg of *M. dobsoni* and *P. indicus* of less than 10 cm., 2.2 kg of *P. monodon* and 40.5 kg of fishes composed of mainly *Ambassis* sp., mullets, *Etroplus* sp., *Elops* sp., *Megalops* sp., *Gerres* sp., and *Arius* sp.

The percentage of survival of prawns was 35.6. During a period of 122 days of culture, *P. indicus* grew from a size of 23 mm to 123 mm and *M. dobsoni* from 23 mm to 83 mm (Fig. 1). The total value of the yield of prawns was Rs. 632.90.

The result of the experiment was not to the expected extent mainly due to the adverse effects of unprecedented rains and consequent breach of the small canal on the southern part of the farm causing overflow of fresh water and entry of undesirable fishes such as *Elops* sp. and *Ambassis* sp.

The second experiment in the same pond was started from 18.4.1978. The pond was slightly deepened and was stocked with 25,682 seed of *P. indicus* of size 11-33 mm. The stocked prawns registered a growth of 30 mm. during a period of 73 days. Thereafter, the growth was found to be very slow due to lowering of the salinity of the pond water. Most of the large size prawns were found to be very "soft" when the low saline conditions prevailed in the pond.

In order to create an interest in intensive culture of selected species of prawns among the prawn farmers, demonstrations were undertaken in two farmers' fields at Narakkal. In a 0.33 ha canal 35,644 *P. indicus* seed ranging in size from 22 mm to 57 mm were stocked in May 1978. In July when the salinity of the canal waters reached 1.79‰, most of the prawn showed "soft" condition. Harvesting of prawn was carried out on different days during October-December, when a total production of 44 kg was realised. In a 0.6 ha canal, 70,000 *P. indicus* seed (31-35 mm size) were stocked in May 1978. In this field also heavy mortality of prawns were registered when they became "soft".

*P. monodon* was cultured in the salt pan reservoirs at Kakinada. The experiments were carried out in two ponds as detailed in Table 10.

**Table: 10** Details of culture experiments on *P. monodon* carried out at Lakshmipathipuram (Kakinada)

Particulars	Pond-B	Pond-A
Pond area	0.20 ha	0.26 ha
Period of stocking	12.2.78 to 28.2.78	26.1.78 to 28.1.78
Nos. stocked	10,000	7,800
Stocking rate	50,000/ha	30,800/ha
Size at stocking	56-103 mm	32-96 mm
Mean size at stocking	79.42 mm	67.15 mm
Size at harvest	100-164 mm	102-163 mm
Mean size at harvest	143.5 mm	125.5 mm
Duration of culture	201 days	224 days
Growth increment	64 mm	58.4 mm
Harvest wt.	53.4 kg	58 kg

**Table 10 (Contd.)**

Production/ha	267.0 kg	223.1 kg
Nos./kg	44	62
Nos. harvested (estimated)	2350	3596
Survival rate	23.5%	46.1%
Expenditure (Rs)		
(Cost of seed and feed)	562	467
Income (Rs)	1441	986
Profit (Rs)	879	519

The prawns in the two fields A & B, were fed with the compounded feed made up of groundnut oil cake, rice bran, tapioca powder and fishmeal in the ratio of 2:2:1:1 at a rate of 0.84 and 0.65 gm per prawn per week respectively.

At Mandapam Camp, 2145 juveniles of *P. indicus*, 100 *P. semisulcatus* and 5 *P. monodon* were stocked in a pond of 0.045 ha area. The seawater was pumped into the pond so as to maintain a minimum water column of 0.75 m in the pond. The prawns were fed with the clam meat during the first month of the culture operation and thereafter clam meat and trash fish. After five months, the pond was harvested to realise an yield of 10.42 kg indicating a production of 232 kg/ha/5 months. During the period of culture, *P. indicus* grew from 23.2 mm to 120.6 mm and *P. semisulcatus* from 14.0 mm to 88.5 mm. The percentage of survival in the former species was 44 and in the latter 49.

At Mangalore, the culture experiment started in December 1977 at Coondapur was discontinued due to the non-availability of the field. Subsequently, four pens constructed by bamboo screen were erected in the state fish farm at Mulki and these were seeded with *P. indicus*. The experiment is progressing.

Several prawn farms in the Central Kerala were surveyed and the prawn farmers were provided with technical advice on prawn culture.

#### *Work contemplated*

The project would be continued to obtain more data on techno-economic feasibility of intensive culture of selected species of prawns and to demonstrate the same to the prawn farmers.

## Mass production of prawn seed (CF/CUL/1.1b)

M. S. Muthu; N. N. Pillai; A. Laxminarayana;  
S. K. Pandian; M. Rajamani; C. Merylal James;  
C. P. Gopinathan; M. M. Kunju; K. K. Balasubramanian;  
K. Devarajan; V. Selvaraj and J. Sunny Nayagam.

### *Salient findings*

Unilateral eye-ablation technique was successfully employed for the first time in the country to induce gonadal maturation and subsequent spawning in *P. indicus*, *M. dobsoni* and *P. stylifera* under controlled conditions. After the ablation of the eye-stalk, the ovary of all the species developed rapidly to reach the fully mature condition and to spawn within 12-20 days. Experiments carried out on rematuration of the spent females through eye-stalk ablation indicated that the ovary of *P. indicus* and *P. stylifera* rematured and attained the final stage of maturity within 10-12 days, while that of *M. dobsoni* after 15 days. Techniques of mass rearing of larvae of *P. indicus* to stocking size providing suitable environment and feed at different larval stages were further perfected. Preliminary experiments on the tolerance of *P. monodon* to low saline conditions indicated that the juveniles of the species, in the medium having a salinity value of 0.5-0.6‰, were actively feeding and moulting, but died when the salinity was lowered to 0.1‰.

### *Work done*

A series of experiments were carried out during the year to perfect techniques of mass rearing of larvae of the marine prawns, particularly *P. indicus* (Table 11). Since the main objective of these experiments was to evolve a viable sequence of operation from spawning through rearing of different larval stages to stocking size by providing the necessary medium, live food organisms (Phytoplankton, Zoo-plankton, *Artemia* nauplii etc.) and compounded feeds, the results of the experiments belie the valuable information gathered. The spawners were fished by short trawl net hauls of 10-20 minutes duration operated at a depth of 6-30 m in the inshore sea and were transported to the laboratory. The spawners were kept individually to spawn in 50 litre-capacity basins. After spawning and hatching of nauplii, they were transferred to plastic pools containing 250 litres of filtered seawater. In certain experiments, the sea water was fertilised to facilitate diatom blooms

**Table 11.** *Details of spawning and rearing experiments on P. indicus.*

Expt. No.	Date of spawning	Spawner's size		Number of larvae in each stage				
		Total length (mm)	Weight (gm)	Nauplius	Protozoaea (No.)	Mysis (No.)	Post larvae (No.)	Juvenile (No.)
1.	13. 1.'78	147	25	14,495	...	...	10,920	21
2.	10. 2.'78	144	22	...	26,105	18,680	...	1,190
3.	22. 2.'78	140	20.75	1,78,890	...	...	...	7,342
4.	24. 2.'78	138	21	84,240	...	...	...	5,560
5.	3. 4.'78	140	19	25,000	19,430	13,294	...	...
6.	20. 6.'78	172	36.4	82,422	...	...	...	...
7.	21. 6.'78	161	35.4	31,692	8,800	...	...	...
8.	21. 6.'78	173	43.1	84,588	55,600	...	...	...
9.	28. 6.'78	...	...	10,280	899	...	...	...
10.	1.12.'78	185	39	1,41,059	58,996	...	...	...
11.	9.12.'78	...	...	1,69,728	67,076	...	...	...
12.	8.12.'78	182	39.5	57,792	5,618	...	...	...
13.	8.12.'78	142	19	63,744	21,206	...	...	...
14.	8.12.'78	142	20	13,632	...	...	...	...
15.	8.12.'78	133	18	76,900	43,105	...	...	...
16.	9.12.'78	148	21	87,174	...	...	...	...
17.	12.12.'78	149	28	57,018	...	...	...	...
18.	2.12.'78	145	...	40,486	22,907	6,874	192	...



synchronising with the development of protozoa stage. Fresh filtered sea water was added periodically. The early protozoa sub-stages were fed with mixed culture of phytoplankton at a rate of 150-330 litres/day or pure culture of *Thalassiosira*. The later protozoal sub-stages and mysis stage were given mixed phytoplankton, supplemented with squid or prawn powder and rotifers. The post-larvae were fed with *Artemia* nauplii as well as compounded feed. Some of the experiments were seriously affected by the ciliate contamination.

During the rearing experiments, the salinity of the medium was maintained between 35 to 36‰. The temperature varied from 27.2°C to 30.8°C.

The seed produced from these experiments were partly stocked in one of the farmer's fields and in the experimental ponds at Narakkal.

Spawning and rearing experiments were also carried out in *M. dobsoni*. The highest survival rate from protozoa to juvenile stage recorded in the total of 10 experiments conducted was 61.8%.

Several consignments of seed of *P. monodon* and *P. indicus* were received from Madras and Waltair as a part of the programme to study the survival rate of the seed prawns during transportation. The seed were packed in polythene bags under oxygen packing and these bags were transported in card-board boxes with proper labels and instructions for handling. In these long distance transportation, some mortality occurred due to predation of weaker larvae by the stronger ones. The seeds thus obtained were acclimatised in the laboratory and reared for a further period feeding with mussel or clam meat before stocking in the experimental ponds.

Experiments were conducted to study the tolerance of *P. monodon*, to low saline water condition. The juveniles of the species were collected from the backwaters having a salinity of 12‰ and were subjected gradually to lower ranges of salinity. The results of the experiments indicated that they were actively feeding and moulting in salinities up to 0.5-0.6‰, but died in the medium having a salinity value of 0.1‰. Further experiments are in progress to confirm the observation.

After an interim assessment of the work carried out on spawning and rearing of larvae, intensive experiments were planned and organised on induced breeding of prawns, particularly on *P. indicus* and *P. monodon*. The problem was tackled by different ways. A set of experiments was carried out with mineral, vitamin and homeopathic supplement to accelerate gonadal maturation and spawning. The observations on the effect of these feed on maturation of the ovaries and testes are progressing. Another set of experiments carried out involved injection of the extract of the eye-stalk endocrine gland obtained from mature female prawns to sexually developing *P. indicus* and of the synthetic hormones. However, these experiments did not give the desired results.

Eye-stalk ablation technique to induce maturation was employed in *P. indicus*, *P. monodon*, *M. dobsoni* and *P. stylifera*. Both bilateral and unilateral eye stalk extirpation were experimented. Successful results were obtained from unilateral eye stalk ablation in all the species except *P. monodon*. Healthy prawns were selected for eye stalk ablation and after unilateral ablation, they were introduced into the plastic pools fitted with biological filters. The prawns were fed with *ad libitum* with mussel or clam meat. The unilaterally eye stalk ablated females became fully mature within 12-20 days after the operation and subsequently spawned. The results of experiments carried out on *P. indicus* are given in Table 12. It was noticed that in some of the experiments, the spawning was partial. The eggs liberated by the eye-ablated prawns underwent normal development producing normal and healthy larvae.

Rematuration of spent females by eye-stalk ablation was also successfully attempted. The results of experiments hitherto conducted indicated that the ovary of *P. indicus* and *P. stylifera* rematured and attained maturity within 10-12 days while that of *M. dobsoni* after 15 days.

#### *Work contemplated*

Investigation on induced maturation and spawning, and mass rearing of larvae with corollary studies on the culture of live food organisms and preparation of suitable artificial feed will be intensified to develop and perfect a suitable indigenous technique of hatchery production of seed of fast growing species of marine prawns.

**Table 12:** Details of experiments on eye-stalk ablation carried out on *P. indicus* and *M. dobsoni*

No.	Total length mm	Carapace length mm	Date of Eyestalk ablated	Date of spawning	Nature of spawning	Total number of eggs	Total number of nauplii	Hatching rate
<i>P. indicus</i>								
1.	160	37	1.11.78	14.11.78	Partial	15,180	Eggs unfertilised	—
2.	154	35	1.11.78	13.11.78	Partial	40,980	Eggs unfertilised	—
3.	145	33	20.11.78	2.12.78	Full	58,920	50,934	86.45%
4.	157	33	30.11.78	14.12.78	Full	29,328	Eggs unfertilised	—
5.	136	30	1.12.78	21.12.78	Full	1,27,420	84,762	66.52%
6.	140	31	1.12.78	21.12.78	Partial	13,640	2,280	16.72%
7.	138	31	1.12.78	21.12.78	Partial	10,624	2,082	19.6%
<i>M. dobsoni</i>								
1.	101	24	15.12.78	31.12.78	Full	58,871	57,291	97.32%
2.	100	26	15.12.78	31.12.78	Full	54,288	48,828	89.94%
3.	(FB)* 94	22	15.12.78	24.12.78	Full	17,784	11,981	67.4%

\*Rostrum broken

R. Marichamy; N. Neelakanta Pillai and M. Kathirvel.

*Salient findings*

Three types of cages, namely (1) basket type made of split-cane, (2) Box-Type fabricated with the soft wood and (3) metal framed net cage, were designed, fabricated and tested for the culture of the green crab, *Scylla serrata*. The metal framed net cage was found to be preferable as it was free from fouling organisms. Seed crabs measuring between 50 mm and 80 mm across carapace were cultured in these cages. The results indicated: (1) the crabs grow at a rate of 12-15 mm across carapace per month till they reach a size of 110 mm; (2) the crabs measuring above 115 mm carapace width grow at a slow rate of 5-6 mm across carapace per month and (3) they attain a marketable size of 145 mm-160 mm across carapace (400-500 gm weight) in about 9-10 months.

*Work done*

Researches on the culture of the commercially important crabs were carried out from Tuticorin and Cochin. Crabs can be cultured in impounded fields or in cages or net enclosures. At Tuticorin, experiments were carried out on the cage culture of crabs and in this connection, three types of cages were designed, fabricated and tested. The basket-type of cage was made of split canes woven closely to form a basket with a lid. Box-type cage of size 2 m x 1 m x 0.3 m was fabricated with soft wooden planks; each cage having 10 compartments of 0.3 m<sup>2</sup> area. Each of the compartments was provided with a lid and an opening at the top through which food was offered to the stocked crabs. These cages were arranged on the racks erected in the creek in such a manner that the top of the cage was above the water mark in the tide. Metal framed net cage was made of 6 mm thick mild steel rod frame, of 1-2 m x 0.6-1.0 m x 0.2 m x 0.2 m size, to which the synthetic twine netting having a mesh size of 10-15 mm, was attached. The cages were tied to bamboo poles erected in the creek and left in position by anchoring with heavy stones. About 5-7 crabs were stocked in the smaller cages, while in the larger ones about 25 to 30 crabs were cultured. Unlike the other two types of cages, the metal framed net cage had the advantage of not being fouled by the fouling organisms.

720 seed crabs measuring 50-80 mm across carapace were collected from the mangrove swamps and creeks around Tuticorin and from the Kallar Estuary, and stocked in the cages. They were fed with trash fish, crushed bivalves and fish waste. The crabs were found to moult at an interval of 30-45 days. The growth rate of the crabs measuring less than 110 mm across carapace was found to be 12-15 mm per month, while the rate of growth in those measuring above 115 mm across carapace was relatively low (5-6 mm carapace width). The seed crabs stocked and grown in these cages were found to attain the marketable size of 145-160 mm (400-500 gm weight) in about 9-10 months, during which period they moulted 4-5 times. At Cochin, laboratory breeding and rearing of *Scylla serrata* was carried out without much success.

#### *Work contemplated*

Intensive studies will be undertaken to develop suitable techniques of culture of crabs in the field as well as on the breeding and rearing under controlled conditions.

#### **Culture of spiny lobsters *Panulirus spp* (CF/CUL/1.5)**

T. Tholasilingam; K. Rengarajan; E. V. Radhakrishnan and V. Selvaraj.

#### *Salient findings*

Maturation of the commercially important spiny lobster, *Panulirus homarus*, their mating, spawning and consequent hatching of "berry" into free swimming phyllosoma larvae under laboratory conditions were reported for the first time in the country. The juveniles reared in polythene tanks under controlled condition and fed with *Katylesia* sp. showed an average weight increase of 10.5 gm per month at a food conversion ratio of 28.7. The growth increment in adult *P. homarus* was 1.4 mm carapace length. The intermoult period in *P. homarus* and *P. polyphagus* was found to be 52 days.

#### *Work done*

During the year, five rafts each measuring 25 sq. metres in area were maintained in the sea at Kovalam at a depth of 8 metres. Various types of collectors like Mangalore tiles, country tiles, pieces of motor car tyres, coir and hump fibres were suspended

from the rafts at different depths. During the period January to June, a total number of 114 pueruli—postpueruli (19 to 23 mm in total length), were collected. The species-wise distribution of pueruli was *P. homarus* 42, *P. ornatus* 36 and *P. polyphagus* 36. During the second half of the year, pueruli could not be collected as the rafts were dislocated due to rough sea.

115 juveniles of *P. homarus* with a mean carapace length of 33 mm collected at Kovalam were maintained in 10,000 litres capacity polythene tanks and fed daily with estuarine clam, *Katylesia* sp. at the rate of 10% of their body weight. The juveniles showed an average weight increase of 10.5 gm in a month at a food conversion ratio of 8.7. The growth increment in adult *P. homarus* was only 1.4 mm in carapace length when fed with excess of fresh clams.

The intermoult period in *P. homarus* and *P. polyphagus* was found to be 52 days. Differential growth rate was observed between the sexes, the males growing faster and putting up more weight than the females during the same period. Preliminary work to increase growth with eye stalk ablation was carried out. The ablated lobsters consumed twice the quantity of food than normal ones and moulted more frequently.

During the course of rearing experiments of pueruli of *P. homarus* to adult, two specimens attained maturity, and they mated and spawned, and subsequently, the "berry" hatched out into free swimming Phyllosoma larvae. Thus for the first time, successful maturation and spawning of *P. homarus* under laboratory condition were reported from our country. Breeding and rearing experiments were carried out with berried *P. homarus* obtained from the wild population. The fecundity of *P. homarus* measuring 75.6 mm in carapace length, weighting 460 gm, was estimated to be 100,000 eggs. The larvae hatched out from the 'berry' were maintained for about a month feeding with *Artemia* nauplii.

#### *Work contemplated*

Researches on the breeding of lobster and rearing of phyllosoma larvae under controlled conditions will be intensified. Viable techniques will be evolved for mass culture of the lobsters in the field.

## MOLLUSCAN FISHERIES DIVISION

During the year altogether 17 projects were taken up for implementation under four major heads viz., resources investigation, culture projects, demonstration projects and training programmes. Overall progress in most of the projects was achieved. Survey of estuaries, backwaters, tidal creeks and coastal areas brought out valuable information and data in respect of clams, oysters and mussel population. Experiments on culture of edible oyster at Tuticorin, mussel at Kozhikode and Vizhinjam established the feasibility of undertaking pilot scale operations and the demonstration projects started on these lines strengthened the conclusions arrived at earlier. Production rate of 235 tonnes of mussels/hectare within a short period of 145 days and an output of 125 tonnes of edible oysters/hectare in 10 months period can be achieved by following the 'raft' culture and 'rack' culture techniques respectively. Although at the present stage seed collection needed for transplantation work is resorted to successfully from natural beds it can not provide a satisfactory system for assured supply of seeds which may be needed in large numbers once commercial scale farming operations are started. In order to eliminate the dependence on natural beds for the procurement of seed needed for the large scale culture, research work on hatchery production is initiated.

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

K. Nagappan Nayar, S. Mahadevan, K. Ramadoss, C.T. Rajan, N. Sundaram, T. Appa Rao, B. Narayana Rao, K. A. Narasimham, Y. Appanna Sastri, W. Venugopalam, R. Sarvesan, K. S. Sundaram, M. M. Meiyappan, A. A. Jayaprakash, K. Satyanarayana Rao, D. Sivalingam, P. Natarajan, K. A. Unnithan, P. V. Srinivasan, K. K. Appukuttan, T. Prabhakaran Nair, P. Radhakrishnan, Mathew Joseph, P. S. Kuriakose, V. G. Surendranathan and others.

### *Salient findings*

Resources survey of commercially important molluscs carried out from Waltair, Kakinada, Madras, Porto Novo, Mandapam, Tuticorin, Vizhinjam, Calicut and Karwar brought to light the species composition and extent of resource of oysters, clams and mussels in the inter-tidal regions, bays, estuaries and backwaters.

## Work done

### Waltair

A stretch of 50 km, along the coast from the south of Waltair to Vadachipuripalli was surveyed for mussels, clams and cockles. Excepting the dead shells of *Arca* sp., *Spisula* sp., *Sunetta* sp., *Gafrarium* sp., *Glycymeria* sp. no other live bivalve shells could be encountered.

During the second phase of the survey, the rocky region from Dolphin's nose mountain to Gangavaram was surveyed. On the rocks of pigeon island near Gangavaram, *Perna viridis*, *Modiolus* sp. and the pearl oysters *Pinctada chemnitzii*, *Pinctada anomioidea* and *Pinctada atropurpurea* were noticed in few numbers. The submerged and partially exposed rocks were populated by *Crassostrea* sp, the concentration ranged from 150-200 numbers per square metre.

In backwater limited area near Dibbapalem, a few numbers of *Meretrix casta* whose size ranged from 40-50 mm were noticed. The backwaters between Tikkavanipalem and Muthyalammampalem were surveyed. Near the mouth of the backwater, *Tellina* sp. whose total length ranged from 10-35 mm were found. Dead shells of *M. casta* and *Crassostrea* sp. were also seen.

### Kakinada

Survey of inter-tidal region of Kakinada area was continued upto September 1978. Seventeen stations, each separated by 250 m were covered. Dead shells of *Anadara granosa* (2-44 mm); *Placenta placenta* (6-55 mm); *Donax* sp. (7-20 mm); *Paphia* sp. (18-48 mm); *Meretrix* sp. (6-45 mm); *Umboonium* sp. (3-8 mm); *Cerethium cerethium* (8-22 mm); formed important groups of molluscs obtained in the samples.

### Madras

The survey of Ennur estuary revealed that the oyster bed exists from the Ferry point to the railway bridge on westernside and the adjoining areas. The area between the Ferry Point and river mouth was devoid of any bivalve population. The oyster bed comprised of 42% live oysters and 58% of dead oyster shells. The bed was mainly composed of *Crassostrea madrasensis*.



During the period of survey the size of live oysters ranged from (10.0 to 139.0 mm). *Perna viridis*, *Crassostrea cucullata* and *Modiolus* spp. were also encountered in oyster bed.

Only a moderate quantity of clams, exclusively consisting of *Meretrix casta* was found in the muddy areas along the banks of Buckingham canal. The average number of clams/1 sq. m area was estimated as only 36. The population mostly consisted of clams of 25.0 to 62.0 mm size with the mode of 48.0 mm. The percentage of seed clam was only about 2%. Another bivalve *Anadara granosa*, the cockle, also occurred in the bed but only in stray numbers. *Meretrix casta* formed 70% of the population while *A. granosa* formed only 2%. The dead shells, mainly *M. casta* constituted about 28%.

During the third quarter, the area between Puzhuthivakkam and Koonakuppam was surveyed. *Donax cuneatus* was the only bivalve species found in the inter-tidal zone. Dead shells *Paphia* sp., *Donax scortum*, *Cardium* sp., *Arca* sp., *Macra mera* and *M. turgida* were found washed ashore at stations near Pulicat barmouth.

An analysis of the data collected in the preliminary survey of the estuaries at Velanganni, Nagore, Thirumalrajanpatnam, Tranquebar, Thirumullaivasal and Cuddalore, revealed the existence of rich beds of *M. casta*. The clams are commercially exploited in good quantities from Vettar estuary at Nagore, Thirumalrajanar at Thirumalrajanpatnam and Uppannar estuary at Thirumullaivasal. The shells are used in lime industry. The average number and live weight of *M. casta* per one square metre area in Vellar, Vettar, Thirumalrajanar, Virasolanar and Uppannar estuaries ranged from 15 to 278 numbers and 0.9 kg to 5.20 kg.

#### *Porto Novo*

Due to unprecedented floods in November 1977, the clam beds of Vellar estuary were destroyed. However, new beds, much wider and heavily concentrated than in 1977, were formed subsequently.

During July and August, Killai backwater area from Muda-sodai village to Chinnavaykal including all the branches were covered. 3 oyster beds and one *Umbo* bed was observed in the area. The oyster beds ranged from 2500 sq. m. to 8200 sq. m and consists of *Crassostrea madrasensis* and *S. cucullata*.

### *Mandapam*

On Palk Bay side of Rameswaram Island *Donax cuneatus* and *D. faba* occurred in 67 stations. Seed of *D. cuneatus* and *D. faba* were recorded in most of the stations along with *D. incarnatus*. On the Gulf of Mannar side of Rameswaram Island from Pamban Bridge to Therkuvadi *D. cuneatus* and *D. faba* occurred with a maximum density of 148/m<sup>2</sup>. On Palk Bay side of Main land from Uppar River to Mullimunai *Donax* sp. were absent. From Mullimunai to Sundarapandianpatnam *D. cuneatus* occurred in most of the stations with a maximum density of 192/m<sup>2</sup> and seed clams to a maximum density of 1512/m<sup>2</sup>. In Kottakarai Estuary at Karangad seven small patches of *Crassostrea madrasensis* were recorded. In Edayanar estuary at Sundarapandianpatnam only one patch of *C. madrasensis* was observed. Seed clams of *Meretrix casta* were found in high densities of 700 to 16000/m<sup>2</sup> in Vaigai estuary from near Perungulam onwards towards the mouth of the estuary upto a distance of 5.25 Km. Adult clams were found in moderate numbers in the estuary.

### *Tuticorin*

The survey of estuaries, backwaters, bays, creeks, etc., was initiated. To start with area lying north of Tuticorin was surveyed. Sippikulam-Vaipar River, Vembar river, Narippayoor backwaters, Mookayoor river, Valinokam backwater and Mayakulam bay were surveyed. No live molluscs were encountered in any one place mentioned. Dead shells of *Meretrix* sp. were found buried in the sand. In some places they formed extensive beds also. Such beds of *Meretrix* sp. (dead shells) were seen in the Mookayoor river, Vaipar river and Valinokam backwaters. Dead shells of window pane oysters, *Arca* sp., and *Crassostrea* sp. were also seen buried in Mookayoor river, Vaipar river and Valinokam backwaters.

### *Special Investigation*

As a special assignment, detailed survey of Kali River bed of Karwar for their commercially important molluscan resources was carried out during the months of November and December 1978. The survey brought to light the existence of a rich clam bed in Kali river. The resources extend in the river bed for an area of 18 Km. upstream. The nature of substratum is a mixed one, generally sandy and intermittent with muddy or clayey.

Sandy bottom forms a good substrata for the clams to settle and grow. The clam resources of the river is represented by *Meretrix meretrix*, *Paphis malabaricus* and *Villorita cyprinoides*. It is also not uncommon to see *Perna viridis*, *Crassostrea* spp. to occupy definite zones.

The intertidal rocks of the small islets near the river mouth is fully encrusted with the green mussel, *Perna viridis* and *Crossostrea cucullata*. *Crossostrea madrasensis* were also seen along with *C. cucullata* in clusters along the shoreward side of the river on both the banks for about 3 Km. upstream. Thereafter no live oysters are noticed.

The river bed in between Kodibag and Nandangaddah is dominated by *Paphia malabaricus*. Its absence in the higher reaches of the river indicates that the species prefer waters of higher salinity ranges almost equivalent to pure sea water. *Meretrix meretrix* enjoys a wide distribution for about 10 Km. or so upstream. It tolerates a wide fluctuation in salinity range. Further upstream in the river when it becomes almost sweet water *Villorita cyprinoides* abounds the river bed. Thus a definite zonation can be seen in the distribution of clam in the river.

An organised clam fishery is existing in the river. Nearly 2000-3000 fishermen families are engaged exclusively in clam fishing and the annual production amounts to 1000-1200 tonnes. Clams are marketed locally and sent to interior markets also.

A detailed report embodying the species composition, distribution pattern, ecological conditions of the river, and the socio-economical conditions of the fishing community is under preparation.

#### *Vizhinjam*

A total of 150 Km. were covered and samples from sandy and rocky stations were collected. In most of the sandy stations populations of edible bivalves was poor. *Donax* spp. was found in some of the station in good numbers. In the rocky area, *Perna indica* was the molluscan resource commercially exploited for edible purpose. *Pinctada* spp. were available at Kanyakumari, Muttom, Enayam, Colachel, Mulloor, Vizhinjam and Thirumullavaram. Preliminary survey of backwater areas showed that backwater oysters, *Villorita*, *Meretrix* sp. and *Sanguinolaria* sp.

were available. Data on chank landings from important centres were also collected during this year.

#### *Cochin*

Survey for the commercial molluscs in the intertidal zone from Cochin to Neendakara was carried out. It was found that in the 150 Km. stretch from Cochin to Neendakara the upper two zones had no molluscan fauna—not even empty shells. The lower water mark regions was found populated by the clam *Donax incarnatus*. And wherever groynes were found jetting into sea, they were populated by *Perna viridis* and to a lesser extent by *Crassostrea cucullata*. During the survey it was found that none of these molluscs have regular fishery and whenever no other fishes were available the local fisherfolk collect *P. viridis* for consumption.

#### *Calicut*

Resources survey of the commercially important molluscs along the west coast from Beypore to Thannur about 50 kilometres distance was carried out. In the absence of rock or any other hard substrata along the beach edible oyster bed was completely absent. Mussel beds were not encountered along the inter tidal area of the surveyed zone. Clam beds of *Donax* sp. were observed from three centres viz., Parappanangadi, Pura river mouth and Thannur.

#### *Mussel fishery resources of Calicut to Mahe area*

Green mussel fishery is the only major molluscan fishery along the Malabar coast. The fishery is seasonal only for a period of 8 months starting from October to May. The total mussel landings from Calicut to Mahe was estimated to be 668 tonnes.

#### *Mangalore*

A preliminary survey of the estuaries of the south Kanara coast indicated the presence of extensive beds of clams and oysters. There is a regular fishery for clams in all the estuaries except Netravati, where the fishery was done only for a few days that too sporadically. There is no regular fishery for oysters even though there are number of beds. At Coondapoor, the major contribution to the fishery is *M. meretrix* whereas at Mulki it is *M. casta. var.*

*ovum*. During 1978 the total landings of clams from Mulky estuary were estimated as 425.5 tonnes with *M. casta*. var. *ovum* contributing 91.7% (397 tonnes).

#### *Work contemplated*

Resources survey of the molluscs will be continued on the above lines.

#### **Investigations on the Cephalopod Resources (MOL/RE/1.2)**

E. G. Silas, Kubervidyasagar, M. M. Meiyappan, K. Prabhakaran Nair, K. Satyanarayana Rao, P. V. Sreenivasan, R. Sarvesan, Y. Appanna Sastry, B. Narayana Rao.

#### *Salient findings*

As estimated 15,629 tonnes of Cephalopods were landed during 1978, mostly by Shrimp trawlers. The catch showed a marked 44.4 % increase over that of 1977. Kerala accounted for 41.7 % followed by Maharashtra (26%). The catch was decreased in Andhra, Tamilnadu, Pondicherry and Goa. Except at Vizhinjam there was no organised cephalopod fishery in any other centre. Besides monitoring the fishery at different centres, biological investigations were carried out on the component species.

#### *Bombay*

The estimated landings at Kasara Bandar was 375 tonnes and at Sasoan Docks 647 tonnes. The landings showed about 17 % and 27.4 % increase from that of last year. Peak catches were in December. *Loligo duvauceli* and *Sepia aculeata* were the dominant species and their size ranges were 36 to 270 mm and 45 to 205 mm respectively.

#### *Cochin*

The shrimp trawlers landed an estimated 181.9 tonnes (1.33 kg/h) of Cephalopods at Fort Cochin Landing Centre. The peak catch was in February and September. Squids formed the bulk of the catch (79.7 %). The landings and size range of *Loligo duvauceli*, *Sepia pharaonis*, *S. aculeata*, *S. elliptica* and *Sepiella inermis* were respectively, 144.7 tonnes and 41-285 mm, 12.5 tonnes and 65-260 mm, 9.6 tonnes and 55-153mm, 4.7 tonnes and 36-120

mm, 10.2 tonnes and 27.120mm. An unusual one day long squid fishery was observed at Thottapally, 25Km. south of Alleppey during the month of September. An estimated 6.5 tonnes of *L. duvauceli* were caught with cast nets at a depth of 1 metre near the beach. The size range was 120-317 mm and most of them were males with stage 1V gonads. The product yield (mantle with fins) was about 51 to 62 % for males and 42 to 47 % for females.

#### *Vizhinjam*

The estimated landings were 280.9 tonnes of which 50 % by Hooks and Lines, 47 % by boat seines and the rest by shoreseines. The catch showed about 92 % increase over that of last year. The peak catch was in September. The squid landings were slightly higher. The boat seine landings comprised mainly of squids whereas cuttlefishes were landed by only Hooks and lines. *Loligo duvauceli* and *Sepia pharaonis* were the dominant species. The size range of *S. pharaonis*, *S. aculeata*, *S. elliptica*, *S. inermis*, *Loligo duvauceli*, *Doryteuthis singhalensis* were respectively 90-330 mm, 40-170 mm, 78-105 mm, 40-155 mm, 30-305 mm and 40-180 mm. During the month of March trawling experiments conducted by CADALMIN II yielded small quantities of *S. pharaonis*, *S. aculeata* and *L. duvauceli* at depth of 20-40 M. Fishing experiments using electric bulbs and petromax and dip net yielded small quantities of squids.

#### *Mandapam*

An estimated 14.2 tonnes of Cephalopods were landed by Mandapam based shrimp trawlers. *S. aculeata* was the dominant species throughout the year. It formed 69 % of the Cephalopod landings. The other species noted in the catches were *S. pharaonis*, *Sepiella inermis*, *L. duvauceli* and *S. arctipinnis*. The size range of *S. aculeata* was 43-228 mm.

#### *PortoNovo*

Shrimp trawlers landed an estimated 9.2 tonnes Cephalopods. The peak catch was in June. *Sepiella inermis* and *S. aculeata* were the dominant species. The size range of *S. inermis* was 21-88 mm and of *S. aculeata* 25-155 mm. *S. pharaonis* and *L. duvauceli* were also present in the catches in smaller quantities.

### *Madras*

An estimated 58.6 tonnes of Cephalopods were landed by shrimp trawlers at Padumanaikuppam at the rate of 0.8 kg/h. The peak catch was in May. 57.8% of the catch was of squids. *S. aculeata* and *L. duvauceli* were the dominant species. *Sepia prashadi* was noticed in the catches in the month of June.

### *Kakinada*

The trawlers landed 130.9 tonnes of cephalopods which was about 49 % less than the landings of 1977. This was attributed to the decreased effort put in. *S. aculeata*, *S. inermis* and *L. duvauceli* were the dominant species. The landings and size range of *S. aculeata*, *S. inermis*, *S. pharaonis* and *L. duvauceli* were respectively 22.2 tonnes and 25-145 mm, 62.8 tonnes and 15-85 mm, 3.8 tonnes and 55-145 mm and 41.1 tonnes and 15-155 mm.

### *Waltair*

An estimated 161.3 tonnes of Cephalopods were landed of which 97.6% by commercial trawlers, 1.5 % by EFP vessels and the rest by indigenous gears. The catch showed a remarkable increase of about 165 % over that of last year. *L. duvauceli* and *S. aculeata* were the dominant species. Size ranges of *L. duvauceli*, *S. aculeata*, *S. winckworthi* and *Sepiella inermis* were respectively 25-165 mm, 45-175 mm, 23-93 mm and 28-83 mm.

### **Pearl Oyster Atlas (MOL/RE/1.3)**

K. Nagappan Nayar, S. Mahadevan and A. Bastian Fernando.

### *Tuticorin*

Details needed for the preparation of the third part of Atlas were gathered during the year. With this, all the essential information for completing the final draft of Atlas had been obtained. The dummies of various plates were also prepared. It may therefore be deemed that the project work has been completed and the final draft of Atlas will be submitted for approval during 1979.

### **Culture of Edible Oysters (MOL/CUL/1.1)**

K. Nagappan Nayar, S. Mahadevan, M. E. Rajapandian, K. Ramadoss, N. Sundaram, R. Thangavelu, C. T. Rajan, K. Satyanarayana Rao, D. Sivalingam and K. A. Unnithan

### *Salient features*

Spawning season failed this year. Although all out efforts were made to lay large numbers of spat collectors in different areas only a small numbers could be collected. Oyster growth in the farm was good reaching 86 mm size in 10 months. Due to unsteady environmental conditions in Athankarai estuary it has been decided to discontinue the oyster farming experiments at Mandapam. However spat collection work is proposed to be attempted to supplement the seed deficiency at Tuticorin.

### **Work done at various centres**

#### *Tuticorin*

Experiments on the large scale collection of edible oyster spat by employing lime coated roofing tiles as collectors were continued during the period under report and completed as on July 1978. Incidence of spat settlement was high (average) during March and April.

As on July 1978 monthly observations on the settlements of oyster spat have been made continuously for a period of one year. Scraping oyster spat from the tiles was initiated. Totally 8,226 spat of August brood, 4,350 spat of September brood and 4,384 spat of October brood were scraped. Oysters scraped from the 'Cultch' were segregated according to their size and stocked in box type cages of size 40 x 40 x 10 cm and reared in the Tuticorin Bay. Periodical thinning of oysters stocked in the farm was also carried out so as to achieve a good growth rate. Length frequency studies revealed that on an average oyster grew to 86 mm over a period of 10 months. Fouling by barnacles did not pose any problem in the bay area. Silting was also not encountered. Periodical mortality was noticed in the farm caused by a prosobranch gastropod, *Cymatium pileare*. Oysters in the size range of 40-60 mm were more vulnerable to the attack of the gastropods.

During March and April high percentage of ripe male and female were observed. Similar conditions were also noted during August and September. Unusually during this year oysters showed ripening of gonads in the months of October and November.

#### *Mandapam Camp*

The cultured oysters *Crassostrea madrasensis* which were transferred from Vaigai estuary to inshore waters of Gulf of Mannar



near CMFRI jetty, Mandapam Camp in the fourth quarter of 1977 were retransferred to the estuary in January 1978 when the salinity attained a level of 24.79‰. 2,915 oyster spat set on country tile cultch given lime coating. The tiles were either kept in trays or spread on bamboo thatties tied to racks. 470 oysters spat set on oyster shell cultch kept in trays. A total of only 45 spat set on 528 shell cultch kept in plastic netting bags. In the third quarter 1,200 additional country tiles given a coating of lime were kept on bamboo thatties tied to culture racks in Vaigai estuary. There was very low spat fall in the quarter. On country tiles 46 spat set in July and 124 spat in August. There was no spat fall in the month of September. On Mangalore tiles 25 spat set in July and 47 in August. On keeping 500 coconut shell cultch in the estuary, 36 spat set in the second quarter and these grew to a size of 33-84 mm in the end of September. It was difficult to remove oyster spat from Mangalore tile and coconut shell cultches.

In February '78 the size of oyster spat set on tiles was 3 mm to 20 mm with an average of 9 mm. In March the size range of spat was 3 mm to 48 mm with a mode at 5 mm. In June the size range was 4 mm to 84 mm with two modes at 15 mm and 65 mm. Large numbers of spat of the size range 10 mm to 25 mm did not exhibit further healthy growth in the second and third quarters. The cultured oysters showed a size range of 16 mm to 91 mm in July, 7 mm to 97 mm in August and 15 mm to 93 mm in September. Two modes were seen at 25 mm and 75 mm in all the three months of the third quarter. The stationary nature of the modes indicate that there has not been much growth in the cultured oysters in the quarter. The cultured oysters of 1978 year class attained an average total weight of 81.4 gm and meat weight of 9.2 gm. at the end of September, 1978.

#### *Work contemplated*

It is proposed to study the optimum harvestable size and also to investigate the predation problem in the farm site.

#### **Culture of Mussels (MOL/CUL/1.2)**

S. Mahadevan, K. Rangarajan, N. Ramachandran, D. Poovannan, Srinivasagam, K. K. Appukuttan, T. Prabhakaran Nair, P. S. Kuriakose, P. Radakrishnan, J. Mathew, K. Thomas, S. S. Dan, S. Reuban, P. Sampson Manickam and others.

### *Salient findings*

Open sea mussel culture has been well established at Calicut with an average growth rate of 12.8 mm/month for green mussels. This gave a production rate of 80-100 kg of mussel/5 rope/4½ months. Constraints posed by adverse weather conditions are being overcome at Madras.

### *Work done*

During the year culture of mussels was undertaken in 4 centres viz., Visakapatnam, Vizhinjam, Madras and Kozhikode. Satisfactory progress was achieved in Vizhinjam and Kozhikode with experiments in open sea culture. The salient features of work are given below.

#### *Visakapatnam*

In February 1978, a raft of 5 x 5 m was anchored in the sea at Mangamripeta, 20 Km north of Waltair. 50 coir ropes, each 5 m long were suspended from the raft over rocky bottom. 1,200 numbers of *Perna viridis* were suspended from the raft securely wrapped up by nylon netting bags. By March, spat of the mussel began setting on coir ropes. The spat measured 5 mm at this stage. Although large-scale mortality of this stock was noticed the remaining spat were transplanted on to the ropes with mosquito net jackets at 250 numbers per rope. In May the individuals on the rope had grown upto 19 mm. This growth can be considered satisfactory. Due to the cyclone in June the raft was washed away. Further attempts on culture can be taken up only in the next mussel spawning season.

#### *Madras*

The mussel culture work was commenced in January 1978 at Kovalam. During the year four rafts were positioned at 8 metres depth. In the early stages, mussel seeds ranging in length from 9 to 18 mm were collected from the rocks at Kovalam. As the stock of mussels on the rocks at Kovalam got exhausted and some buried under sands due to changing configuration of the beach, seeds were obtained from Ennore in the north and Cuddalore in the south. During the year 166 coir ropes measuring 6 m. each were seeded with 3 Kg of mussel seeds each. The attachment of mussels on the ropes was not uniform. After initial attachment

most of the mussels detached and fell off the ropes. The remaining mussels at the end of March reached an average length of 58 mm and a weight of 15 gm. The increase in length of mussels was 0.43 mm per day and weight 0.14 g. per day. Heavy mortality of mussels was noticed in April and May as the water around the raft was very turbid. Heavy accumulation of silt over the seeded ropes was noticed. Spawning of mussels took place during late May and June. Heavy spat fall was noticed on Mangalore tiles by the middle of June. The spat measured 0.5 to 2 mm in length.

The sea conditions became rough during May and June. Strong winds and choppy sea were encountered at Kovalam bay on the onset of the south-west monsoon along the west coast. The seeded ropes were damaged due to the drifting of the rafts during June. It has not been possible to work out the production per raft during 1978 due to periodic drifting of the rafts. In fact the chief constraint in mussel culture work in the open sea at Kovalam has been the inability to keep the rafts anchored continuously from January to September. The rough conditions of sea prevalent at Kovalam bay for most part of the year require modification and strengthening of the rafts and very strong anchorage. The matter has been discussed with the local port authorities and they have suggested the use of thicker and longer chains and heavy anchors. Arrangements are being made to incorporate these suggestions during 1979 and positive results are expected from the work during the ensuing year.

During the year some work was also carried out on the growth of mussels at different depths by enclosing known number of mussels in velon bags and suspending at different depths from the raft. Better survival rate and faster growth was obtained in the surface layers. The survival rate at the surface was 92% whereas at the bottom it was only 67%. The growth rate and increase in weight was, however, less when compared the mussels on the ropes.

#### *Vizhinjam*

2 rafts of 6 x 6 m length were launched in the open sea. Because of mussels slipping down the rope in this environment, the rafts were repositioned inside the bay in April. Seeding work could be started only in November since settlement of mussel spat was poor over the natural beds during September-October. 260 ropes were suspended of which 176 ropes of 6 m length each

contained spat of size 20-30 mm. The total weight of seed transplanted was 1,440 kg. 87 ropes were further seeded with spat of size 20-35 mm collected from spat collectors. The total weight of seed transplanted was 515 kg; average weight per metre of rope was 1.3 kg. The growth rate of mussel in the bay was calculated at 3 mm per month. Mature specimen cultured in the bay ranging from size 50-25 mm attained sexual maturity during June to August. Environmental conditions in the farm area were monitored to find out their possible influence. Mussel fishery was poor in 1978. Only 31 tonnes were landed. There was no fishery from February-September.

#### *Kozhikode*

Rope culture of mussel in the open sea was successfully carried out during this year also. An experimental raft was floated at 10 m. depth in April covering 64 sq. m. area. Elatur natural bed was again exploited for collecting seeds needed for the culture. 23-40 mm mussel was collected and 5 kg of these were wrapped round each rope of 8 m length and suspended from the raft. 50 such ropes were hung from the raft. The growth rate observed was 12.8 mm per month when compared with the slower rate of 7.9 mm/month in natural bed. Sexual maturity was reached within 30 days on seeding. The flesh weight attained also was very good.

#### *Work contemplated*

Mussel culture work will be intensified at all the centres to perfect the low-cost technologies and to give improved production rates.

#### **Culture of clams (MOL/CUL/1.3)**

K. A. Narasimham, P. V. Srinivasan, S. Reuben, T. Appa Rao and P. E. Sampson Manickam.

#### **Work done**

##### *Waltair*

Work on the culture and biology of the clam *Meretrix casta* was continued. In August a new rack was set up about half km from Bhimmunipatnam and specimens of *M. casta* of the length range 15-28 mm with two modal lengths at 18 and 22 mm along

with a few adult clams of the size 47-62 mm were kept in cages suspended from the raft. Cages stocked with clams were also kept on the bottom. The growth of the clams kept in cages at the bottom was 2 mm per month while the growth of the clams kept off bottom was less than 1 mm/month. The size range of the clams at Nagamayapalem varied from below 5 mm to 49 mm and the modal length was between 28 to 41 mm during November-March period. Spat below 5 mm appeared in April and the spat measured 18 mm modal length by September. During the first quarter the clams were mature and in the second quarter there was spawning with heavy spat settlement. Also data on temperature, salinity, dissolved oxygen and pH were collected.

#### *Porto Novo*

Culture experiments on *Meretrix casta* involved transplantation of seeds to 1) new bed below low tide level and 2) new bed above low tide mark where formerly there were no clams. The observations clearly indicated that submergence of clams always under water is essential for their normal growth. Off-bottom rack culture of *M. casta* was also experimented and it was also found that growth in off-bottom racks was better than in transplanted areas.

Growth in *K. opima* on transplantation was observed to be from 5.6 mm (0.11g) to 33.2 mm (14.14g) in 8 months from March to November. These experiments brought to light the following results. 1) Transplantation of clams into a new area was successful with 84 % survival and 6 times increase in weight in 6 months. At this rate 56.8 tonnes of clams can be harvested per hectare which can yield 5.68 tonnes of clam meat. 2) Significance of depth on the growth of clams was observed and this factor will be of immense help in locating the site for clam culture. 3) Growth of *Katylsia opima* was first studied on transplantation. This observation indicated that the growth attained in 9 months was equal to 2 years growth in natural bed as observed by earlier workers.

#### *Kakinada*

Work on the culture and biology of the clam, *Anadara granosa* was continued. Experiments were conducted to culture the clam off-bottom without muddy substratum in synthetic yarn mesh cages, each of 0.2 m area, suspended in tiers one below the

other from a raft floated off Vakalapudi in 5 m depth on the open coast. The work was initiated in March and terminated in October 1978. A total of 55 cages were stocked with clams of various sizes during the period 3-3-78 to 11-5-78. The results were not encouraging since growth nearly ceased with heavy mortality and the condition of the clams was poor when compared to the natural population. However, when the clams were kept in a metallic box of the size 1'x1'x 8'', provided with 4'' deep mud and suspended from the same Vakalapudi raft so that other conditions are identical, growth was good (2mm/month). This suggests that *A. granosa* does not thrive well if muddy substratum is not provided.

#### *Work contemplated*

Work on culture of clams will be continued at Waltair, Kakinada and Porto Novo.

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

K. Rangarajan, N. Ramachandran, P. Poovannan, Sreenivasagam, K.K Appukuttan, P. Radhakrishnan, T. Mathew and others.

#### **Work done**

This project was commenced in 1978 with a view to develop suitable hatchery techniques for the seed production of mussels so as to get a constant supply of healthy seeds throughout the year for growing them to marketable size in farms. The project is located in Madras in the east coast for the production of seeds of green mussels and in Vizhinjam in the west coast for the brown mussels.

Various physical or chemical 'stress' were tried on the brown and green mussels to induce them to spawn in the laboratory. Brown mussels responded to external stress like increase of temperature, mechanical pressure to adductor muscle etc. In the case of green mussels increase and sudden lowering of temperature gave some initial success. Chemicals like Potassium Chloride was tried with green mussels. All these methods gave some success in inducing the mussels to spawn. But no method has given cent per cent success. In some cases even without any

external stress the green mussels were noticed to spawn in the laboratory. The success of any of these methods, will, to a great extent depend upon the physiological condition of the mussels and it will be necessary to condition the mussels in the laboratory before these methods are employed to induce them to spawn.

Both at Madras and Vizhinjam it was possible to attain the late veliger stage. Total mortality occurred beyond this stage due to ciliate growth by filtering the sea water through rapid filtering systems and also sterilizing the filtered water by ultra violet radiation.

A running water hatchery system with tanks for conditioning, spawning, rearing and settlement of mussel larvae are very essential for the successful implementation of this program and efforts will be diverted to achieve this in the current year.

*Work contemplated*

Work will be intensified and continued.

## FISHERY ENVIRONMENTAL DIVISION

### OCEANOGRAPHY

#### **Fishery Oceanography Investigations (MBO/ES/1.1)**

A. V. S. Murty, C. P. Ramamirtham, D. S. Rao, R. Vasantakumar, N. P. Kunhikrishnan, D. Vincent, N. S. Radhakrishnan, C. M. Allikunju, G. G. Annigeri, S. Krishna Pillai, R. Marichamy, Pon Siraimetan, M. Selvaraj, M. Najemuddin, K.G. Girijavallabhan, S. Muthuswamy, P. Mojumder and others

#### **Salient findings**

##### *Cochin*

Analysis of oceanographic data in eight quasi-meridional sections off the west coast of India revealed that intensive changes in the hydrographic conditions during monsoon are mostly restricted to the coastal waters, especially within a coastal belt of 50-60 miles width. The region of Mangalore exhibited the presence of upwelling even in the post monsoon period and the phenomenon was most intense in this region during the monsoon period. The results of upwelling were confirmed by the dissolved oxygen content also. The salinity maximum zone was located within the shallow thermocline. Monitoring of the hydrographic conditions off Cochin revealed that upwelling existed in the shelf waters during July-August and a drastic depletion of dissolved oxygen content was also noticed in the subsurface waters.

During the current year nutrient distribution studies in the region Cape Comorin to Cochin was continued. Horizontal distribution charts for reactive phosphate and silicate for the monsoon period were prepared. A general increase of phosphate contents of the waters were observed in the region Cape



Comorin to Cochin during the monsoon period. An increasing trend in nutrient content of the waters was noticed from South to North in this region. Cochin region showed higher value than the region south of Quilon. The reactive phosphate values varied from 0.73  $\mu\text{g at. P/l}$  to 1.2  $\mu\text{g at. P/l}$  at surface the highest being in the section off Cochin. This is due to the upwelling phenomenon prevailing along the coast the intensity of which is more pronounced in the region of Cochin. Uniformly higher phosphate contents were noticed at the bottom over the shelf, the value being 2.1  $\mu\text{g at. P/l}$ . The reactive silicate values varied from 1.5  $\mu\text{g at. Si/l}$  in the region south of Quilon to 6.5  $\mu\text{g at. Si/l}$  in the region off Cochin at Surface. The bottom values ranged from 13.3  $\mu\text{g at. Si/l}$  to 24.0  $\mu\text{g at. Si/l}$  in the region off Cochin. The vertical distribution of phosphate in general showed an increase in phosphate content with depth, thereby showing an inverse relationship with dissolved oxygen content.

#### **Work done**

##### *Bombay*

Environmental observations of Bombay offshore waters were carried out when vessel facilities were available.

##### *Karwar*

Studies of hydrological conditions for the year were continued at Karwar Bay. The first three parameters, temperature, pH and salinity show their maximum during summer months and the nutrients show their peak during monsoon and soon after monsoon months. Dissolved oxygen values show their minimum in the sub-surface layers from July to September months.

##### *Mangalore*

Hydrographic data were collected off Mangalore. Fluctuations were observed in the temperature, pH, salinity and oxygen values. The silicate and phosphate values were comparatively higher in January-May period.

##### *Calicut*

Collections and analysis of the routine samples from the inshore and nearshore were continued at Calicut during the period. The general conditions of the parameters are given below.

Salinity showed upward trend from January to April. Lowest salinity was noticed in November for the inshore stations. The salinity content was the lowest for the surf samples in September. The salinity values for the samples collected at the time of mud bank formation in November were very low in surf and was between 10.01‰ to 30.91‰. High oxygen values were observed in January. Very low oxygen content was observed in November at surf at the time of mud bank formation. pH was found comparatively low in the post monsoon season especially after the mud bank formation. Reactive phosphorus content was lower during the premonsoon period both in the inshore and surf stations. Very high reactive phosphorous was same as in the post monsoon period especially in the surf stations. The Nitrite nitrogen and Nitrate nitrogen content showed fluctuations. But very high values of both nitrite N and Nitrate nitrogen were observed in a few occasions. The Reactive Silicate content showed fluctuations. The surf values were comparatively higher. The river waters showed very high silicate content during monsoon and post monsoon seasons. In November, the samples collected at the time of mud bank formation showed high values of reactive silicate.

#### *Tuticorin*

Regular observations on the hydrology and planktonology of the inshore and offshore waters off Tuticorin coast have been carried out during the year 1978. Observations were made from the fishing grounds namely Harbour Point (Spic coast), Pinnakayal estuary and 8/78-4 'B' (offshore) where the depth varied from 6 to 15 metres.

The average temperature in the surface water recorded was 25.1-31.0°C. In April 1978 a monthly average of 31.0°C was noticed. The monthly average salinity varied from 33.12 to 38.82‰. The maximum average salinity 38.82‰ was recorded in October 78. The average dissolved oxygen content was recorded in the range 4.3-8.0 ml/l. Maximum average oxygen content was encountered in the month of April 78.

#### *Mandapam Camp*

During the year, hydrological investigations were carried out at Athankarai Estuary, Palk Bay and Gulf of Mannar. Collection of water samples were made fortnightly

in Athankarai Estuary and weekly once at other two places of study (Mandapam) and analysed for the estimation of salinity, dissolved oxygen, Hydrogen ion-concentration and nutrients. In addition some of the physical characteristics such as atmospheric temperature and surface water temperature were also observed.

#### *Madras*

During the period under report surface sea water samples were collected on board Government of India trawlers from 20 to 25 fathoms in the area of 13/80- Ic fishing square off Madras.

#### *Waltair*

Sea water samples were collected from the open sea nearshore of Waltair and analysed with respect to their physical and chemical constituents. A total of nineteen samples of sea-water were collected during the year and analysed.

Both air and water temperatures have identical fluctuations during the months of the period of study. Air temperature was minimum in January and maximum in March, whereas the minimum for water temperature was found to be in February and maximum in September. pH values were the same. Thereafter a steady fall in salinity could be observed and the minimum could be found in the month of December. Dissolved oxygen was highest in January, after that the value was more or less steady upto the month of May. Minimum was encountered during June. During July and August again, high dissolved oxygen values were observed afterwards more or less steady values were found during rest of the period. During the period of August to December, inorganic phosphate contents were high. After December, an abrupt fall in the phosphate values could be observed, the minimum being in March. Silicate values had a steady fall from April to July. During August and September, silicate was high; after September, the values started to fall again.

#### **Mud bank and their influence on fisheries (MBO/MB/1.1)**

D. S. Rao, K. J. Mathew, C. P. Gopinathan, A. Regunathan, V. K. Balachandran, C. Thankappan Pillai and others.

### *Salient findings*

During this year field trips and surveys to the various mud bank regions along the coast from Thollapilly in the south to Muzhipilangad, Edakad beyond Tellichery in the north were conducted in the premonsoon, and post-monsoon seasons. The places covered were Thollapilly, Purakad, Ambalapuzha, Punnappra, Alleppey, Thumboli, Chellanam, Nattika, Valapad, Thanur, Parapanagadi, Beypore, Calicut, Elathur, Quilandy, Kollam, Muzhipilangad and Edakad. This year the mud banks had formed south of Purakad, Kollam, and Edakad. Though the S. W. Monsoon had started in time this year the mud bank formation was delayed by about a month. The fishery was very poor in the mud bank regions compared to previous years. The water characteristics such as salinity, dissolved oxygen, and nutrients of the mud bank at Edakad were comparable to that at Purakad. High phosphate and nitrate contents were noticed in the Edakad mud bank waters. Salinity values were higher than that of Purakad mud bank waters by about 1‰. Red tide phenomenon was noticed both at Edakad mud bank region and Kollam mud bank region. The mud bank project team was also engaged in finalising the bulletin on the mud banks of the Kerala coast on the basis of the work done during the previous years. The mineral analysis of mud samples collected in each month from mud bank at Purakad were analysed. Acid insolubles, Alumina, Ferric oxide, Calcium have been analysed for 18 samples. From the mineral analysis carried out no significant monthly variation in acid insolubles, alumina, ferric oxide and calcium was noticed.

### MARINE BIOLOGY

#### **Phytoplankton and primary productivity (MBO/PP/1.1)**

P. V. Ramachandran Nair, C. P. Gopinathan, V. K. Balachandran, K. G. Girijavallabhan, P. Karuppaswamy, C. V. Mathew, Prasad.

#### *Cochin*

Investigations on the primary production in the inshore area of Cochin were carried out to make an assessment of the potential resources. Rate of production during May-June was found to be high (150 mgC/m<sup>3</sup>/day) in the surface waters, the rate of production was low in the bottom regions, the values being 50 mgC/m<sup>3</sup>/day.

In connection with the survey of resources and mariculture potentialities in the Andaman-Nicobar Islands,  $^{14}\text{C}$  measurements were made to estimate the productivity of this area. The rate of production at Port Blair, Mayabunder, Diglipur and Rangat regions of the Andaman groups indicated values up to  $100 \text{ mgC/m}^2/\text{day}$ . Similarly the coastal regions of Car Nicobar, Katchal, Kamorta and Spiteful Bay of the Nicobar Island also showed high values. Qualitative estimation of the phytoplankton samples collected by the half-metre net indicate that dinoflagellates were dominant in the Andaman Sea area during the period January to April. Species such as *Peridinium*, *Ornithoceros*, *Phalacroma*, *Dinophysis*, *Ceratium* and *Goniaulax* were abundant in the Nicobar waters.

#### *Karwar*

Qualitative investigations on the phytoplankton samples obtained by net collections in the inshore waters of Karwar indicate that the Diatomaceae were abundant during May and June. Dinophyceae were few.

#### *Calicut*

Productivity investigations were carried out in the inshore area of Calicut at depths of 15 and 25 m. It was found that Diatomaceae dominated the phytoplankton as compared to Dinophyceae. Light penetration was found to vary from 2.78 m in March to 3.95 m in April at 15 m depth while at 25 m depth the values ranged from 7.30 m in February to 14.18 m in April.

#### *Mandapam*

Productivity studies were conducted in the Palk Bay, Gulf of Mannar and in the estuarine waters at Athankarai during the period May to December. The range in production rate and respective periods are indicated below:

Area	Range and period
Palk Bay	: $242.77 \text{ mgC/m}^2/\text{day}$ (October)– $951.12 \text{ mgC/m}^2/\text{day}$ (May)
Gulf of Mannar	: $331.03 \text{ mgC/m}^2/\text{day}$ (September)– $955.88 \text{ mgC/m}^2/\text{day}$ (December)
Athankarai Estuary	: $204.11 \text{ mgC/m}^2/\text{day}$ (October)– $1214.05 \text{ mgC/m}^2/\text{day}$ (May)

### *Madras*

Qualitative studies on phytoplankton conducted in the inshore area of Madras indicate that *Rhizosolenia* sp. bloom occurred during February and April in the plankton samples collected from 20-25 fathoms area. During May, *Thalassionema* sp., *Pleurosigma* spp., *Thalassiothrix* spp., and *Biddulphia* spp. also occurred in lesser abundance. Colonies of *Ceratium* spp. were present in limited numbers during April to June period.

### *Waltair*

Productivity investigations carried out at the outer harbour area of Visakhapatnam indicate that the net production was at a higher level during February ( $15 \text{ mgC/m}^3/\text{hr}$ ) in the enclosed area. During January, the production rate was  $13 \text{ mgC/m}^3/\text{hr}$  in the open sea. Decrease in trend of production was observed at both the places during the ensuing months. In the Bhimilipatinam area, high rate of production was noticed in March in the open sea ( $10 \text{ mgC/m}^3/\text{hr}$ ) and at the mouth of the backwaters it was  $22 \text{ mgC/m}^3/\text{hr}$  during February.

### **Phytoplankton and primary productivity (MBO/PP/1.2)**

C. P. Gopinathan, P. V. Ramachandran Nair, M. Vijayakumaran, V. Kunjukrishna Pillai, V. K. Balachandran, K. K. Valsala.

Altogether 51 stations were covered in the entire estuarine area from north Munambam to south Kumarakam including the Vembanad Lake.

Productivity measurements indicated that the middle region of the estuary near the prawn fields have high values of production ( $200 \text{ mgC/m}^3/\text{day}$ ) as compared to the interior regions due to the direct connection with the sea. Moderate or average values ( $50\text{--}200 \text{ mgC/m}^3/\text{day}$ ) were observed in the interior regions especially Cherai, Varapuzha, Chittoor and Vaduthala among the northern stations and southern stations such as Nettur, Kumbalam, Edacochin, Perumbalam, Poochackal etc., low values ( $50 \text{ mgC/m}^3/\text{day}$ ) were noticed in the prawn fields where there is connection with the main land.

Qualitative and quantitative assessment of the epifauna and quantitative estimation of the particulate organic matter (POM)

of the prawn fields around Cochin were conducted during the period under report. In the suspended POM, the quantity of detritus ranged from 13-74 % of the total volume. Metazoan plankton constituted about 35 % of the total detritus volume in the prawn fields north of Cochin. A rapid increase in the biogenic constituents (35-60 %) was noted in the southern area, especially in the fields around Edacochin and Poothotta.

Faunistic composition of the epifauna indicates that rotifers belonging to the genus *Brachionus* and larval and adult copepods belonging to the genera *Acartia*, *Pseudodiaptomus*, *Acartiella* and *Oithona* constituted the major components. Other groups such as radiolarians, foraminiferans, nematodes, polychaetes and bivalve larvae were present in fewer numbers in most of the prawn fields investigated.

The pattern of distribution of the major components of epifauna indicates that they are abundant mostly in the vicinity of Pallipuram, Cherai, Edacochin, Poothotta and around Thanner-mukkom in the south. They were moderately abundant in the areas near Perumbalam and Vaikom.

Direct correlation between the primary production rate and the abundance of epifauna was difficult to derive, but salinity has been found to have influence on their distribution in the areas investigated. Rotifers showed distinct abundance in most of the areas where gross production rate and the quantity of POM were relatively high.

The dominant fauna of the benthos were found to be molluscs (Bivalves and gastropods), polychaetes, amphipods, kinorinchids, isopods and cumaceans. The pattern of distribution indicates an abundance in stations located in the immediate vicinity of Cochin bar mouth, both to the north as well as to the south. This is in support of the high rate of primary and secondary production in the various other trophic levels observed in these areas. Moderate abundance of fauna were noticed in the southern regions, from Arookutty to Vaikom. The region lying south to the Thanneermukkom Bund appears to be the least productive as far as the benthic fauna are concerned.

Data on phosphorus and potassium of the benthos showed comparatively higher values in the areas of north. Total soluble salts showed an increase towards south and north and a decreasing

trend in the middle region. The percentage of organic carbon also showed almost the same pattern. The pH values ranged between 3.50 to 7.15.

#### **Secondary Production (MBO/PL/1)**

K. J. Mathew, K. Rengarajan, C. V. Mathew, K. G. Girijavallabhan, T. S. Naomi, S. Krishna Pillai, R. Marichamy, Pon. Siraimetan, C. M. Allikunju.

The studies on secondary production at various centres such as Madras, Tuticorin, Calicut, Mangalore, Karwar and Bombay showed that the rate of production differed at these centres during various months in 1978. The overall production was rich at Madras and Mangalore with, of course, wide fluctuations, while at Tuticorin it was almost moderate and uniform. For Bombay, Calicut and Karwar an estimate is difficult due to lack of regular data. However, at Bombay the standing crop of zooplankton was poor during the months of observations but the ever recorded maximum of 5.6 ml/10 minutes haul was registered at this centre in the month of December and it was due to the abundance of salps. In Karwar eventhough the investigations were started during the last quarter only, a steady decrease of zooplankton from October to December was clearly indicated.

#### *Madras*

In Madras offshore waters the zooplankton biomass was at its peak in January, May and August. Copepods and Chaetognaths were mainly responsible for the high values during January and May while in August the pelagic tunicates contributed to the bulk of the plankton. From January to March there was a gradual decline in the number of copepods and during the same period there was a steady increase in the number of tunicates. It is obvious that the herbivorous copepods might have avoided the areas where pelagic tunicates were abundant as tunicates are also voracious phytoplankton feeders. Chaetognaths occurred throughout the year and their peak was noticed during January to May. Swarming of cladocerans during summer months is an annual feature in the inshore waters. While the maximum number of fish eggs were taken during January and February, the fish larvae were more during April and May.



### *Tuticorin*

The standing crop of zooplankton in the inshore waters of Tuticorin fishing grounds varied from 3.7 to 12.3 ml/10 minutes haul. The copepods were found in large numbers during June-August period. Their minimum number was during September and October. The cladocerans were abundant in September. The decapods showed their peak in December and January. While the fish eggs were more in the plankton in October and the fish larvae were numerically abundant in June. The lucifers were rich in plankton during the first half of the year.

### *Calicut*

The displacement volume of zooplankton during the 3 months of observations was 4.9 ml, 9.1ml and 14.5 ml in March, November and December respectively per 10 minutes haul. The majority organisms of the zooplankton were copepods followed by Chaetognaths, lucifers, decapod larvae, siphonophores, medusae etc

### *Mangalore*

Off Ullal the zooplankton displacement volume was found to be high in January and December. Copepods were the dominant group in most of the months. The cladocerans were the major group during October-December period. In early December the pleurobrachia dominated the plankton.

### *Karwar*

The Investigations on secondary production in the Karwar Bay were initiated in October 1978. The zooplankton biomass declined from 19.1 ml to 9.0 ml per 10 minutes haul during the October-December period. The various groups of zooplankters in the order of their abundance were copepods, cladocerans, decapod larvae, lucifers, polychaete larvae, chaetognaths, bivalve larvae and fish eggs.

### *Bombay*

In Bombay waters the zooplankton biomass was comparatively less ranging from 5.9 ml in February to 1.73 ml in December. In November the displacement volume was 50.6 ml and it was due to the dominance of salps in the samples. Copepods were the

numerically abundant group in all the samples, and their peak was observed in September. Chaetognaths were found in all months. *S. inflata* was abundant in the month of December and this agreed with the previous years observations in the same month. Fish eggs and larvae were poorly represented.

#### **Fish eggs and larvae (MBO/FEL/1.1)**

C. Mukundan, K. Rengarajan, I. Davidraj, S. Krishna Pillai,  
K. G. Girijavallabhan, M. Rajagopalan, Pon Siraimectan.

The qualitative and quantitative analysis of the fish eggs and larvae obtained in the inshore and off-shore plankton samples was continued during the year from and four centres, Bombay, Cochin, Madras, and Tuticorin.

#### ***Bombay***

Fish eggs and larvae collected from the fishing grounds off Bombay were studied, from samples taken by the exploratory fishing vessel, Meena Bharati. Because of dry-docking and other repair work the collections were interrupted in January, April, August and October. Quantitatively the peak abundance of eggs was in September from the area 18-72 and least in February in the same area. The larvae were however, more abundant in March.

#### ***Cochin***

During the year collections from the deeper stations off Cochin, using the departmental boat, were not regular, as the samples had to be mostly confined to within the 20 m depth. Clupeid and anchovy eggs were the commonest here. Surf collections taken between Ponnani and Neendakara were analysed and eggs of Ambassis, mullets, Therapon, clupeids, gobiids and *Chanos* were among the common groups/species obtained. Part of the samples collected during the MURENA cruises was also analysed during the year.

#### ***Madras***

Fish eggs and larvae from plankton collected in area 13-80 (depth 20-25 m) were analysed. The collections were interrupted in November-December owing to repairs to boat, heavy monsoon

conditions, and also a port strike. The largest number of eggs was recorded in February and the least in July, while the larvae were most abundant in August and least in October. Carangid eggs were common during the first quarter, anchovy eggs in the later months. Saurida eggs were also available in good numbers in the second quarter.

#### *Tuticorin*

Plankton collections from the important fishing grounds—Harbour Point, Pinnakayal, and area 8-78/4B (depth 6-15 m) were analysed for fish eggs and larvae. The maximum number of eggs was obtained in June and the minimum in July, while for the larvae the maximum was in April and the minimum in September. There was no collection in November due to repairs to the vessel. Some of the hydrological factors at the stations concerned were also analysed during the year to examine possible aspects of correlation between these two.

#### **Survey of economically important seaweed resources (MBO/SW/1.1)**

V. S. K. Chennubhotla, S. Kalimuthu, M. Selvaraj, M. Najmuddin, J. R. Ramalingam, Radhakrishnan, Panigrahi.

Arrangements for conducting survey of the seaweed resources along Kerala coast are under way.

#### **Seaweed resources investigations (MBO/SW/1.2)**

V. S. K. Chennubhotla, S. Kalimuthu, Radhakrishnan, M. Selvaraj, and others.

Field culture of *Gracilaria edulis* and *Sargassum wightii* were continued in the Hare Island. Studies on the growth rate of *G. corticata* were continued in the field as well as in the laboratory at Vizhinjam. Seed material of *G. edulis* in the coir ropes on the northern side of the Island has grown well but grazing of the crop by predators was observed and hence the ropes were removed.

On the southern side 1063 coir ropes and 5 nos. of 5 x 2 m sized coir nets were introduced with seed material of *G. edulis*. Good growth was noticed in all ropes and nets. Comparatively, coir nets supported a good crop than ropes.

*Sargassum*, fragments introduced in coir nets did not show good growth and hence discontinued.

Culture experiments carried out in the laboratory at Vizhinjam with seedlings of *G. corticata* has given encouraging results. An average of 0.3 to 0.5 mm growth per day was observed. The seed material in the coir netting introduced in Vizhinjam Bay decayed due to silting.

#### Ecological energetics (MBO/EE/1.2)

C. P. Ramamirtham, V. Josanto, P. P. Pillai, V. K. Balachandran, I. David Raj, R. Vasanthakumar.

Regular observations were conducted at the fishing ground off Cochin at 5, 10, 20 m depth contours.

During late winter in January, temperature inversion was observed in the area which became prominent during March. During May-June, noticeable decrease in temperature occurred and the inversions observed in pre-monsoon period practically disappeared. Data collected during monsoon indicate that upwelling was prevalent during August and by September this feature began to disappear. Salinity and oxygen values were relatively low in the water column during monsoon, but in October a proportionate increase was observed on these values in the whole vertical column.

Gross primary production rate was low in June and high in October in the estuarine sector of the fishing ground. Similar trend of production was noted in the marine area.

Biomass values of zooplankton ranged from 0.42-15.8 ml/100 l during the period of study. Major peaks were observed during November-December period in the estuarine area (3.92 and 3.5 ml/100 l) and during August-September at the inshore station (6.60 and 15.8 ml/l). During monsoon season, faunistic depletion was observed. Carnivorous groups dominated the samples collected from the marine area whereas herbivorous forms were predominant in the estuarine waters. Secondary production studies at two trophic levels show average values of 36.6 gC/m<sup>3</sup> and 7.1 gC/m<sup>3</sup> for carnivorous zooplankton and 13.3 gC/m<sup>3</sup> and 5.1 gC/m<sup>3</sup> for herbivorous forms at the inshore and estuarine sectors of the fishing grounds.

Studies on the faunistic composition in the trawl catches indicate that during June, *Leiognathus* sp. and during July *Johnius ossens* dominated the fish fauna of the ground. Sciaenids were represented during September to December. October-November period was characterised by the presence of jelly fishes and squilla (*Oratosquilla napa*). Fishery improved by November-December and major constituents during this period were sciaenids, mackerel and prawns (*Penaeus indicus*, *Metapenaeus dobsoni*).

#### Benthos of the fishing grounds (MBO/BF/1.1)

V. Kunjukrishna Pillai, C. P. Gopinathan, V. Chandrika, M. Ayyappan Pillai, K. K. Valsala.

Short-term and long-term studies were carried out on the effects of the *Salvinia* weed deposits on the ecosystem in the fishing grounds off Cochin. Productivity measurements using  $^{14}\text{C}$  on water and mud samples indicate that during May-June the production rates of the surface water was high and that at the bottom regions moderate, with values  $150 \text{ mgC/m}^3/\text{day}$  and  $50 \text{ mgC/m}^3/\text{day}$  respectively. Production rate in the mud samples was very low ( $10 \text{ mgC/m}^3/\text{day}$ ). Benthic fauna were represented by 11 groups of which Foraminiferans were represented in maximum numbers. Polychaetes were abundant in terms of biomass and were represented by the families Nephtyidae, Glyceridae and Spionidae. Other groups met with in the samples were Sipunculids, echinurans, molluscs composed of *Arca*, *Nassa* and *Dentalium* calanoid copepods, amphipods, nematods and cake urchins (Echinoderm). Young stages of *Tellina* sp. also were met with, but most of them were in a decomposed stage.

Further a wax extract which appears to be characteristic of *Salvinia* has been found to be existing in the deposits. Analysis of the samples indicate that wax is persistent in the benthic areas in the fishing grounds, and its concentration decreased towards the inshore fishing areas. Quantitative estimates were being made to estimate its effects on the living resources of the area.

In sea water samples, the average population of proteolytic, anylolytic and lipolytic organisms were less; sediment samples harboured maximum population. Water sediment ratio of uneolytic, gelatinolytic, chitinolytic, caseinolytic, amylolytic and lipolytic micro organisms declined in the southern area of the fishing grounds which indicate the formation of a different environment in the area where weeds ultimately settle down.

## Mass culturing of plankters (MBO/MCP/1)

P. V. Ramachandran Nair, D. C. V. Easterson, V. K. Balachandran, M. Ayyappan Pillai, P. K. Martin Thompson, C. M. James.

### Cochin

Action spectrum and maximum absorption concentration against optical density were determined spectrophotometrically using various unialgal cultures.

At Narakkal, large scale culture of *Thalassiosira subtilis*, *Chaetoceros affinis* and *Chlorella marina* have been started in enriched media under aeration using artificial light conditions. 1500 litres of *T. subtilis* and 200 litres of *C. affinis* have been supplied in its exponential growth phase for feeding the larvae of, *Penaeus indicus*, *P. monodon* and *Metapenaeus dobsoni*.

Decapsulation of *Artemia* eggs have been carried out successfully using Sodium hypochlorite. This enhanced direct feeding of prawn larvae with decapsulated eggs helped to avoid the interference of empty cysts and delay in hatching time.

Perfected techniques for the isolation and mass culture of the rotifer, *Brachionus urceolaris* in the plastic pools and concentrations upto 6.5 lakhs/l could be raised under laboratory conditions. Isolation and mass culturing of certain species of copepods are being attempted.

### Madras (Kovalam)

Two species of phytoplankton, *Thalassiosira subtilis* and *Chlorella* sp. were maintained in the laboratory. Feeding experiments have been conducted with mussels for testing the acceptability of *Phormidium* (blue green alga). Cultures of different concentrations were experimentally tried and a density of about  $1 \times 10^5$  cells/ml appears to be most acceptable.

### Tuticorin

Six species of phytoplankters such as *Synechocystis salina*, *Tetraselmis gracilis*, *Oscillatoria* sp., *Chlorella* sp. and *Phormidium* sp. were maintained in the laboratory and supplied for feeding experiments in the pearl oyster hatcheries.

## Marine Pollution (MBO/MP/1.1)

P. V. Ramachandran Nair, M. V. Pai, G. G. Annigeri, M. S. Rajagopalan, C. P. Gopinathan, V. Kunjukrishna Pillai, V. Chandrika, K. G. Girijavallabhan, S. Muthuswamy, R. Marichamy, M. Selvaraj, P. Karuppaswamy, D. Vincent and others.

### Karwar

Investigations on marine pollution was continued and five parameters, viz. temperature, pH, residual chlorine, dissolved oxygen and salinity were monitored regularly each week at stations in the Nullah, confluence of Nullah and sea, and sea. Phytoplankton samples were collected at these stations study to the effects of effluents on the phytoplankton and production in this area. Samples were also drawn from the factory sump for studying the hydrological factors. The effects of the effluents on fish and other forms of life in the Nullah and the sea were studied by collecting samples regularly and examining them. It was observed that the prime hydrological factors such as temperature, pH and residual chlorine were within the permissible limits.

Fish mortality was detected in the Nullah during August. Acidic reaction of the Nullah waters caused this incident. The bulk of the dead fish aggregating to about one tonne comprised of *Mugil parsia* and *Etroplus suratensis* followed by *Gobius* sp., *Gerres oblongus* and cat fishes.

### Calicut

Following the grounding of a cargo vessel at Ezhimalai near Payyannur in August, a team from Calicut Research Centre visited the spot. Monitoring of the important parameters were carried out. It was observed that there was no serious pollution as the spill expected was only very little. The available oil in the ship is expected to be pumped out to avoid pollution.

### Cochin

Two pollution monitoring surveys were conducted from Ambalamugal to Cochin Harbour Area to study the water pollution in the Chitrapuzha river due to the effluents discharged from the FACT (CD). High dissolved oxygen values (10.2 ml/l) no-

ticed in the upper reaches of the river during the surveys has been attributed either to the interference of free ammonia which is the major pollutant of this area or due to eutrophication. Very low values of primary production was observed in the factory site, but it increased downstream and average values were obtained at the river mouth leading to the Cochin backwaters.

Three sensitive bacterial indicators namely, coliforms, faecal coliform and faecal streptococci were selected for monitoring fishery water quality in the offshore region from 10, 20, 30, and 40 m depths. The faecal index range from 0.6 in January to 4.8 in March. The faecal index was above 4 in March, April, July, August and November which shows that the sources of pollution for other months is from animal wastes. Water/sediment ratio of Ureolytic, proteolytic, anylolytic and lipolytic micro-organisms delivered in the areas where there was more *Salvinia* deposits.

42 pure bacterial strains were isolated. They belonged to Enterobacteriaceae with active fermentative capacity of various sugars. *Acetobacter*, *Enterobacter*, *Serratia*, *Klesiella*, *Escherichia coli*, *Citrobacter*, *Aeromonas proteus* and *Providencia* are the main groups of organisms isolated.

Based on the faecal index of sea-surface water in March, April, July, August and November months the offshore region from 10, 20 m depth were considered most polluted areas by sewage and other drainage means.

#### *Mandapam Camp*

Regular pollution monitoring surveys were made at the fish meal plant site at Mandapam. Water samples collected at the factory site and away from it revealed that there has been not much pollution in this area.

#### *Madras*

A preliminary survey conducted on the potential source of marine pollution along the Madras Coast indicate that the solid wastes, especially the fly ash from the Ennore Thermal Station were being conveyed into the sea. Closure of the bar mouth of rivers like Coovum and Adayar during the early part of the year barred the flow from these rivers into the sea.



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

C. S. Gopinadha Pillai and others.

Detailed survey of the coral formations of Gulf of Kutch along the coast of Gujarat was carried out and 20 genera of corals were identified. The coral formation was observed to be patchy in this region and it was found that the area is not ideal for coral growth due to the high interference of silt.

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

M. S. Rajagopalan, C. S. Gopinadha Pillai, C. P. Gopinathan, G. S. Daniel Selvaraj, P. M. Aboobaker, A. Kanagam, A. Bastin Fernando and others.

Observations on ecological aspects were continued in the mangrove swamps situated in the Cochin backwater, and also at Tuticorin.

During February-March, a four week survey in the mangrove areas of Gulf of Kutch was conducted to study the special type of ecosystem prevailing in these areas. The mangrove areas in general were patchy and a limited number vegetation was seen in these areas. The dominating plants are *Avicennia marina* and *Rhizophora mucronata* and the vegetation does not exhibit distinct zonation.

The mudflats in the mangrove areas exposes to about 2 to 3 km in certain areas near Dwarka and the south western coastal regions of the Gulf at low tides. Mud puppies are abundant in these areas. The usual compliment of gastropods, *Cerithidia*, fidler and other crabs, gobioid fishes were observed as resident fauna in the mangrove areas.

In the mangrove creeks subjected to tidal variations, juveniles of fishes such as mullets and *Therapon* and prawns were abundant as migratory fauna. The creeks near Dwarka and Mitapur serve as fry collection centres for mullets. The possibilities of developing mariculture of fishes, prawns and molluscs are good in these areas. The coastal stretch from Okha to Porbunder may provide the necessary seed resources of finfish and shellfishes.

## Investigations on Sponges (MBO/SP/1.1)

P. A. Thomas, K. Ramadoss and others

### Goa

The investigations on the pathogenic sponges of the Goa coast showed that the boring sponge *Cliona vastipica* infests the rock oysters in the estuaries of Goa. About 60 % of the natural populations of windowpane oysters are infested with this species of sponge. The upper flat valves of these oysters are the most susceptible to infestation and due to this, these valves are often discarded by this mollusc.

Racial studies pertaining to *C. vastipica* are under progress.

### Tuticorin

A study of a sample of pearl oyster shells attached by *C. vastipica* from the culture rafts revealed that the umbo and the right shell were the main targets of attack. The juvenile liberation factor of this sponge is found to be very high during February at Tuticorin.

The following pathological symptoms were noticed in the pearl oyster. 1. Porosis, 2. Pustulosis, 3. Lysis, 4. Rugosis, 5. Naereosis.

**Survey of prawn, fish and molluscan (Bivalve) seed resources  
(CMFRI/IDP/1)**

E. G. Silas, K. Rengarajan, M. Rajagopalan, K. S. Sundaram,  
K. M. Ameer Hamsa, P. Nammalwar, R. Thiagarajan, G.  
Nandakumar, S. Shanmugam, A. Bastin Fernando, K.  
Prabhakaran Nair, S. Lazarus, K. J. Mathew, G. S. Daniel  
Selvaraj, K. N. Gopalakrishnan R. S. Lal Mohan, K. V.  
Somasekharan Nair, Gopinatha Menon, P. Ramadoss, K.  
Nandakumaran

*Work done*

The work done from January 1976 to May 1978 was reviewed and it was decided to publish the results obtained so far as a Bulletin under the following heads: Topography and hydrography of the data collection centres, relative abundance of seeds of various species of prawns and fishes, seasonal abundance of seeds, seasonal size distribution of seeds, areas suitable for seed collection and culture and areas of pollution.

Results of observations conducted on the quantitative abundance of prawn and fish seeds in the surf areas from Neendakara to Ponnai will be published soon.

Extensive surveys were conducted along the Kerala and Tamil Nadu coasts to identify sites suitable for brackish water prawn/fish farming. Vast stretches of semicultivated or barren areas which could be profitably converted into seasonal or perinneal farms have been located. The surveys included estimation of abundance of seeds of various species in each location.

*Calicut:* There were large concentration of seeds of *Penaeus indicus* and *Metapenaeus dobsoni* in the surf and estuaries between Azhikode and Badagara during March, mullet seeds between

Badagara and Ferooke in March and seeds of the green mussel in Azhikode, Edakkadu, Dharmadam, Mahe, Chombala, Tikkodi, Elathur and Kadalundi.

About 1000 hectares of seasonal inundated brakish water areas in the Cannanore and Calicut districts were found suitable for prawn culture.

**Cochin:** Diurnal observations indicated that prawn seeds are abundant during the new moon phase whereas mullet fries were abundant during the full moon phase. Several sites were identified between Ponnani and Neendakara as suitable for aquaculture. One such farm at Ayiramthengu has been adopted by this Institute under the 'Lab-to-Land' Programme for prawn culture in connection with the Golden Jubilee Celebrations of the ICAR during 1979.

**Vizhinjam:** Mullet fries below 20 mm size were abundant in all the centres of observations between Marukudi and Paravoor. They concentrated during the new moon phase. In the centres at Perumthura, Edava and Paravoor sillago fry were abundant especially during the mid-lunar phase.

**Mandapam:** In the Palk Bay and Gulf of Mannar area post larvae and juveniles of *P. indicus* were abundant in January, April-May and October. *Chanos* fry were abundant in the Pamban tidal pools and in the Mandoli island mullet fry were abundant.

**Madras:** Live *Penaeus monodon* juveniles could be collected at Point Calimere and transported to Madras by road without oxygenation or change of water.

#### **Investigations on fish and shell fish diseases (CMFRI/IDP/2)**

S. Mahadevan, G. S. Daniel Selvaraj, C. Thankappan Pillai, S. Lazarus, K. Dorairaj, K. Rengarajan and others.

#### **Salient findings:**

**At Cochin:** The aetiological agent of the soft shell disease in prawns at Narakkal was diagnosed to be the pathogenic bacteria *Vibrio anguillarum*. The infection caused mass mortality of *Penaeus*

*indicus* numbering nearly 1500-2000 nos. at the co-operative intensive prawn farming at Narakkal. A case of *Haemorrhagic septicaemia* in *Mugil* spp. at Narakkal was documented and further studies are in progress. Timely treatment was given to the milk fish *Chanos chanos* suffering from this disease with the disinfectant brilliant green. *Pseudomonas alcaligenus* were found to cause the above two diseases.

*At Mandapam Camp:* Studies on diseases of cultured eels revealed that gill-rot caused by *P. columnaris* was the commonest disease of eels in culture ponds. One sided eye blindness was also occasionally met with. Despite isolation and maintenance in aerated water eels infected thus eventually died. A third kind of disease due to the infection of the gall bladder caused by rod shaped bacteria has been recorded. The bacteria are being identified. In June 1978 incidence of the cripple body disease was observed. The protozoan parasite *Pleistophora* seems to be the cause of this infection.

*At Tuticorin:* Bryozoans encrusting cultured mussels and pearl oysters were removed. Periodical occurrence of death of shells on culture ropes seem to be caused by a planarian which invariably occupies these dead shells. Parasitic infestation of commercially important fishes by parasitic isopods and copepods was recorded.

*At Madras:* At the Kovalam farm no instance of mussel mortality was noted.

#### **National programme of tagging oil sardine, mackerel and prawns (CMFRI/IDP/3)**

P. Vijayaraghavan, A. Noble, M. M. Thomas, N. Gopinadha Menon, N. S. Radhakrishnan and others.

#### *Salient findings*

Of a total of 3685 prawns marked and released in the backwaters near Bolghatty (Vembanad lake) 5 prawns belonging to species *Penaeus indicus* were recovered from the usual trawling ground in the sea off Nayarambalam, roughly 10 km from the place of release. Their rate of growth was 1-1.4 mm per day, which did not differ greatly from what was recorded (0.8-1.3 mm) in the backwaters and (0.5-1 mm) in the experimental pond.

**Work done:** Besides continuing the tagging programme at Cochin, it was initiated at Calicut and Mangalore during the year. **At Cochin:** Tagging operations at sea—A total of 4125 prawns (species *Penaeus indicus*, *P. semisulcatus*, *Matapenaeus dobsoni*, *M. monoceros*, *M. affinis* and *Parapenaeopsis styliifera*), 15 mackerel and 392 oil sardine were tagged and released in the open sea off Cochin during the first quarter of the year. In the 2nd, 3rd and 4th quarters no tagging could be undertaken due to rough sea and weather.

Except prawns, there has been no recovery of either mackerel or oil sardine. Recoveries of prawns confirmed the earlier observations that the species involved scarcely migrated beyond their place of release. Their growth rate was 1-1.4 mm per day.

**Tagging operations in back waters—**A total of 3936 juvenile prawns (*P. indicus*, *P. semisulcatus* and *M. monodon*) were tagged and released in the backwaters at Bolghatty and Perumbalam. Of these, 25 prawns from Bolghatty and 7 from Perumbalam were recovered within 2 weeks of their release and within 2-3 km from their place of release. However, 5 marked prawns which were released at Bolghatty were recaptured in the trawlers off Nayarambalam in the open sea. A growth of 0.5-1. mm per day was recorded in the prawns released at Perumbalam and 0.8-1.3 mm per day among those released at Bolghatty.

Of the 1466 prawns tagged and released in the experimental pond at Perumbalam a growth rate of 0.5-1 mm per day was observed.

**At Calicut** Tagging operations at sea—The work was started during the last quarter of the year. In the sea, 300 oil sardine were tagged and released off West Hill and 146 prawns (spp. *M. dobsoni*, *P. styliifera* and *P. monodon*) were marked and released. There has been no recovery yet.

**Tagging operations in backwater—**435 tagged prawns (*P. indicus*, *P. monodon*, *M. monoceros* and *M. dobsoni*) were released in the estuary at Koorapuzha. Of these, 10 prawns were recovered within the same month in the estuary itself.

**At Mangalore** Though preparations for tagging were completed early in the year, no fish could be tagged since the departmental pablu boat was too small to go out into the sea in the fishing season when the sea was rather rough and on a single trip that could be undertaken, neither mackerel or oil sardine could be procured.

**National Tagging Programme: Tagging of cat-fishes  
(CMFRI/IDP/4)**

P. Mozumdar, T. Appa Rao, S. Reuben, S. S. Dan, P. E. Sampson Manickam, B. Narayana Rao.

*At Waltair* Tagging of cat-fishes had been entirely dependent on the short voyages of the vessels of Govt. of India Exploratory Fisheries Project. Since during this year these vessels were fully engaged in long voyages and as single day fishing trips could not be arranged, it was not possible to undertake any cat-fish tagging operation during this year.

**Fishery resources of the economic zone—Exploration of fishery resources of the continental shelf edge and oceanic waters of India's economic zone (CMFRI/IDP/5)**

S. V. Bapat, B. Krishnamurthy, M. V. Pai, C. Mukundan, R. S. Lal Mohan, C. Muthiah and others.

In the absence of any offshore fishing vessel which can fish beyond the 40 fathoms line and areas covered by the Exclusive Economic Zone, no major effort to collect data on the resources could be made.

Data collected during 1977 by the associates during the six cruises of *M. T. Murena* were processed and a final draft report was prepared. The report gives a detailed account of the conventional and non-conventional fishery resources, their distribution pattern and abundance in time and space. Biological notes on a few selected species in respect of length frequency, maturation and food and feed having also been covered by the report.

**Artificial enrichment of lagoon waters of Minicoy Island  
(CMFRI/IDP/6)**

A. V. S. Murty, G. Subbaraju, V. Josanto, K. J. Mathew  
During the year the relevant literature was being collected.

**Impact of Thannermukam Bund on the fisheries of the Vembanad Lake (CMFRI/IDP/7)**

P. Vedavyasa Rao, S. K. Dharmaraja, K. K. P. Panikkar, V. Josanto, C. Suseelan, M. Kathirvel, V. Kunjukrishna Pillai, K. J. Mathew, G. Radhakrishnan, G. S. Daniel Selvaraj and M. Ayyappan Pillai.

### *The Background*

To increase paddy cultivation in approximately 50,000 ha. of low-lying fields in Kuttanad, a scheme for preventing saline water from the sea entering the fields, a scheme for the construction of a bund across the Vembanad Lake at Thannirmukom was initiated in the 1960 which became operative with the completion of the Cofferdam and closure of shutters in 1976. The final phase of the construction was begun in 1978.

While the construction of this barrier has considerably helped to augment paddy production of the State it has brought in a number of problems concerning the natural ecosystems of the lake, its fisheries and other living resources, and the socio-economic conditions of the people inhabiting in that area. It is also apprehended that certain crops like coconut and industries like coir are also adversely affected. Accumulation of unused fertilisers, leaching of pesticides and luxuriant growth of undesirable aquatic weeds pose problems of pollution and necessitate measures for the conservation and management of the ecology and resources of the area.

It was in this context that this project was initiated this year to make a comprehensive investigation on the impact of the bund on the ecology and living resources of the lake, particularly on the fishery resources.

### *Work done*

On the basis of a preliminary survey of the area, stations were fixed on either side of the bund to collect regularly data on the environmental parameters, distribution pattern and seasonal abundance of various organisms, on the fishery of prawns, molluscs and fishes and on the socio-economic conditions of the people.

During the dry March-April season the salinity of the lake water south of the bund was 3‰ and in the northern side 10‰. During monsoon when the sluices were opened there are no differences in salinity in the lake water upto Aroor. The benthic fauna was represented principally by the small bivalves, gastropods, polychaetes and amphipods, they being more abundant in the stations north of the bund. *Villorita cyprinoides* mainly and *V. caribicula* are fished throughout the year, their shell being purchased by a co-operative society at Pallipuram and the flesh sold



in the local markets. Small-sized (about 23 mm) *Penaeus indicus* were caught in this area upto Pallipuram in April. *Metapenaeus dobsoni* (41-70 mm), *M. monoceros* (61-85 mm) were the other prawns caught in this area using stake nets to the north and drag nets to the south of Thanneermukom bund. During monsoon *M. rosenbergii* of (130-205 mm size) occurred between Thanneermukom and Muhamma in the cast net catches. This fishery was relatively poor in the northern side of the bund.

It was reported that the catch of prawns around the bund was relatively of lesser magnitude during the last couple of years after the commission of the Thanneermukom scheme. Consequently, most of the fishermen engaged in prawn fishing have now taken up other avocations.

#### Nutritional physiology of fish and shell fish (CMFRI/IDP/8)

P. V. Ramachandran Nair, M. S. Muthu, M. Vijayakumaran, A. Lakshminarayana, M. Rajamani, D. C. V. Easterson, C. V. Mathew, C. M. James, M. Ayyappan Pillai, M. Narayanan and others.

During the period under report, experiments were carried out with the juveniles of *Penaeus indicus*, *P. monodon* and *Metapenaeus dobsoni* to study the rate of intake, absorption and conversion and efficiencies of absorption and conversion of energy.

The average intake of energy was found to be in the order of 0.159, 0.149 Cal/individual/day respectively for I, II, and III five days (Table 13). The trend indicated that beyond a period of 10 days, continuous feeding with the same type of feed results in the decreased intake of energy. It is believed that a change in the quality of feed might have resulted in more intake. The absorption efficiency of energy (worked out for the first ten days were found) was found to be as high as 98% (Table 14).

A comparative study on the utilisation of two types of synthetic feed by *M. dobsoni* (one with animal matter and the other without animal matter) revealed that when animal matter is incorporated the intake increased to a considerable extent in terms of both dry weight and energy.

**Table 13.** *Time course trend in the intake of energy*

Period	Group	Dry wt. of food consumed (g/individual)	Energy consumed	
			(Cal/individual)	(Cal/individual/day)
Ist five days	1	0.163	0.752	0.150
	2	0.181	0.835	0.167
IIInd five days	1	0.235	1.084	0.217
	2	0.264	1.218	0.244
IIIrd five days	1	0.175	0.798	0.160
	2	0.148	0.683	0.137

**Table 14.** *Absorption efficiency of energy during the first ten days' period*

Group	Energy consumed	Energy in faeces	Energy absorbed		Absorption efficiency(%)
	(Cal/10 days)	(Cal/10 days)	(Cal/10 days)	(Cal/day)	
1	1.836	0.054	1.782	0.178	97.06
2	2.053	0.041	2.012	0.201	98.00

#### Inter-Institutional Projects

##### Fish/Prawn feed development for intensive culture (CMFRI/IIP/1)

Syed Ahamed Ali, M. Vijayakumaran, M. Kathirvel and  
Scientists of CIFT

##### *Salient features*

The work was undertaken at the CMFRI laboratories at Narakkal and Kovalam by the scientists of the Institute in collaboration with scientists of CIFT.

At Narakkal, four types of pellet feeds of 3 mm diameter were prepared with prawn waste, powdered squilla, clam meat powder, fish meal powder, ground nut cake powder and tapioca powder.

in the local markets. Small-sized (about 23 mm) *Penaeus indicus* were caught in this area upto Pallipuram in April. *Metapenaeus dobsoni* (41-70 mm), *M. monoceros* (61-85 mm) were the other prawns caught in this area using stake nets to the north and drag nets to the south of Thanneermukom bund. During monsoon *M. rosenbergii* of (130-205 mm size) occurred between Thanneermukom and Muhamma in the cast net catches. This fishery was relatively poor in the northern side of the bund.

It was reported that the catch of prawns around the bund was relatively of lesser magnitude during the last couple of years after the commission of the Thanneermukom scheme. Consequently, most of the fishermen engaged in prawn fishing have now taken up other avocations.

#### **Nutritional physiology of fish and shell fish (CMFRI/IDP/8)**

P. V. Ramachandran Nair, M. S. Muthu, M. Vijayakumaran, A. Lakshminarayana, M. Rajamani, D. C. V. Easterson, C. V. Mathew, C. M. James, M. Ayyappan Pillai, M. Narayanan and others.

During the period under report, experiments were carried out with the juveniles of *Penaeus indicus*, *P. monodon* and *Metapenaeus dobsoni* to study the rate of intake, absorption and conversion and efficiencies of absorption and conversion of energy.

The average intake of energy was found to be in the order of 0.159, 0.149 Cal/individual/day respectively for I, II, and III five days (Table 13). The trend indicated that beyond a period of 10 days, continuous feeding with the same type of feed results in the decreased intake of energy. It is believed that a change in the quality of feed might have resulted in more intake. The absorption efficiency of energy (worked out for the first ten days were found) was found to be as high as 98% (Table 14).

A comparative study on the utilisation of two types of synthetic feed by *M. dobsoni* (one with animal matter and the other without animal matter) revealed that when animal matter is incorporated the intake increased to a considerable extent in terms of both dry weight and energy.

**Table 13.** *Time course trend in the intake of energy*

Period	Group	Dry wt. of food consu- med (g/indi- vidual)	Energy consumed	
			(Cal/indi- vidual)	(Cal/indi- vidual/day)
Ist five days	1	0.163	0.752	0.150
	2	0.181	0.835	0.167
IInd five days	1	0.235	1.084	0.217
	2	0.264	1.218	0.244
IIId five days	1	0.175	0.798	0.160
	2	0.148	0.683	0.137

**Table 14.** *Absorption efficiency of energy during the first ten days' period*

Group	Energy consumed	Energy in faeces	Energy absorbed		Absorption efficiency(%)
	(Cal/10 days)	(Cal/10 days)	(Cal/10 days)	(Cal/day)	
1	1.836	0.054	1.782	0.178	97.06
2	2.053	0.041	2.012	0.201	98.00

#### Inter-Institutional Projects

##### **Fish/Prawn feed development for intensive culture (CMFRI/IIP/1)**

Syed Ahamed Ali, M. Vijayakumaran, M. Kathirvel and  
Scientists of CIFT

##### *Salient features*

The work was undertaken at the CMFRI laboratories at Narakkal and Kovalam by the scientists of the Institute in collaboration with scientists of CIFT.

At Narakkal, four types of pellet feeds of 3 mm diameter were prepared with prawn waste, powdered squilla, clam meat powder, fish meal powder, ground nut cake powder and tapioca powder.

**Table 15. Protein content of raw materials used.**

<i>Ingredients</i>	<i>Crude Protein % on dry bases</i>
Prawn waste	39.86
Prawn meat ( <i>Villorita cyprinoides</i> )	48.65
Squilla powder ( <i>Oraotosquilla nepa</i> )	64.26
Fish meal powder	66.91
Ground nut cake powder	57.98
Tapioca powder	2.00

**Table 16. Composition of experimental feeds.**

<i>Ingredients %</i>	<i>Feed No. 1</i>	<i>Feed No. 2</i>	<i>Feed No. 3</i>	<i>Feed No. 4</i>
Groundnut cake powder	35.0	38.0	40.0	35.0
Tapioca powder	17.0	31.0	19.0	37.0
Prawn waste	45.0	—	—	—
Squilla powder	—	28.0	—	—
Clam meat powder	—	—	38.0	—
Fish meat powder	—	—	—	25.0
Minerals mix	2.0	2.0	2.0	2.0
Vitamin mix	1.0	1.0	1.0	1.0
% of crude protein on dry basis	337.60	40.97	40.35	30.07

Preliminary growth rate experiments performed on juveniles (19.4 mm to 26.05 mm mean size) of *Penaeus indicus* indicated that feeds made of squilla powder and clam meat powder gave the best results. Feeding with mantle of fresh mussel did not give encouraging results.

At Kovalam, preparation of pellet feeds using clam meat (*Meretrix casta*), prawn waste, fish meal, groundnut cake, rice bran and tapioca powder is in progress. It is proposed to feed *Panulirus homarus*, *P. Polyphagus* and *P. ornatus* with those artificial feeds.

**Operation of conventional and experimental 'Dol' nets from two centres, viz., Bassein and Nawabunder (IIP/2)**

S. V. Bapat, Alexander Kurien, S. Seetharaman, M. Z. Khan  
M. Jayachandran and CIFT staff.

The 'Dol' net for operation from Nawabunder in Gujarat has been designed and fabricated and handed over to the Veraval

Research Centre. The net will be put into operation in February 1979. The same design has been adopted for operation from Bassein also so that the results could be compared. Its fabrication is in progress.

**Product development and quality control of molluscan products (IIP/3)**

K. Alagarwami, A. C. C. Victor and S. Dharmaraj.

Preliminary and preparatory work connected with the project was attended to discussions were held with scientists of the Central Institute of Fisheries Technology for preparing a detailed plan of work and procedures to be adopted in the implementation of the project.

**Demonstration Projects**

**Demonstration in Pearl oyster culture and pearl production (CMFRI/PP/1)**

K. Alagarwami, A. Chellam, A. C. C. Victor, S. Dharmaraj, T. S. Velayudhan, A. D. Gandhi, J. Antony Pitchai, Dasman Fernando and Soosai V. Raghu.

The scientists attached to pearl culture work were given intensive training in nucleus implantation techniques. Their attainments in adoption of the techniques were evaluated and constant improvements were made. A team of scientists who could successfully carry out this vital programme was prepared for the Demonstration Project.

Oyster collection programme were intensified to increase the stock of pearl oysters in the farm.

**Demonstration in Edible Oyster Culture (CMFRI/PP/2)**

P. Muthiah, R. Thangavel, N. Vaithianathan, M. Manivasagam, G. Srinivasan and others.

*Salient features*

Spat collection work was intensified but the natural bed did not yield the necessary quantity of spat during the peak spawning

Research Centre. The net will be put into operation in February 1979. The same design has been adopted for operation from Bassein also so that the results could be compared. Its fabrication is in progress.

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*Salient features*

Spat collection work was intensified but the natural bed did not yield the necessary quantity of spat during the peak spawning

period. The change in the location of farm to the open sea conditions posed predation problem by gastropods. Otherwise the oysters maintained steady and encouraging growth rate.

#### *Work contemplated*

It is proposed to expand the farm to 200 racks and raise a stock of 5 lakhs of oysters to yield 100 tonnes of oysters.

#### **Demonstration in mussel culture (CMFRI/PP/3)**

P. S. Kuriakose, V. G. Surendranathan and M. P. Sivadasan.

#### *Salient features*

The demonstration project on the open sea mussel culture at Calicut was started in September 1978. Altogether six units of rafts (each unit covering a surface area of 275 square metres) were fabricated and floated in the open sea at a depth of 8 metres. The total surface of all the rafts together is about 0.2 hectare. A total 2400 ropes each of 7 metres length have been seeded and suspended from the rafts. The growth of the juvenile mussels in the farm is very rapid and is at the rate of 16 mm per month. At an estimated rate of 30 Kg. of mussels per rope, the final harvest in March is expected to yield a total of 60 tonnes.

#### *Works Contemplated*

It is proposed to intensify demonstration programme in 1979.

#### **Demonstration Project in seaweed culture (CMFRI/PP/4)**

V. S. Krishnamurthy Chennubhotla.

No demonstration was undertaken during this year. However, it is planned to organise four demonstrations during 1979.

#### **Elver Resources Survey and Eel Culture (SPP/1)**

K. Dorairaj.

The project was initiated on November 15th 1978. By December the sea shore pools at Vedalai and Seeniyappa Dharga around Mandapam the low lying backwaters at Kadarshapad,



the Athankarai ferry point and the Srivaikundam Anicut on Tambraparani were surveyed. 7955 glass eels and elvers of *Anguilla bicolor* and *A. bengalensis* weighing 3586.5 g were collected from these centres and transferred in fish tincarriers to the culture laboratory at Mandapam.

### Training Programmes

#### Training in Marine Prawn Culture (CMFRI/TR1)

P. V. Rao, S. Ramamurthy, M. M. Kunju, P. V. R. Nair, K. Alagaraja, M. S. Muthu, M. M. Thomas, C. Suseelan, N. S. Kurup, S. K. Pandian, M. Rajamani, A. Laxminarayana, N. N. Pillai, M. Kathirvel and C. M. James.

A training course for research/managerial/developmental personnel in various aspects of marine prawn culture at postgraduate level was conducted from 24th April to 3rd June, 1978. Twelve officers sponsored by the Department of Fisheries of Gujarat, Maharashtra, Kerala, Karnataka, Tamilnadu, and Andhra Pradesh and by the Marine Products Export Development Authority, Cochin as well as by this Institute underwent training which consisted of lectures, demonstrations, discussions and practical exercises based on the latest developments in marine prawn culture.

Ten quality Supervisors of the Marine Products Export Development Authority, Cochin, were given training in the identification of the commercially important prawns, lobsters and crabs in September, 1978.

The ARS Probation Officers who joined the Institute during the year were trained in the biology, fishery, and culture of crustaceans as part of the Institute's training to them.

Mr. Ali Poernomo Tirthoredgo, Director of the Shrimp Culture Research Centre, Japara, Indonesia, was attached with the Crustacean Fisheries Division from 11th November 1977 to 24th January 1978 to study techniques of prawn filtration/culture in the paddy fields of Kerala. Besides undergoing training in various aspects of prawn culture in the paddy fields, he visited the Research Centres of the Institute at Tuticorin and Madras. Following this, Mr. Ebrahim Abdul Rahim Abdul Qadir, Research Officer, Fisheries Resources Bureau, Ministry of Commerce and Agriculture, Baharin, underwent a training in shrimp biology and

Small-scale fisheries for two months. He was given intensive training on taxonomy, distribution, nutrition, age and growth, maturation and spawning, mark-recovery experiments and population characteristics of the commercially important prawns. He also visited the Regional Centre, Mandapam Camp to observe the fishing of *Penaeus semisulcatus* which forms an important fishery in his country.

#### *Work contemplated*

Advanced Training Course on marine prawn culture will be organised and conducted for the Research/Managerial personnel in the Government, Public and Private Sector organisations.

#### **Training in Pearl Culture: (TR/2)**

K. Alagarswami.

It was decided to organise the second short-term Training Course in Pearl Culture early in 1979 and preparatory work was carried out towards that. Hence no training programme was taken up during the year 1978.

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

K. Nagappan Nair.

#### *Salient features:*

Large scale collection of spat of edible oysters during spawning season in April and October was not satisfactory to the expectation. This posed a major problem in initiating the training programme as proposed. The closing of the Karapad creek mouth for a considerable period also delayed the implementation of the programme. Therefore, the programme could not be started in 1978.

#### *Work contemplated:*

During the Golden Jubilee year of the ICAR this programme will be implemented as part of the Lab to Land Programme.

## **Training in SCUBA underwater diving (CMFRI/TR/4)**

S. Mahadevan.

### *Salient features:*

The training programme could not be started during the year since the associates were engaged in priority programmes of the Institute.

### *Work contemplated:*

The training programmes will be taken up during the fair season of October-November in 1979.

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

K. Alagaraja, S. K. Dharmajara, C. R. Shanmughavelu, M. G. Dayanandan, K. Narayana Kurup, B. Prasanna Kumari, K. Vijayalakshmi, G. Balakrishnan, Varughese Philipose, G. Krishnankutty Nair, Varughese Jacob, V. P. Annam, K. Santha Kumari, P. L. Ammini.

The first training course of six weeks duration in fishery resources assessment including population dynamics was conducted from 18-12-78. The 10 trainees were mostly drawn from State Fisheries Departments and Agricultural Universities. The lecture notes have been prepared with suitable examples selected from the respective fields for the same.

## REPORTS ON OTHER PROJECTS

### Scheme on Pearl Culture

K. Alagarwami, A. Chellam, S. Dharmaraj,  
A. C. C. Victor, T. S. Velayudhan, A. D. Gandhi.

The *ad hoc* Scheme on Pearl Culture has done pioneering work in the field of pearl culture in India. The breakthrough in the development of pearl culture technology was achieved in 1973 and rapid strides have been made subsequently in biological and technical researches. Raft culture techniques for open-sea farming of pearl oysters have been developed. The procedures for pearl oyster surgery have been standardised. The success in multiple implantation has given the means for increasing pearl production at least three-folds in a given number of oysters. The cultured pearls produced in India have received the acclaim of pearl merchants for their quality. Diversification of techniques on the use of the pearl oysters other than *P. fucata* and reuse of oysters has yielded moderate success which needs to be further pursued.

On the pearl oyster resource side, the Scheme has made substantial contributions. Starting from a stage when the oysters in the natural beds were reported nil or rare, a pearl oyster farm with adequate stock was developed. This perhaps has contributed to the revival of pearl oyster populations in the natural beds, such as Devi Paar and Farnando Paar seen during last three years. Some of the southern beds such as the Karawal and Poonthottam paars which had not been examined since the pearl fishery series of 1955-61 were surveyed and the presence of oysters on these has been reported.

Another contribution on the resource aspect has been the discovery of multispecies *Pinctada* population in the inshore waters which was not known before. *P. fucata* component in this was poor. The dominant species was *P. sugillata*. The oyster population in the harbour basin, the spatfall in the farm and the oysters in the inshore beds off Rameswaram belonged to this complex. The insurgence of the mixed population on the natural beds, particularly those in the northern zone, was evident. The shifting

proportions of *P. fucata* in relation to the flat oysters (other than *fucata*) from year to year have been recorded.

It can be shown that spatfall, though occurs, in the inshore waters cannot be depended upon for pearl culture as it is constituted mainly by species other than *P. fucata*. It is likely that spat collection of *P. fucata* may be successful in the natural beds such as Devi paar and Fernando paar if the problem of setting up the collectors and monitoring spatfall in the far off deeper areas could be solved. The problems involved in collection of oysters from nature have shown the imperative need for hatchery production of seed to sustain large-scale commercial operations in pearl culture.

On the technical side, chank shell waste has been utilised for making shell-bead nuclei. These have been found suitable as core material for cultured pearls. Certain refinements are necessary to achieve dimensional accuracy and the required surface finish. Surgical tools have been fabricated by indigenous efforts.

Biological studies on *P. fucata* have provided information on the growth, food, maturity and spawning of pearl oysters. Environmental parameters have been studied. The problem of fouling and boring organisms has received special attention and control measures have been investigated and adapted. Among the two areas, the shallow inshore waters of Veppalodai and deep and fairly clear waters of the harbour basin, the latter has been found to give better results on the well-being of the oysters and production of cultured pearls.

The scheme also took up extension programmes among which the most important is the training course both long term and short term conducted in pearl culture. The maritime States have been immensely benefited through these programmes and officers trained in these courses are manning the projects on pearl culture in Kerala, Tamil Nadu and Gujarat.

All the results obtained under the scheme have immediate application for taking up commercial projects in pearl culture. A Pilot project has been taken up by the Govt. of Kerala at Vizhinjam for which the scheme has extended support. The Govt. of Tamil Nadu is still considering a pilot project the proposals for which were prepared by the CMFRI. Several private entrepreneurs are showing interest in the pearl culture technology.

**An integrated approach to blending sea farming with capture fisheries at Kovalam, Madras**

E. G. Silas, S. J. Rajan, S. Kandaswamy and others.

An Operational Research Project on "Blending sea farming with traditional capture fisheries" was started in April 1978, at Kovalam a fishing village 35 km south of Madras, with the objective of improving the socio-economic condition of the traditional small scale fishermen with an additional input of blending sea farming with capture fishery. It will have as its major functions the following:

1. To establish the possibilities of supplementing traditional fishing with sea farming (mariculture) in order to increase production and improve the socio-economic conditions of the fisherfolk.

2. Demonstrating the feasibility for mussel culture and other cultivable organisms such as prawns, fish, seaweeds, etc. on a large scale and its economic viability by transferring the technology available with C.M.F.R.I.

3. To create a sense of involvement and participation among local fishermen in this project by associating them from the initial demonstration stages itself, so that this venture becomes self-generating, equipping them to take to seafarming along with their traditional fishing.

4. To demonstrate the scope for overall improvement of the socio-economic conditions of the rural area where this project becomes operative through development of infrastructure for processing, marketing and better methods of utilisation.

5. To assess the direct and indirect impact of this project in the area where it is operative in comparison to the socio-economic conditions of the project area prior to the introduction of the project.

*Work done*

The staff were in position by April end. Organisational work was started and a series of meetings were arranged to explain the

objectives of the project to the fishermen. A Management Committee consisting of Scientists, Administrators, Village elders, participant leaders and a lady member was formed to help the implementation consortium to formulate the action programme and for review.

One hundred youth of the village chiefly in the age group of 15 to 25 have been enrolled and grouped in batches of ten with an elected leader for each group.

Five hundred teak poles of about 8 metres length and 50 to 60 cm girth at the bottom were purchased from the Forest Department of Kerala and transported to the site at Kovalam. These logs started arriving from the middle of June and by August first week all the poles had reached the spot. Pile driving work, in a selected area in the depth range of 4 to 6 metres in Kovalam bay, north of the village and just outside the present fishing area and also off the usual navigational route, was started in July but due to rough weather conditions of the sea, progress was slow. Only about 150 piles were in position by the middle of September.

The participant youth of the project enthusiastically accompanied the staff to Cuddalore, Ennore and Coovum area to collect mussel seed and breeder stock. This work started late in August and continued during the first week of September. The collected seed were cleaned, bagged and wound round the poles. By the middle of September the seeds were found attached uniformly on the poles. Natural seed settlement on some poles was also noticed by the end of August. At the time of this report, in 2½ months time, the mussels have grown well and are expected to establish themselves well in the farm area. Attempts to fix the last batch of 350 poles could not be done due to the on-set of the north east monsoon, and they will be fixed again after the monsoon is over.

A training programme for fish and prawn seed identification, collection and transport, was conducted for 10 selected fishermen boys of Kovalam and Karikadukuppam villages, from the 2nd of October to 6th October. Apart from lectures, practical demonstrations were also arranged in which the boys themselves took part in collection, identification, packing and transporting.

*Particulars of activities of KVK during the year 1978.*

V. BALAKRISHNAN, K. N. R. KARTHA & OTHERS.

*Training:*

During the year 16 batches of farmers numbering 268 including 70 women and 74 persons belonging to Scheduled caste have been given training in prawn culture.

*Survey/Evaluation:*

Socio-economic survey of six villages in Vypeen Island was carried out and a detailed report was submitted to ICAR. Post-training activities of the trainees were closely followed by paying frequent visits to their farms.

Prawn seed resources survey was conducted by the staff, and a number of potential seed grounds have been located in Vypeen Island.

*Meetings held:*

Two meetings were organized in connection with the harvesting of prawns from the canals belonging to Shri K. P. Mani an ex-trainee of KVK.

Shri Mani possesses about 0.39 ha. of water area amidst his coconut grove. After eradication he stocked the canals with the seeds of fast-growing commercially important 'white prawn'. Harvesting was done after 85 days. He fetched a net profit of Rs. 2,215/-.

Many progressive prawn farmers were present when the technique of scientific prawn culture was highlighted. They were convinced by the innovative technique introducing scientific prawn culture in the hitherto unutilized brackishwater canals in coconut groves.

Meeting of the Management Committee of KVK was held on 18-11-1978.



*Meetings/Seminars attended:*

Dr. V. Balakrishnan, Officer-in-Charge of KVK attended the following meetings:

- (i) Meeting organized by MPEDA to consider the shrimp conservation measures.



Farm-women collecting prawn seeds from backwater canals.

- (ii) The second All India Workshop on KVK & TTC at Koshbad Hill, Bombay.
- (iii) The third workshop on All India Co-ordinated Research Project on Backwater Fish Farming at CIET, Cochin.
- (iv) Seminar on the Role of Small Scale Fisheries and Coastal Aquaculture in Integrated Rural Development.



An out-going farmer trainee receiving essential implements for seed collection such as bucket, drum and nylon net. Seen here is Deputy Director of Public Relations, Kerala State, Shri Muhammed Koya distributing the implements.

*Particulars of Training Courses conducted in 1978.*

Year and quarter	No. of courses conducted	Persons trained	
		Men	Women
1978			
Jan-March	3	35	—
April-June	2	23	—
July-Sept.	6	69	39
Oct-Dec.	5	71	31
Total:	16	198	70
		268*	

\* Including 77 Scheduled Castes

## ADDITIONAL INFORMATION

### *Participation of officers in meetings/advisory bodies*

- Shri T. Tholasilingam, Senior Scientist, served as an Expert for assisting Madras Public Service Commission at the Interview for the Direct recruitment of candidates for appointment to posts in Fisheries Department-Sub-ordinate service from 27-11-78 to 30-11-78.
- Shri S. J. Rajan, Officer in Charge, Operational Research Project on Blending Seafarming with Capture Fisheries, was nominated as Executive Committee Member of the Tamil Nadu Board of Rural Development, Madras and also nominated to the Faculty of the Madras University to give lectures to Post Graduate Diploma Course students in Aquaculture.
- Dr. S. Ramamurthy, Senior Scientist, attended the VIIIth Regional Advisory meeting on the Exploratory Survey of Marine Fisheries held at Mangalore on 10-4-78.
- Shri G. Venkataraman, Senior, Scientist participated in the meeting of the Co-ordinators of the A. R. S. Probationers held on 1st and 2nd December 1978 at the Central Staff College for Agriculture at Hyderabad.
- Shri T. Jacob, Senior Scientist and Dr. K. Alagaraja, Scientist, participated in the meetings for the reconciliation of annual estimates of fish landings with the Govt. of Maharashtra and Tamil Nadu during July-August 1978.
- Shri S. K. Dharma Raja, Scientist, attended the 32nd Annual Conference of the Indian Society of Agricultural Statistics, held at Ludhiana between 21-12-78 and 23-12-78 and read a research paper "on the estimates of abundance, mortality rate and the total annual stock of *Sardinella longiceps*."

*The Officer-In-Charge, Bombay Research Centre of CMFRI, Bombay.*

1. Attended the Sub-committee meeting of Central Advisory Committee of Marine fisheries of Exploratory Fisheries Project, Kandla, during 3-1-78 to 5-1-78.
2. Attended the 3rd meeting on a sub-group to develop a paper on the requirements of Research Development and Training in fisheries at Dapoli, Konkan Krishi Vidyapeeth, during 8-11-78 to 9-11-78.
3. Attended Regional Committee No. 7 meeting at Bombay on 30-9-78.
4. Attended 9th Central Advisory Committee meeting of Exploratory Fisheries Project at Bombay on 27-4-78.
5. Convened the 10th Meeting of State Level Co-ordination Committee on 6-3-78 at Bombay.

*Distinguished Visitors*

*Research Centre of CMFRI, Veraval.*

- |          |      |  |
|----------|------|--|
| 18- 4-78 | Dr.  | R. A. Deshmukh, Marathwada University, Aurangabad. |
| 22- 4-78 | Shri | B. B. Dhoot, Marathwada University, Aurangabad.    |
| 12-12-78 | Shri | Y. Sreekrishna, Professor, CIFE, Bombay.           |
| 17-12-78 | Mr.  | Pitaya, Bangkok, Thailand.                         |

*Bombay Research Centre of CMFRI, Bombay.*

- |          |     |   |
|----------|-----|---|
| 19- 1-78 | Dr. | S. Z. Qasim, Director, National Institute of Oceanography, Goa.         |
| 24- 1-78 | Dr. | M. S. Swaminathan, Director-General, ICAR, New Delhi.                   |
| 24- 1-78 | Dr. | N. Gopalakrishnan, Vice-Chancellor, Punjabrao Krishi Vidyapeeth, Akola. |
| 1-11-78  | Dr. | R. Raghu Prasad, Asst. Director-General (Fish.), ICAR, New Delhi.       |
| 6-12-78  | Dr. | Fumio Yamazaki, Faculty of Fisheries, Hokkaido University, Japan.       |

*Research Centre of CMFRI, Karwar*

- 1978 Prof. Dr. R. Natarajan, CAS in Marine Biology,  
Annamalai University, Porto Novo.  
Dr. Prem Narain, Senior Professor, IARSI, New  
Delhi.  
Dr. P. N. Ganapathi, Visiting Professor, Dept. of  
Marine Sciences, Waltair.  
Shri. D. Balagopalan, Divisional Commissioner,  
Belgaum.  
Smt. Renuka Viswanathan, IAS, Deputy Commi-  
ssioner, Karwar.

*Research Centre of CMFRI, Mangalore*

- 12- 4-78 Dr. S. Dutt, Head of Dept. of Marine Sciences and  
Dr. K. Srinivasa Rao, Dept. of Zoology,  
Andhra University, Waltair.

*Research Centre of CMFRI, Calicut*

- 10- 1-78 Smt. S. G. Sarojini, Professor, Nirmala College,  
Coimbatore.  
20- 1-78 Dr. S. V. Job, Madurai Kamaraj University.  
„ Prof. N. Ramalingam, Madras University.  
„ Prof. N. P. Kalyanam, Pachiappa's College, Madras.  
21- 3-78 Dr. K. K. Iya, Retd. DDG, ICAR.  
13- 4-78 Dr. R. K. Pandey, IARSI, New Delhi.  
29- 4-78 Shri. C. A. Nedungadi, Secretary, Ministry of Home  
Affairs, New Delhi.  
21-10-78 Shri. A. F. Somde, FAO Fellow, Nigeria.

*Visitors to Narakkal (Prawn Culture Laboratory)*

- 6- 1-78 Mr. Chua Thia Eng., School of Biological Sciences,  
Univ. Malaysia, Penang  
„ Mr. Yousif Abu Gideiri, Faculty of Science, Univ.  
of Khartoum, Sudan.  
„ Dr. T. A. Mammen, MPEDA, Cochin.  
17- 1-78 Shri. T. G. K. Menon, Kasturi Bai National  
Memorial Trust, Indore.

- 24- 1-78 Sir Charles Pereira, Consultative Mission on Aquaculture Research, IDRC, Vancouver.
- „ Mr. W. Allsopp, IDRC, Vancouver.
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- 21- 2-78 Mr. D. W. Thorne & Glesone Thorne, Utah State University, Logan, Utah, USA.
- 22- 2-78 Mr. V. L. C. Pieterz, Ministry of Fisheries, Colombo
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- 30- 1-78 Mr. Chadwick, Commonwealth Foundation, London
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*No. 3. November 1978*

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Crustacean Fisheries Division—Intensive culture of marine prawns.

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S. RAMAMURTHY, M. H. DHULKED, N. S. RADHAKRISHNAN AND  
K. K. SUKUMARAN—Experiment on polyculture in a brackish-  
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Shri K. Ramachandran Nair  
 Shri A. C. Sekhar  
 Shri P. S. Sadasiva Sarma  
 Shri P. Karunakaran Nair  
 Shri P. K. Mahadevan Pillai  
 Shri R. Reghu  
 Shri K. Ramakrishnan Nair  
 Shri R. Bhaskaran Achari  
 Shri N. Retnaswami  
 Shri A. Agastheesa Pillai Mudaliar  
 Shri K. C. Yohannan  
 Shri T. Girija Vallabhan  
 Shri R. Guruswami  
 Shri M. Babu Philip  
 Shri A. A. Thankappan  
 Shri K. Nandakumaran  
 Shri N. P. Kunhikrishnan  
 Shri P. Ananda Rao  
 Shri M. Ayyappan Pillai  
 Shri M. Badruddin  
 Shri V. K. Balachandran  
 Shri M. Mohamed Sultan  
 Shri T. G. Vijaya Warriar  
 Shri Jacob Jerold Joel  
 Shri A. Hanumantha Rao  
 Shri A. Bastin Fernando  
 Shri C. V. Seshagiri Rao  
 Shri S. G. Vincent  
 Shri K. K. Balasubramanian  
 Shri P. M. Aboobacker  
 Shri K. V. S. Seshagiri Rao  
 Shri S. Kalimuthu  
 Shri K. N. Gopalakrishnan  
 Shri E. K. Raveendran  
 Shri S. B. Chandrangathan  
 Shri G. V. Lakshmiah  
 Shri M. V. Somaraju  
 Shri I. P. Ebenezer  
 Shri C. K. Krishnan  
 Smt. K. Koumudi Menon  
 Shri K. S. Krishnan  
 Shri P. Ramadoss  
 Miss S. Lakshmi  
 Shri S. Kandasamy

Shri A. Ganapathi  
 Shri B. Narayana Rao  
 Shri C. Kasinathan  
 Shri Joseph Xavier Rodrigo  
 Shri K. Ramasomayajula  
 Shri K. P. Viswanathan  
 Shri C. Thankappan Pillai  
 Shri Joseph Andrews  
 Shri N. Jayabalan  
 Shri V. Selvaraj  
 Shri K. Dhanaraju  
 Shri V. A. Narayanan Kutty  
 Shri V. Sivaswami  
 Shri K. Muniyandi  
 Shri N. Palaniswami  
 Shri K. Muthiah  
 Shri K. Ramadoss Gandhi  
 Shri T. Chandrasekhara Rao  
 Shri K. Balachandran  
 Miss A. Kangam  
 Shri D. Sundararajan  
 Shri D. Vincent  
 Shri J. R. Ramalingam  
 Shri M. Najmuddin  
 Shri K. B. Waghmare  
 Shri Y. D. Savaria  
 Shri G. Subramania Bhat  
 Shri C. Balasundaram  
 Shri L. Jayasankaran  
 Shri L. Chidambaram  
 Mrs. C. M. Allikunju  
 Shri O. M. M. J. Habeeb Mohamed  
 Shri M. Selvaraj  
 Shri R. Thangavelu  
 Shri A. Srinivasan  
 Shri T. S. Balasubramanian  
 Shri V. Thanapathi  
 Shri H. Kather Batcha  
 Shri K. Ramachandra  
 Shri S. Palanichamy  
 Miss K. Umakumari  
 Shri Sapan Kumar Ghosh  
 Shri S. Subramani  
 Shri K. Chitti Babu  
 Shri S. Russel Conard Samuel  
 Shri M. Manikaraja

**Technical Assistant (T. I. 3)**

Shri C. T. Rajan  
 Shri S. Manivasagam  
 Shri K. K. Kunhikoya  
 Shri V. Suresh  
 Shri K. Soman  
 Shri S. Siddalingaiah  
 Shri R. Vasanthakumar  
 Shri P. Ramalingam

**Junior Technical Assistants (T-2)**

Shri M. Shriram  
 Shri K. Balakumar  
 Smt. C. Nalini  
 Shri J. L. Oza  
 Shri K. Thulasidas

**Field Assistant (T-1)**

Shri Jacob D. Eapen  
 Shri T. Krishnankutty  
 Miss K. K. Valsala  
 Shri K. Chellappan  
 Shri K. Chandran  
 Shri Mathew Joseph  
 Shri M. N. Kesavan Elyathu  
 Shri T. Gangadharan  
 Miss T. A. Omana  
 Shri K. K. Surendran  
 Shri K. K. Narayana Rao  
 Shri C. S. Sasidharan  
 Shri V. Achutha Rao  
 Shri M. Manivasagam  
 Shri S. Sankaralingam  
 Shri P. Palani

Shri M. Chandrasekhar  
 Shri C. Manimaran  
 Shri N. Vaithinathan  
 Shri G. Arumugam  
 Shri S. Rajapackiam  
 Smt. P. Swarnalatha  
 Shri G. Srinivasan  
 Shri R. Somu  
 Shri M. Radhakrishnan  
 Shri M. Chellappa  
 Shri A. Ramakrishnan  
 Shri T. Dhandapani  
 Shri J. Krishna Babu  
 Shri M. Bose  
 Miss V. K. Janaki  
 Shri V. G. Surendranathan  
 Shri M. P. Sivadasan  
 Shri J. Narayanaswami  
 Shri S. D. Dhuri  
 Shri K. T. Thomas  
 Shri Sailada Satya Rao  
 Shri A. K. Velayudhan  
 Shri P. Poovanan  
 Shri P. Venkatakrishna Rao  
 Shri A. Prosper  
 Shri C. J. Josekutty  
 Shri K. Srinivasagam  
 Shri Dalavadi Pradulemen  
 Mohanlal  
 Shri A. Ahamed Kamal Basha  
 Shri K. Shahul Hameed  
 Shri Shreekanth Shreedhar Sugawekar  
 Shri H. Ramachandra  
 Shri S. Hanumantharaya  
 Shri Mascarenhas Robert  
 Shri C. K. Dinesh  
 Shri B. Sridhara  
 Shri G. Krishnaiah  
 Shri P. Padmasekara  
 Shri D. Nagaraja  
 Shri N. Chennappa Gowda  
 Shri Y. V. Venkatachala Murthy  
 Shri J. Bhuvaneswara Varma  
 Shri C. H. Ellithathya  
 Shri N. Narayana  
 Shri R. Dias Johnny  
 Shri Dhokia Harsukhlal Karsambhai  
 Shri Bhupendra Popatlal Thumber  
 Shri Solanki Pravinchandra Dahyala  
 Shri S. Chandrasekar  
 Shri D. G. Jadhav

#### Computer (T. II. 3)

Shri Varghese Jacob  
 Shri G. Krishnankutty Nair  
 Shri P. Sivaraman  
 Shri V. Rajendran  
 Mrs. V. P. Annam

#### Computer (T-2)

Shri A. Kanakkan  
 Shri S. Haja Najeemuddin  
 Shri C. J. Prasad  
 Mrs. P. L. Ammini  
 Mrs. K. Santhakumari

#### Skin Drivers (T-2)

Shri J. Antony Pitchai  
 Shri A. Dasman Fernando  
 F. Susai V. Rayen

#### Senior Library cum Documentation Assistant (T-4)

Shri K. Kanagasabapathy

#### Senior Library Assistant

Shri E. Johnson

#### Administration

#### Senior Administrative Officer

Shri S. Rajagopalan

#### Administrative Officer

Shri K. M. Mathai

#### Accounts Officer

Shri Gopalakrishnan Potti

#### Superintendents

Shri S. Subramaniam  
 Shri M. P. Lakshman  
 Shri A. Sethubaskaran  
 Shri P. A. Naik  
 Shri M. Subbiah  
 Shri R. Dorairaj