ANNUAL REPORT FOR 1975

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

CONTENTS

Abbreviations used

SFS	—	Senior Fishery Scientist
FS	—	Fishery Scientist
JFS	—	Junior Fishery Scientist
AFS	—	Assistant Fishery Scientist
SRA	—	Senior Research Assistant
RA	—	Research Assistant
JSA	—	Junior Scientific Assistant
LFA	—	Laboratory-cum-Field Assistant

INTRODUCTION

The Research and Development Programme of the Institute recorded steady progress during 1975. While the Fishery Survey and Statistics Division laid emphasis on speedy processing and dissemination of marine fish production data, the Fishery Biology Division paid increased attention to mariculture investigations, exploratory surveys and monitoring of exploited resources and the Marine Biology and Oceanography Division to natural and man-made changes to the marine environment and their effect on the distribution and abundance of living resources. Both the volume and variety of consultancy service undertaken by the Institute especially with reference to export trade has also grown. The salient features of the work done are given below.

1. The total marine fish production in India during the year 1975 was estimated at 1,422,693 tonnes as against, 1,217,797 tonnes during 1974. The total landings in 1975 showed an increase of about 17% as compared to 1974 and was also the highest recorded so far.

2. The Institute has set up a prawn culture laboratory at Narakkal where most of the commercially important penaeid prawns namely, *Metapenaeus dobsoni* ('Poovalan'), *M. affinis* ('*Kazhandan*'), *M. monoceros* ('Villan'), *Parapenaeopsis stylifera* ('Karikadi') have spawned in the laboratory and the larvae have been reared for mass culture under controlled conditions. *Penaeus indicus* ('Naran') has also spawned in the laboratory for the first time and the eggs have been successfully reared upto the post-larval stage suitable for stocking in the culture ponds.

3. Abundant resources of prawn seed for culture have been found in the surf area at Narakkal.

4. A new series of mussel culture experiments have been undertaken at Vizhinjam; similarly mussel culture work has been intensified at Tuticorin and Calicut.

5. The pearl culture work at Tuticorin and Vizhinjam is well established. The young pearl oysters are being collected in large numbers by special devices and cultured in cages.

6. The percentage of immature fishes in the landings of Bombay duck has declined and this would improve the fishery for this species during the ensuing months.

7. Biomass distribution charts for zooplankton were prepared for demarcating the very productive zones in the Laccadive Sea. Similarly the distribution of Chaetognaths in the upwelling area of the west coast was investigated and their significance as 'indicators' of water movements have been brought out.

8. The pro-larval and post-larval stages of Indian mackerel, *Rastrelliger kanagurta* identified from the plankton of the south west coast and Laccadive sea were studied for the first time, and this has given a clue to the spawning grounds of this fish. The distribution of the larvae, their occurrence during the day and night, the relative abundance in the continental shelf and oceanic waters, latitude-wise abundance, frequency of occurrence and distribution in relation to the hydrological conditions have been worked out in detail.

The occurrence of scombroid larvae in Tuticorin waters in large numbers during the cold months has given an indication of the spawning season of these fishes.

9. A detailed survey of the economically important seaweeds has been carried out along the Tamil Nadu coast and the total available harvest of agarophytes and alginophytes has been estimated. Cultivation of seaweeds has been carried out by means of vegetative propagation using plant fragments on frames fabricated with coconut fibre ropes. 1.25 kg of plant fragments introduced on 8 sq. m. frame yielded a harvest of 43.2 kg.

10. Uni-algal culture of 10 species have been developed to provide the basic raw material for experimental work and for rearing the higher animals of the marine food chain.

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, and

v. to develop techniques for the culture of suitable species of marine animals and plants for augmenting natural production.

Organisational set-up

The Institute has at present five Divisions, namely Fishery Survey and Statistics, Fishery Biology, Crustacean Fisheries, Molluscan Fisheries, and Marine Biology & Oceanography. Besides the Headquarters at Cochin, the Institute has one Regional Centre (at Mandapam Camp), 8 Sub-stations (at Waltair, Madras, Tuticorin, Vizhinjam, Calicut, Mangalore, Karwar and Bombay); 7 Research Centres (at Veraval, Goa, Minicoy, Porto Novo, Kakinada, Puri and Port Blair) and 26 Survey Centres along the east coast and west coast of India. The present staff strength of the Institute is 827.

During 1975 the Institute has undertaken 33 Research Projects and an all-round progress was maintained in these projects at the Headquarters and the Outstations. The scientific work carried out by the different divisions have been reviewed under the chapter 'Progress of research'.

Library

About 200 books and 500 new numbers of periodicals were added to the library. As usual the library continued its service of loaning books and periodicals to different Universities, Institutes, Central and State departments and other interested organisations. Many visitors from colleges and Universities made use of the library consistently throughout the year.

During the year, *the Indian Journal of Fisheries* Vol. 21 (1) was published and C. M. F. R. I. Bulletin No. 20 on the Sea-cow, *Dugong dugong* was issued. The Institute has started publishing a science oriented "News Letter" to communicate the activities of the Institute to the Institute's staff at the various stations, interested individuals, Universities, Institutes and the Industry.

Training offered

Shri Ahmed Latif, Colombo Plan trainee from the Republic of Maldives underwent training in Fishery Survey and Statistics during May to December 1975. During the year, training in Fishery Survey and Statistics was also offered to a team of 8 FAO sponsored trainees from Indonesia.

Foreign service

1. Shri K. H. Mohamed, Fishery Scientist has taken up a F. A. O. assignment at Baharain.
2. Shri D. Chakraborty, Junior Fishery Scientist, now on deputation to the Pelagic Fisheries Project, has taken up a F. A. O. assignment at Philippines.

Advisory / Consultancy service provided

I. Dr. E. G. Silas, Director has 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 on the Programme Priorities and Cruise Committee for the National Institute of Oceanography, Goa.
4. Member, Research Advisory Committee of the Kerala Agriculture University, Trichur.
5 Member of the 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.
13. Member, Central Government Employees Co-ordination Committee, Cochin.
14. Member, Expert Committee for framing rules, regulations and syllabus for B. Sc., Marine Science, Madurai University.
15. Member, Executive Council and Vice-President, Indian Society of Ichthyologists, Madras.

II. Dr. K. V. Sekharan, Senior Fishery Scientist, served as a member of the Review Committee on the work of the Research Stations of the Kerala State Fisheries Department. He also served as Examiner for M. Sc. Degree examination in Marine Biology, Dept. of Marine Sciences, University of Cochin.

III. Dr. P. V. Ramachandran Nair, Junior Fishery Scientist served as a member of the panel for marine disposal of effluents of the Indian Standards Institution.

IV. The Institute extended its consultancy service to the various departments of the Government at the Centre and at the States, the International bodies such as the FAO, to Scientific organisations, to the Industry and individuals on various kinds of fisheries problems and answered hundreds of queries.

Fellowships and Scholarships

Eight Research Scholars underwent training in research under the Scholarships scheme instituted by the Government of India, Ministry of Education and Social Service.

One ICAR Senior Fellow and one CSIR Junior Fellow were also doing research at the Institute during the year.

List of distinguished visitors:

1. Dr. M. S. Swaminathan, F. R. S., Director General, ICAR visited the Substation at Mangalore on 24–12–1974.
2. Shri Devaraj Urs, Chief Minister of Karnataka, visited the CMFRI stall in the exhibition organised by the Karnataka Fishermen Parished at Karwar.
3. Mr. Modun, Hon'ble Minister for Fisheries Mauritius and Mrs. Modun visited the Headquarters laboratories and also the field station at Narakkal on 16–1–1975.
4. Shri K. T. Rathod, Hon'ble Minister for Fisheries and Horticulture, Karnataka visited the Institute on 22-1-1975.
5. Mr. Januzhzu (Hungary), Mr. Felikispetrovaki (Poland) and Mrs. Kvetislava Buschora (Czchoslovakia) journalists visited the Institute on 28-2-1975.
6. Mr. G. R. Courts and Dr. David Burton of the British Council, Madras visited on 4-3-1975.
7. Dr. John B. Jellet, Director, Porto Bello Marine Laboratory, Porto Bello, New Zealand, visited on 6–3–1975.
8. Shri Shah Nawas Khan, Hon'ble Union Minister of State for Agriculture visited Bombay Substation on 1-6-1975 and the Headquarters, Cochin and Prawn Culture Laboratory, Narakkal on 11-9-1975 and Vizhinjam Substation on 13-9-1975.
9. Shri Pratap Singh Rane, Hon'ble Minister for Law, Fisheries, Forests etc., Govt. of Goa, visited Madras Substation on 29-5-1975.
10. The F. A. O. mission led by Dr. H. C. Winser visited the Institute on 14-5-1975.
11. Dr. Joseph C. Madamba, Director General, Philippines Council for Agriculture Research visited the Institute on 22–5–1975.
12. Dr. Odd M. Swerdratad, Institute of Marine Research, Bergen, Norway and Mr. John Blindheim of Pelagic Fisheries Project, Cochin visited the Institute on 24-6-1975.
13. Dr. Francois Bourgois, Leader, World Bank Team on Fisheries visited the Institute on 29-7-75.
14. Dr. W. H. L. Allsopp, Assistant Director (Fisheries), International Development Research Centre, Canada, visited the Institute on 4-8-75.
15. Dr. Salim Ali, Ornithologist and President, Bombay Natural History Society visited the Institute on 11-12-1975.
16. Shri S. M. Krishnatry, Chief Commissioner, Andaman Nicobar Islands visited the Institute on 12-12-1975.

Appointments

Dr. E. G. Silas, Senior Fishery Scientist was appointed as Director of this Institute with effect from 25-6-1975.

PROGRESS OF RESEARCH

FISHERY SURVEY AND STATISTICS DIVISION

Annual production of marine fish (FSS/FRA/FS-1)

The total marine fish production in India during the year 1975 was estimated at 1,422,693 tonnes as against 1,217,797 tonnes during 1974. The total landings in 1975 showed an increase of about 17% as compared to 1974, and was also the highest recorded so far. Excepting in Andhra Pradesh where the total landings showed a marginal decline, the landings increased in all the maritime States of India. While in the States of West Bengal & Orissa, Tamil Nadu, Maharashtra & Gujarat the total marine fish production was significantly higher, in other maritime States, the landings increased only marginally (Table 1).

TABLE 1

Statewise marine fish landings in India (in tonnes)

	State	1975	1974
1.	West Bengal & Orissa	45,761	26,092
2.	Andhra Pradesh	155,638	158,818
3.	Tamil Nadu	221,215	175,713
4.	Pondicherry	8,150	7,698
5.	Kerala	420,836	420,257
6.	Karnataka	87,494	76,263
7.	Goa	29,170	19,534
8.	Maharashtra	256,619	184,961
9.	Gujarat	193,775	145,309
10.	Andamans	1,104	920
11.	Lakshadweep	2,931	2,232
	Total	1,422,693	1,217,797

The landings in West Bengal and Orissa increased by about 19,700 tonnes during 1975 as compared to 1974. The significant increase in the total landings was due to higher landings of *Hilsa ilisha,* other clupeids, cat fishes, sciaenids, pomfrets and prawns. The catch of elasmobranchs, lesser sardines, seer fish and mackerel, however, was poor.

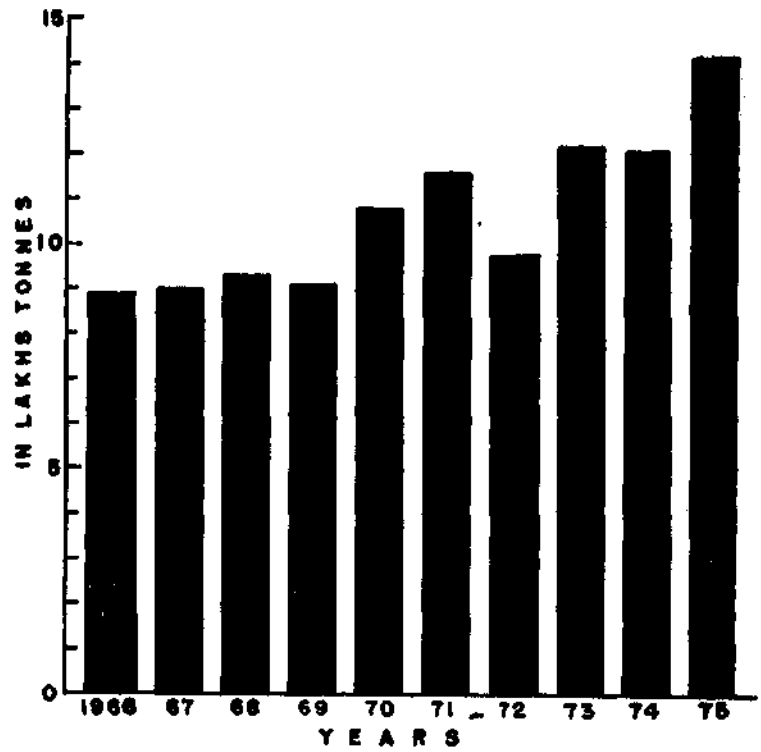

Fig. 1 Annual marine fish production in India during the years 1966 to 1975

In Andhra, the total catch decreased marginally. While the landings of silver bellies, pomfrets, seer fish, and perches increased significantly, the catch of elasmobranchs, cat fishes, anchovies, other clupeids, prawns and sciaenids was comparatively poor.

The total marine fish producion in Tamil Nadu during 1975 increased by about 45,500 tonnes (26%) as compared to 1974. While the landings of lesser sardines and ribbon fish were significantly higher, the catch of silver bellies was poor. The landing of prawns, other crustaceans, pomfrets and mackerel were, however, better.

In Pondicherry, the total landings increased only marginally. The fishery for ribbon fish, *Caranx*, prawns and cephalopods was better as compared to last year. But the catch of elasmobranchs, lesser sardines, anchovies, other clupeids and sciaenids, was, however, poor.

The total marine fish catch in Kerala during 1975 remained more or less stationary. The landings of prawns, sciaenids, mackerel and *Caranx* were comparatively better, but the fishery for ribbon fish and silver bellies suffered a set back as their landings declined steeply. The landings of oil sardine, *Anchoviella*, Red mullets and perches were also poor.

In Karnataka, the total landings showed an increase of about 11,200 tonnes during 1975. The fishery for oil sardine was good during the year and a record catch of about 53,000 tonnes was noticed. While the landings of mackerel, cat fishes and other crustaceans were comparatively higher, the catch of sciaenids, silver bellies, *Lactarius*, seer fish and tunnies was poor.

The total landings in Maharashtra during 1975 increased by about 71,700 tonnes. The landings of Bombay duck, penaeid prawns, non penaeid prawns, sciaenids and other clupeids were comparatively better. But the catch of mackerel and *Bregmaceros* was poor.

In Gujarat, the total landings increased by about 48,500 tonnes (33%) during 1975 as compared to 1974. The landings of Bombay duck, prawns and sciaenids were significantly higher. The catch of elasmo branchs, lobsters, seer fish and *Hilsa* was also good. The landings of pomfrets were comparatively low.

Variety Composition

The marine fisheries of India which consist of more than 200 commercially important species of fish have been grouped and presented in Table 2 for the years 1974 and 1975.

Table 2 shows that the principal fisheries of India viz. oil sardine, mackerel, *Harpodon neherus* and prawns contributed about 37% of the total fish production during 1975 as compared to 32% of the total fish production during 1974. The increase in the percentage was due to comparatively higher landings of the principal fisheries during 1975.

Oil sardine

The landings of oil sardine showed an increase of about 32,600 tonnes. While the catch of oil sardine in Kerala declined, Karnataka and Goa recorded higher landings during 1975.

Mackerel

Mackerel fishery during 1975 was comparatively better especially during the first half of the year. The catch increased by about 8,500 tonnes. While the landings improved in Kerala and Karnataka States, poor catch was recorded in Maharashtra and Goa coasts.

Bombay duck

The landings of Bombay duck showed an increase of about 38,500 tonnes, mainly due to higher landings along Maharashtra and Gujarat coasts.

Penaeid prawns

Excepting in Andhra and Karnataka the landings of penaeid prawns were good in all the maritime States of India. Due to very good fishery during the period January to September, the catch of penaeid prawns was good in Kerala.

TABLE 2

The composition of total marine fish landings in India during 1974 and 1975 (in tonnes)

Sl. No.	Name of fish	1975	1974
1.	Elasmobranchs	65,230	66,054
2.	Eels	5,710	4,011
3.	Cat fishes	68,689	76,196
4.	*Chirocentrus*	11,813	9,026
5. (a)	Oil sardine	159,240	126,676
(b)	Other sardines	112,117	83,921

Sl. No.		Name of Fish	1975	1974
	(c)	*Hilsa ilisha*	8,897	4,248
	(d)	Other *Hilsa*	7,567	7,541
	(e)	*Anchoviella*	30,744	41,507
	(f)	*Thrissocles*	9,997	11,433
	(g)	Other clupeids	52,786	43,226
6.	(a)	*Harpodon nehereus*	99,614	61,138
	(b)	*Saurida and saurus*	14,323	12,520
7.		*Hemirhamphus* and *Belone*	1,980	4,574
8.		Flying fish	1,832	1,012
9.		Perches	35,232	36,837
10.		Red mullets	2,641	7,009
11.		Polynemids	14,044	10,637
12.		Sciaenids	114,535	79,261
13.		Ribbon fish	57,330	63,029
14.	(a)	*Caranx*	23,005	19,316
	(b)	*Chorinemus*	3,380	3,797
	(c)	*Trachynotus*	64	122
	(d)	Other carangids	207	91
	(e)	*Coryphaena*	411	286
	(f)	*Elacate*	221	222
15.	(a)	*Leiognathus*	39,813	50,909
	(b)	*Gazza*	424	338
16.		*Lactarius*	11,848	8,913
17.		Pomfrets	24,987	22,421
18.		Mackerel	45,947	37,462
19.		Seer fish	18,897	19,841
20.		Tunnies	11,285	10,839
21.		*Sphyraena*	2,150	4,862
22.		*Mugil*	3,515	4,497
23.		*Bregmaceros*	1,043	1,872
24.		Soles	12,044	18,917
25.	(a)	Penaeid prawns	141,713	114,934
	(b)	Non Penaeid prawns	79,038	55,244
	(c)	Other crustaceans	22,884	16,663
26.		Cephalopods	7,889	3,677
27.		Miscellaneous	97,607	72,718
		Total	1,422,693	1,217,797

Non-penaeid prawns

The landings of non-penaeid prawns showed an increase of about 23,800 tonnes during the year. Maharashtra, and Gujarat, Andhra, West Bengal & Orissa recorded comparatively higher landings.

Sciaenids

The catch of sciaenids was significantly higher and showed an increase of about 35,300 tonnes. The increase in the landings was due to comparatively higher catch in the States of Gujarat, Maharashtra, Kerala, and West Bengal and Orissa.

Lesser sardines

The fishery of lesser sardines was good and the total catch increased by about 28,200 tonnes. Excepting in West Bengal and Orissa and Pondicherry the landings of lesser sardines were good in all the maritime States of India.

Silver bellies

The landings of silver bellies were comparatively poor and the total catch declined by about 11,100 tonnes. Excepting in West Bengal & Orissa Andhra and Pondicherry, the catch of silver bellies was poor in all the maritime States of India.

Input of fishing effort

The total all India fishing effort (excluding Goa, Andamans and Lakshadweep) increased to 275, 505 thousand man – hours in 1975 from 262, 901 thousand man hours in 1974. Excepting Kerala, Karnataka and Gujarat all the maritime State of India expended higher input of fishing effort during 1975. An increase in the catch per unit effort was noticed in the States of West Bengal & Orissa, Kerala, Karnataka, Maharashtra and Gujarat. In the State of Andhra, Tamil Nadu & Pondicherry, however, the catch per unit decreased marginally.

Frame Survey (FSS/FRA/FS–2).

The census data collected so far have been scrutinized, compiled and tabulated. The frame survey could not be continued due to lack of T. A. funds. With the allotment of additional T. A. funds during January 1976, the census work is to be continued during the period January to June 1976. Instructions to field staff and schedules for the collection of census data were prepared for the continuation of frame survey work during 1976.

Stock assessment and estimation of potential yield of Commercially important fishes (FSS/FRA/ST-1).

The length-frequency data collected at the landing centres along with the routine survey work in respect of oil sardine, mackerel,Bombay duck and penaeid prawns were scrutinized and analysed. The work in respect of the preparation of frequency table for the calculation of mean-size of commercially important fishes will be continued for studying the dynamics of fish populations.

Fishery Data Centre (FSS/FRA/ST-2).

The monthly production data on specieswise and Statewise marine fish production in India and also the processed catch data of off-shore vessels of the Exploratory Fishery Project and Integrated Fisheries Project vessels of Govt. of India and other mechanised vessels operating at various fishing harbours in India were sent to the various outside agencies, both Government and private. The details of equipment required for the Fishery Data Centre, were placed before the Management Committee of the Institute for taking further necessary action.

Personnel: M. S. Prabhu, FS, C. R. Shanmughavelu, AFS, M. G. Dayanandan, AFS, S. K. Dharmaraja, AFS, P. Karunakaran Nair, RA, U. K. Satyavan, RA, G. Balakrishnan, RA, Varghese Philippose, RA, B. Prasannkumari, RA, K. Balan, RA and others.

FISHERY BIOLOGY DIVISION

Salient findings:

During the period under report emphasis was placed on estimating the characteristics of the resources which support commercially important fisheries with special reference to recruitment, size and age structure and distribution. Exploratory surveys in collaboration with other organisations were intensified with a view to extending these to new grounds and resources. At the same time increasing emphasis was placed on the development of technology for culturing marine fishes. The following are the salient features of the work done:

1. The recruitment of the 0-year-class of the oil sardine was greater in 1975 than in 1974 which was reflected in the slightly increased yield in the 1974–1975 season compared to the previous season. On the other hand in 1975 recruitment was on the whole lower in the Calicut-Mangalore region and the catch in January-June 1976 may not touch the same level as that of the same period of 1975.

2. In the mackerel fishery the recruitment of one-year-old fish which forms the mainstay of the fishery was less in 1974 than in 1973, which was reflected in the reduced yield of the fishery in the 1974–1975 season compared to the previous season. On the other hand the relative abundance of the 0-year old fish was comparatively better in 1975 than in 1974 and in the coming season the catch could be expected to improve.

3. An important development taking place in the Calicut region is that the non-mechanised boats are being towed by mechanised boats to the grounds 50–60 m deep and back to the landing centre. This has resulted in the enlargement of the operational range of the non-mechanised boats, giving them access to resources not fished by them previously. Thus a fishery for pelagic fishes such as bill fishes is developing in the Calicut region.

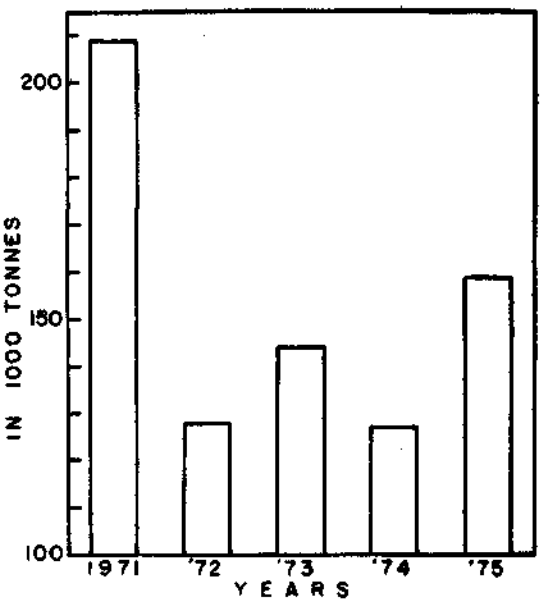

Fig. 2. Oil sardine landings in India during the years 1971 to 1975

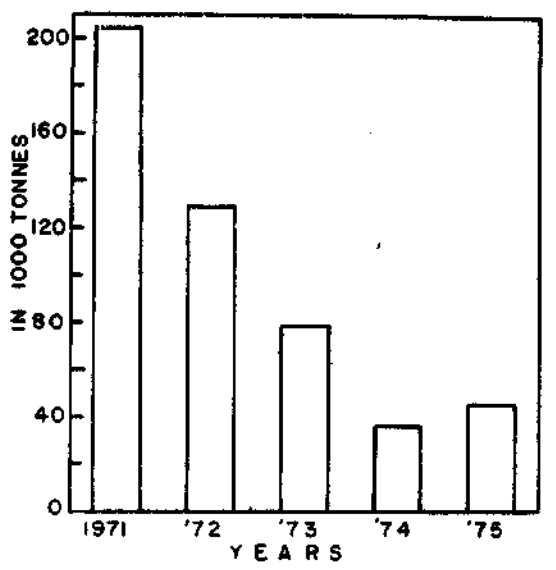

Fig. 4 Mackerel landings in India during the years 1971 to 1975

4. The shark fishery has been declining at some of the centres where the fishermen have been diverting the effort to the lobster and prawn fisheries. The potential catch of sharks is greater than what is landed at present.

5. There was a general improvement in the Bombay duck fishery in all aspects as compared to the last year, which was due at least partly to the reduction in fishing effort.

6. On the other hand the catch, effort and catch per unit of effort of silver bellies from the Palk Bay declined in 1975 compared to the 1974. This was, however, accompanied by an increase in the mean size of the fish.

7. Five species of marine prawns namely *Metapenaeus monoceros, M. affinis, M. dobsoni, Parapenaeopsis stylifera* and *P. acclivirostris* spawned in the laboratory. With improvement in the techniques, the larvae of some of the species could be reared with negligible mortality to the post-larval stage.

8. In eel culture in running water, it was seen that sorting the fish according to size and restocking them in different densities in the culture tanks was very effective in accelerating the growth.

Studies on the oil sardine resource of the Indian seas (FB/MF/1)

Fig. 2. gives the annual landings of oil sardine in India during the years 1971 to 1975. The 1974–1975 season closed with a catch of 142,000 tonnes of oil sardine as against 141,000 tonnes in the 1973 – 1974 season. There was a delay in the entry of recruits and the commencement of the season in the second half of 1974, because of which it was expected that the peak would also depart from normal. Actually it was found that the catch in Kerala was much greater in January-June of 1975 than in the corresponding period of 1974. The catch per unit of effort of different age groups at various observation centres is given in Fig. 3 in respect of the two seasons from which it will be apparent that there was an improvement in the relative abundance of the 0-year-class in the latter season in the Calicut-Karwar region; this is reflected in the increased landings.

In the current season (1975–1976) also recruitment has been moderate at most of the centres during July-September and the

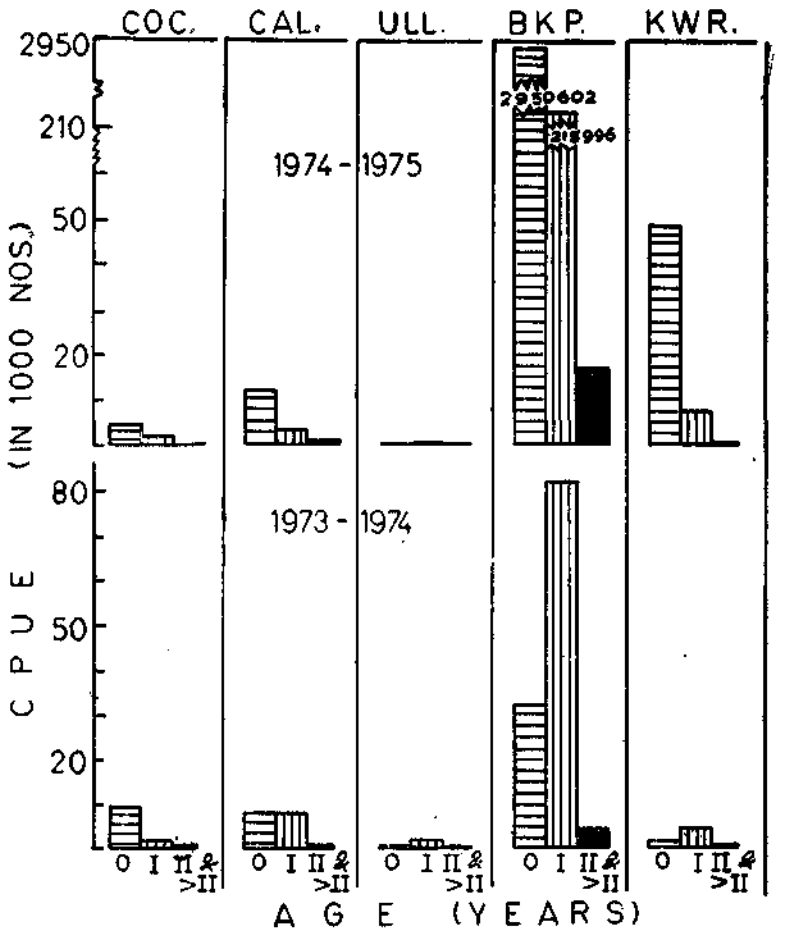

Fig. 3 The age composition of cpue (in Nos) of oil sardine at different centres during 1973-74 and 1974-75

COC- Cochin (Thanguvala)
CAL- Calicut (Pattenkollivala)
ULL- Ullal (Chalabale)
BKP- Baikampaday (Rampan)
KWR- Karwar (Rampan)

catch has also been good. There was a set back to the entry of recruits at some of the centres during September-November. The catch per unit of effort of different age groups in the latter halves of 1974 and 1975 is given in Table-3.

On the whole recruitment was lower in the Calicut Mangalore region in the second half of 1975 and it appears probable that in January-June 1976 the catch may not touch the same level as that in the corresponding period of 1975.

The scale studies generally confirm previous findings on growth. Serological studies for delimiting the sub-populations of oil sardine were continued.

Personnel: K. V. Sehkaran, SFS; V. Balan, JFS; P. Vijayaraghavan, JFS; M. H. Dhulkhed, AFS; G. G. Annigeri, AFS; V. S. Rengaswamy, RA; T. Prabhakaran Nair, RA; R. Reghu, JSA.

Studies on the marckerel resources of the Indian seas (FB/MF/2).

Mackerel landings in India during the years 1971 to 1975 are shown in Fig-4. The fishery followed a course similar to that of the oil sardine fishery. The 1974-1975 season ended with a catch of only about 31,000 tonnes as against 73,000 tonnes in 1973–1974. Recruitment of the new year class and the commencement of the season on the west coast were delayed in the second half of 1974 with the result that the catch declined compared to the same period of the previous season. However, as in the oil sardine fishery improvement was expected in the second half of the season and this has been found to be true in Kerala where the January-June catch in 1975 was more than double that in the same period of 1974. The approximate catch per unit of effort of mackerel of different age groups at the important observation centres in 1973–1974 and 1974–1975 are given in the Fig. 5. from which it will be seen that the relative abundance of one-year-old fish which forms the mainstay of the fishery was less in the latter season than in the former season. It was reflected in the decrease in the catches. Both scale and length frequency studies showed that the mackerel had a faster growth rate in 1974–1975 than in the previous seasons.

The recruitment in the current season on the west coast was good in July-September, with the catches also being good in com-

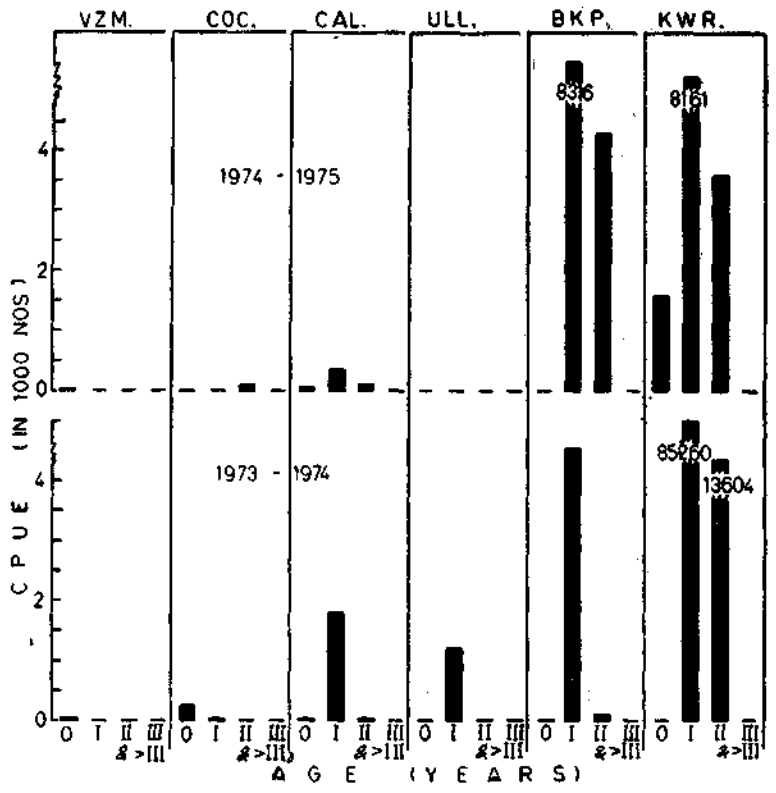

Fig. 5 The age composition of cpue (in Nos) of mackerel at different centres during 1973-74 and 1974-75

VZM- Vizhinjam (Boat seine)
COC- Cochin (Transuvala)
CAL- Calicut (Pattenkollivala)
ULL- Ullal (Pattabale)
BKP- Baikampady (Rampan)
KWR- Karwar (Rampan)

TABLE 3

Catch per unit of effort (in numbers) of different age groups of oil sardine at important observation centres in the second halves of 1974 and 1975

Centres & (net)	c. p. u. e. of age groups					
	July-December 1974			July-December 1975		
	0	1	2 & above	0	1	2 & above
Cochin (Thanguvala)	3,800	1,270	200	3,970	2,990	450
Calicut (Pattenkolli)	11,940	1,250	740	7,015	3,100	920
Ullal (Chalabale)	8	230	105	240	1,500	70
Baikampady (Rampan)	552,720	0	0	182,420	8,115	135
Karwar (Rampan)	17,570	15,800	1,745	30,920	5,235	860

parison with the same period of last year at most centres but declined at some of the centres later on as in the oil sardine fishery. The catch per unit of effort of mackerel of different age groups in the second halves of 1974 and 1975 are given in Table 4.

The relative abundance of 0-and 1-year-old fish at most of the centres had improved in the latter half of 1975; it is therefore to be expected that the fishery on the west coast would improve in the coming season.

The morphometric, meristic and serological studies with a view to identifying the unit stocks were continued.

An important development taking place in the mackerel fishery of the Calicut area is that Pattenkolli units (6 boats with 3 nets) are towed to the fishing grounds 25–30 fathoms deep by the mechanised boats and back to the landing centre. This has led to the enlargement of the area of operation of the non-mechanised boats.

In the Mandapam area the drift net has replaced the shore seine as the major gear for mackerel; the former has a much wider operational range than the latter. About 70% of the catch came from the Gulf of Mannar and the rest from the Palk Bay. The length range was 130–289 mm with modes in the size range 170–189 mm in the shore seine, and 190–320 mm with modes in the range 200–249 mm in the drift net catch.

At Port Blair the mackerel season in 1975 was better than in 1974; the mackerel formed 18% of the catch of all fishes. Over 80% of the catch was composed of *Rastrelliger kanagurta* and the rest of *R. brachysoma*. The size range of the fish was 50–240 mm. Juveniles with the modes 70–80 mm appeared in February-March.

Personnel: K. V. Sekharan, SFS; G. Seshappa, FS; M. Vasudeva Pai, JFS; V. Balakrishnan, JFS; R. S. Lal Mohan, AFS; N. S. Radhakrishnan, AFS; A. Noble, AFS; V. N. Bande, AFS; T. M. Yohannan, RA; P. Nammalvar, RA; P. Livingston, RA; G. M. Kulkarni, RA; K. Rajasekharan Nair, RA.

TABLE 4

The c. p. u. e. (in Nos.) of mackerel of different age groups at important centres in the second halves of 1974 and 1975

Centres	c. p. u. e. of age groups							
	1974				1975			
	0	1	2	3 & above	0	1	2	3 & above
Vizhinjam (Boat seine)	–	No sample			21	1	0	0
Cochin (Thanguvala)	5	7	1	0	783	6	0.1	0
Calicut(Pattenkolli vala)	51	455	136	3	173	355	102	1
Ullal (Pattabala)	–	No landings		–	0	255	5	0
Baikampady (Rampan)	0	7900	4800	0	No Sample			
Karwar (Rampan)	3280	11800	128	0	0	52750	3354	0

Studies on commercially important elasmobranch resources (FB/OF/1)

Sharks: Long line fishing for sharks at Tuticorin which usually extends from May to July was not in operation this year, as fishermen have been diverting the effort to the lobster and prawn fisheries. The estimated catch from drift nets and hook and lines this year at Tuticorin was about 34 tonnes. The drift net was also the main gear for shark fishing at Pamban and Kilakkarai, where the annual catch was 30 tonnes and 18 tonnes respectively. The potential catch of sharks is much greater than what is landed.

At Tuticorin, *Loxodon macrorhinus* had the size range 468–645 mm with modes in the ranges 570–580, 590–600 and 600–610 mm. The percentage of females ranged between 62 and 85 in different months. Among the intrauterine embryos also females were dominant (70%). About 2/3rds of the females examined in June were gravid, and the size range of the embryos was 47-417 mm. At Mandapam, *Rhizoprionodon oligolinx, R. acutus* and *Loxodon macrorhinus* were the important species. For *R. oligolinx* two prominant modes were observed, namely 271–390 mm and 571–630 mm. In *R. acutus,* the mode at 431–460 mm was dominant at Kilakkarai and 731–760 mm at Pamban. The young ones of *Sphyrna lewini* ranging from 455 to 490mm were available at both centres. The gravid females of *R. oligolinx* with early stage embryos were observed in March-April, and with late stage embryos in June. Gravid females of *R. acutus* were collected in the first quarter and just released embryos of *S. lewini* in June. *Sphyrna blochii* collected from gill net exhibited multiple pregnancy and compartments are formed inside the uterus during the development. The development of the embryos was studied in detail.

The Study of the growth of the shark, *Scoliodon sorrakowah* was completed at Bombay.

Rays: About 255 tonnes of rays were caught in trawl net at Mandapam. The landing were high in April (73 tonnes).

Himantura alcockii was the most important species (about 23% of the catch) followed by *Aetobatus nari-nari* (about 20% of the catch), *Gymnura poecilura* (18%) and *H. bleekeri* (17% of the catch). While *G. poecilura* was caught in more or less equal quantities in most of the months, *Himantura* spp. were landed in large quantities only in April. The size of males of *G. poecilura* varied

from 200 to 570 mm and that of females from 220 to 990 mm in disc width. In both sexes there were one to three modes in the size frequency distribution and these were in the range of 241–560 mm in the case of males and 241–920 mm in the case of the females. Adults were recorded only in very few numbers throughout the year, the catch being composed mostly of juveniles. Gravid females were recorded only in February-May and in July. The size range of the gravid females was 720–946 mm and of the embryo 105–214 mm in disc width.

Personnel: R. V. Nair, Officiating Director (till 24–6–1975). K. K. Appukuttan, RA; K. Prabhakaran Nair, RA; R. Soundararajan, RA; M. E. Rajapandiyan, RA

Evaluation of the resources of Bombay duck and Lizard fishes (FB/OF/2.)

Bombay duck

At Versova: There was a general improvement in the fishery as compared to last year. The C. P. U. E. in numbers and weight improved from 2242 and 31.0 kg respectively in 1974 to 3200 and 52.5 kg in 1975. The average size has also showed an increase to 180.75 mm as against 139.0 mm in the previous year. The dominant size group has moved in the higher size range of 210–355 mm as compared to last year's 120–135 mm. The decline in the average number of hauls and the percentage of juveniles in the catch from 46.3 to 37.2 on the days of observation and from 89.6% to 83.5% respectively has borne out the improvement anticipated last year. The improvement in all the parameters consequent to the reduction in fishing effort in terms of hauls indicates that possibly overfishing has been taking place in the Bombay duck fishery.

At Nawabunder: The estimated landings for this year showed a decline to 21044 tonnes from last year's 27843 tonnes. The average length varied from 156 to 231 mm. The C. P. U. E. was highest in December in weight (350 kg) and numbers (575). It was lowest in March by numbers (290) and by weight (160 kg) in April. The percentage of juveniles varied between 41 and 84. Spawners (38.46%) were observed during December.

Population genetics of Bombay duck: The inbreeding coefficient worked out on the basis of the genetics of Lactate dehydrogenase showed disagreement with that of muscle myogens.

Therefore, searching of eye lens protein which is considered very stable has been initiated during the year. In the case of LDH. variant, Izozyme patterns were found among least type Iozymes

General Biochemical studies:– Studies on the bound amino acids in the developing ovary showed that as maturity stages advanced, proline, alanine and arginine increased while glycine dcreased. So also their weight showed an increase till IV stage and then onwards a decrease reaching normal after spawning. Investigations on trimethylamine Nitrogen in Bombay duck during storage showed that 0.35 mg/100 g TMAN increased to 1.8 mg/ 100 g in four days. An increased protein-water ratio was found during growth and spawning. As growth increased and with subsequent spawning, protein decreased and water increased in the muscle.

Lizard fishes: The catch of the lizard fish, *Saurida tumbil* by the Govt. of India Exploratory Vessels at Madras amounted to about 6 tonnes, the monthly catch per hour varying from 0.03 kg in October to 16.4 in June. June-August and November-December were periods of higher abundance of this fish. The size range in the catch was 51–430 mm with the main modes in the range 161–330 mm. Ripe specimens were recorded in September.

At Mandapam about 8.7 tonnes of the lizard fish were landed by trawlers during January-June. The catch was poor during February to April but improved later on. The length range was 91–380 mm with the modal sizes in the range 136–320 mm.

Personnel: S. V. Bapat, JFS; A. S. Kaikini, AFS; V. M. Deshmukh, AFS; S. Basheeruddin, AFS; J. P. Karbhari, SRA; M. K. George, SRA; D. Sivalingam, SRA; A. Kurian, RA.

Studies on the resources of tunas, seer fishes and bill fishes (FB/OF/3).

Tunas: The tuna catch was poor at Vizhinjam, and about 78% of the catch was landed during the second and last quarters, the peak landings amounting to nearly 50% of the annual total were obtained in April. Drift nets, hooks and lines and shore-seine contributed to 48.5%, 50. 5% and 1% respectively of the catch. On the Rameswaram Island also the fishery was poor, the estimated catch in 1975 from the Gulf of Mannar being about 27.5

tonnes as against 66 tonnes in 1974. The drift gill net with 76 mm mesh landed about 25.8 tonnes and those with 140 mm mesh size 1.7 tonnes. The C. P. U. E. of Tunas for 76 mm mesh net was 11 kg as against 9 kg last year. The IFP vessels at Cochin landed about 652 kg of tunas in February, April, May, November and December using purse seines in the areas 9/76 and 10/76.

At Vizhinjam *Euthynnus affinis* and *Auxis thazard* formed 69% and 30% respectively of the tuna landings; the size range of *E. affinis* was 300–779 mm, the groups 360–379 mm forming the bulk of the catch in hooks and lines and the groups 480–499 mm in the drift net catches. Mature specimens were common in May. Males were dominant in almost all months. Larval forms of *Sarda orientalis* were collected from plankton. In the Rameswaram island also the tuna catch was composed of the two species mentioned above. The former ranged from 470 mm to 870 in length with modes at 570, 690, and 710 and the latter from 305 to 465 mm with modes at 305 mm, 385 mm and 445 mm.

Tuna landings at Minicoy was estimated at 580 tonnes during 1975 and this showed an increase of 26% over the catch of 1974. This increase in catch was attributed to the mechanisation of the fishing fleet. *Katsuwonus pelamis* formed 86.1% of the catch. The CPUE for this species was high during January to May and during December. Environmental studies in relation to the tuna fisheries are being carried out at this centre as also on the bait fish resources.

Bill fishes: The estimated drift net landings of the sail fish, *Istiophorus gladius* at Calicut was 2300 kg. There were no landings during the second and third quarters. The best catch was in November. A small catch of 246 kg of marlins was also recorded at Calicut during the year. The modal sizes (in standard length) of the sail fish were 185 and 220 mm in January and 205 and 210 cm in November. All the specimens examined were immature. There was no record of bill fish catch on the Rameswaram island during this year. During November, R.V.VARUNA of the IFP conducted longline operations in areas 9–74 and 10–74 landing small catches of sail fish, marlins, yellowfin, tuna and sharks.

Seer fish: During 1975 about 158 tonnes of seer fishes were landed on the Rameswaram Island, 103 tonnes from the Palk Bay and 55 tonnes from Gulf of Mannar. The drift net with mesh

of 76 mm and 140 mm were operated. The bulk of the catches was landed by net of former type; the latter type of net was introduced the first time this year.

The catch per unit of effort for the island as a whole was 12. kg; the respective figures for Palk Bay and the Gulf of Mannar being 10 kg and 20 kg respectively. In the Palk Bay, C P U E for the net of 76 mm mesh type was 8 kg and for the 140 mm mesh type 26 kg. In the Gulf area the CPUE for the two types of nets was 20 kg and 22 kg respectively. The data show that operation of the 140 mm mesh drift net is likely to be more remunerative.

Scomberomorus commersoni, S. guttatus and *S. lineolatus* formed the seer fish catch in the island. In respect of the first species the size range in the 76 mm mesh net was 225–1275 mm with modes at 525 mm and 975 mm in the Palk Bay and 375, 575, 775 and 975 mm in the Gulf of Mannar; one year old fish formed the bulk of the catch both in the Palk Bay (87% of the landings) and the Gulf of Mannar (67% of the landings). With regard to the catch of this species by the 140 mm net, the size range was 675–1475; 3 year-old fish were dominant in the landings from both the Palk Bay (46%) and the Gulf of Mannar (67%). *S. guttatus* sampled from the 76 mm mesh net from the Gulf ranged between 255 mm and 676 mm, 2 year old fish being dominant (58%). *S. lineolatus* from the net of 76 mm mesh had the size range 460-910 mm; about 67% of the catch was composed of 2 year old fish.

Personnel: M. D. K. Kuthalingam, JFS; M. S. Rajagopalan, AFS; M. Devaraj, SRA; P. Linvingston, RA; M. M. Meiyappan, RA.

Evaluation of the resources of the lesser sardines, anchovies and other clupeoids (FB/OF/4).

Lesser sardines: The estimated landings in 1975 at important observation centres along the south-west and south-east sections of the coast were: Vizhinjam–104 tonnes (mainly by gill net); Tuticorin: 3300 tonnes (exclusively by gill net); Palk Bay observation centre: 70 tonnes (exclusively in the first half of the year and mainly by shoreseine); Gulf of Mannar centre: 33 tonnes, (7 tonnes by shore-seine and the 26 tonnes by gill net). Observations show that the yield is likely to increase with increase in gill net operation. *Sardinella gibbosa, S. albella, S. sirm* and *S. dayi,* were the important constituents of the catch at all centres,

the first species being the dominant one. In respect of the Palk Bay this was a case of reversal of species dominance, *S. albella* having been dominant previously. The catch was composed mainly of 0-year-old fish, in respect of all species, except *S. sirm*, the landings of which were supported mainly by one-year-old fish. Stray catches of oil sardine, *S. longiceps* were also recorded at Tuticorin.

Rainbow sardine: An important feature noted in the Mandapam area was that the trawl nets are emerging as a main gear for the rainbow sardine, *Dussumieria acuta*. In 1975, of the total catch of 11 tonnes, the trawl nets landed 70%, the rest being landed by gill net and shore-seine. The fishery was good through out the first and last quarters. The size range in the catch was 40–159 mm, the mode being in the range 60–139 mm in nonselective gear and 130–144 mm in selective gear.

Anchovies: The fishery was poor at Vizhinjam and accounted for only 84 tonnes. Boat seine landed the bulk of the catch with an annual cpue of 2.4 kg; the annual cpue for shore seine was 2.1 kg. *Stolephorus devisi*, *S. bataviensis* and *S. buccanceri* were the main species in the fishery; there was recruitment of *S. devisi* at 40–44 mm size and *S. bataviensis* at 35–39 mm in April–May. The length frequency study shows a monthly growth of 8.3 mm for the former and 10 mm for the latter.

Clupeoid investigation at Bombay: The work was initiated in 1975. *Coilia dussumieri*, the commercially important species had peak season in November at Sassoon Docks and in December at Versova. The total catch at the two centres was estimated as 180 tonnes; cpue at both centres being high in November. The size range of the fish was 74–190 mm. Juveniles were recorded during November-December. The other clupeoids in the fishery were *Chirocentrus dorab*, *Ilisha filigera*, *Hilsa toli*, *Dussumieria acuta*, *Thryssa* spp. and *Stolephorus* spp. The first three were taken in gill nets and the others in trawl nets.

Personnel: S. V. Bapat, JFS; P. Sam Bennet, AFS; G. Luther, AFS; S. Lazarus RA; R. Thyagarajan, RA; P. N. Radhakrishnan Nair, RA; C. Muthiah, RA.

Studies on the resources of cat fishes, perches and carangids (FB/DR/1).

Cat fishes: There was a fall in the relative abundance of cat fishes, along the coasts of Andhra Pradesh and Orissa as indicated by the catch rate of the Government of India Exploratory trawlers *M. V. Meena shodhak* and *M. V. Meena Jawahar,* the catch per hour of fishing being 10.6 kg in 1975 as against 19.8 kg in 1974. The C P U E of *Tachysurus thalassinus* was 3.6 kg and of *T. tenuispinis* 7 kg. The first and 4th quarters recorded peak catch rates of the first species and the 2nd and the 3rd quarters, peak catch rates of the other. Unlike in the offshore regions, there was an improvement in the cat fish fishery in the inshore area at Waltair during the year, and 44 tonnes of cat fish with a catch rate of 1.4 kg per unit of gear was recorded in 1975 as against 26 tonnes with a catch rate of 0.6 kg per unit of gear last year. The size range of *T. thalassinus* in the catch was 100–460 mm and of *T. tenuispinis* 147–440 mm. Apparently in the case of both species one year-old fish were dominant in the landings.

In the Mandapam area the cat fish fishery was concentrated mainly in the Palk Bay during February-September and in the Gulf of Mannar during January and October-December. The catch per unit of effort was high in April-October. The trawl net catches were composed mainly of *T. thalassinus, T. dussumieri, T. caelatus* and *T. maculatus* in the order of abundance and drift net catches mainly of *T. dussumieri, T. thalassinus,* and *T. caelatus* and *T. tenuispinis* in that order. This indicates that *T. dussumieri* is a more surface dwelling fish than *T. thalassinus.* In the catch of *T. thalassinus* in trawl net, the size range was 60–490 mm with 0-year-and one-year-old fish being dominant and in the drift net the size range was 230–580 mm with 3- and 4-year-old fish being dominant. The trawl catch of *T. dussmieri* comprised fish of the size range 80–400 mm, 0-and one-year-old fish forming the bulk of the landings. In regard to the drift net catch however the size range was 290–685 mm, with fish of age 4 to 6 years being dominant.

Carangids: About 125 tonnes of carangids forming 8% of the all fish catch was landed at Vizhinjam during the year; this was the lowest catch on record over the last 5 years. *Decapterus dayi* formed 31% of the catch. The size range of the fish was 63–227 mm. The length frequency studies indicate that the 0-year old and one-year-old fish form the fishery.

Mature and spent individuals were observed from February to November, *Megalaspis cordyla* which formed only 4.5% of the total catch had the size range 189–363 mm, 0-year class and one-year-old fish were more or less equally dominant in the fishery.

Personnel: B. Krishnamurty, JFS; P. Mojumder, AFS; S.S. Dan, AFS; N. Gopinatha Menon, RA; P.V. Sreenivasan R.A.

Sciaenid and Polynemid resources of the east and west coast of India (FB/DR/1).

Sciaenids:

Bombay: The estimated catch and biological data in respect of the important species at Sassoon Docks in 1975 are given below:

Species	Catch (tonnes)	Important modal size gruops (mm).	Spawning period of the fish
Johnius vogleri	66	140–230	June-December
J. dussumieri	66	120–190	January-March & July-December
Johnieops sina	355	160–300	September-October
Otolithes argenteus	645	163–345	July-October

The size ranges of the first two species were 38–305 and 91–234 mm respectively. A detailed study of *J. vogleri* showed that the catches are composed mainly of 1 year old fish.

Calicut: The total landings of sciaenids at Vellayil were estimated as 282 tonnes. The size range and periods of occurrence of mature individuals of the major species are given below:

Species	Size range (mm)	Period of occurrence mature and spent fish
Johnieops sina	55–195	November-February
J. dussumieri	45–175	July–December
Otolithes cuvierii	55–355	July–September

With regard to *J. sina* the specimens from inshore collections were immature.

Madras: The best monthly landings of *Otolithes ruber* were recorded in January (24.6 tonnes) followed by September (15.9 tonnes). The length range was 110–345 mm.

Kakinada: The sciaenid catch of the trawlers in 1975 was estimated as 795 tonnes, the periods of high catches being January-February and July-August. The biological observations on the important species are summarised below:

Pennahia aneus: The length frequency distribution in all months was bimodal, indicating the occurrence of two age-groups. Small individuals of the size-range 60–89 mm were recorded in February and November. Advanced maturity stages were observed from February to May and in December.

Johnius carutta: Individuals with maturing ovaries occurred during February-May. The ova diameter studies indicate fractional spawning during a single spawning season.

J. osseus: Although individuals in maturity stage IV occurred continuously from March to July, fish with ripe and running ovaries (stage VI) were recorded only in May.

Polynemids : Investigations on the Polynemid fishery were conducted at Mandapam, *Polynemus microstoma* and *P. sextarius* being the species under study. The former had the size-range 104–174 mm and the latter 100–172 mm. Spent recovering individuals were recorded in October in respect of the first species and in February in respect of the other.

Personnel: T. Tholasilingam, FS; S. J. Rajan, AFS; K. Dorairaj, AFS; R. S. Lal Mohan, AFS; K. V. Somasekharan Nair, RA; A. A. Jayaprakash, RA; C. Muthiah, RA; S. Srinivasarengan, RA; V. Sriramachandra Murty, RA.

Studies on the resources of silver bellies and ribbon fishes (FB/DR/3)

Silver bellies : The declining trend in the catches of silver bellies by trawlers at Mandapam, which was noticed in 1974 continued in 1975 also. The total catch of silver bellies in 1975 (4825 tonnes) was about half of that in 1974 (8800 tonnes). The catch per boat per day also showed a decline from 463 kg in 1974 to 238 kg in 1975. Taking into account only day fishing, which is more

productive than night fishing for this group of fishes, the total landings were 3640 tonnes in the year under report, as against 7775 tonnes in 1974. At the same time, the numbers of day trips of the boats decreased to 5720 from 8720 during the last year, and the number of night trips increased to 14600 from 10300 in 1974. Two factors influenced the fishermen to go for more night fishing this year. (1) the higher catch rate of prawns at night than during day and (2) the easier availability of diesel oil. Although the catch and catch per unit of effort have declined, the mean size of *Leiognathus jonesi* the dominant species, has been increasing from 70.4 mm in 1970 to 76.4 mm 1975 which could be due to both fishery dependent and fishery-independent factors. These aspects are being investigated further. The size range of the fish landed was 25 to 115 mm, the modal sizes varying from 35 to 110 mm. in different months. The catch was dominated by one year old fishes. April-August was the period of high catch of silver bellies in the Palk Bay. At Madras (Royapuram) the estimated catch of silver bellies by trawlers was 660 tonnes, forming 14% of the total landings. The highest catch rate was recorded in January and the lowest in December. *Leiognathus bindus* (size range 45–130 mm, and modal sizes of 81–85 mm, 91–95 mm and 101–110 mm), *L. dussumieri* (with size range of 45–150 mm, modal sizes of 91–95 and 101–105 mm) and *Gazza minuta* (size range 55–150 mm and modes 96–100 mm, 101–105 mm, 116–120 mm and 121–125 mm in different months) dominated the landings.

Ribbon fishes

The trawler catch at Royapuram (Madras) was better in 1975 (145 tonnes) than during the last year (100 tonnes). The best catch per hour (15 kg) was in November. At Kakinada the catch was 375 tonnes, almost equal to what was estimated during the last years, the catch per hour (2.02 kg) was also almost equal during the two years. *Trichiurus lepturus* with size range of 190–892 mm and modes 300–500 mm and 700–900 mm at Madras and size range of 121–751 and modal sizes in the range 240–630 mm at Kakinada dominated the landings of ribbon fishes.

Personnel: G. Venkataraman, JFS; P. T. Meenakshisundaram AFS; J. C. Gnanamutthu, AFS; Y. Appanna Sastry, RA; V. Sriramachandra Murty, RA.

Evalution of demersal resources of some selected areas (FB/DR/4).

During the year, analysis of the trawler landings from the six selected centres were continued, viz. Bombay, Cochin, Tuticorin, Kakinada, Visakhapatnam and Port Blair. The highlights of the results as regards effort, catch and return per unit effort for the different centres are given below:

BOMBAY

During the period of January-November, four trawlers *Meena Bharati, Meena Sachatak, Meena Udyog* and *Kalyani,* fished in squares 15–73, 16–73, 16–72, 17–71, 17–72, 17–73, 18–71, 18–72, 19–71 and 19–72 for 1393. 14 hours, landing a total catch of 1,64,423 kg, at a catch rate of 118.02 kg/hr. The catches were mainly of catfish and elasmobranchs at catch rates of 41.42 and 25.06 kg/hr respectively. The highest monthly catch was in January, which gave a rate of 202.77 kg/hr. In 1974 the annual figures were 1,50,244 kg, with a catch rate of 119. 45 kg/hr. This shows an increase, in 1975, of 14,179 kg in total landings, and a marginal 1.43 kg/hr in catch rate. The lower catch was probably due to the lesser effort in 1974, when *Kalyani* fished only for two months.

COCHIN

During the year demersal fishing operations carried out by the vessels belonging to the IFP and EFP in the inshore as well as deeper waters gave the following main points. By inshore trawling, the medium boats of IFP, fishing at 5–40 m, caught 6743 kg. of fish for an effort of 485.7 hrs, thus giving a catch rate of 13.88 kg/hr. This shows a decline both in catch rate from the previous years values of 8342 kg and 24.33 kg/hr. The larger IFP vessels, fishing at 18–94 m, caught 321533 kg of fish in 2282.15 hours at a rate of 140.89 kg/hr. This too indicated a decline in abundance from the previous year, when the corresponding values were 357585 kg and 162.16 kg/hr. The larger IFP vessels, fishing in deeper waters of 190–325 m depth, caught a total of 24208 kg in 287.25 hr, at 84.26 kg/hr, as against 39037 kg 470.96 hr and 82.89 kg/hr. in 1974. A slight rise in relative abundance is thus seen in the increase in catch rate, though the total catch was less, obviously due to the smaller effort this year. In addition to trawling, the IFP vessels also caught fish by hand lines (3633 kg) and by Kalava

trips introduced this year (3454 kg. at the rate of 11.06 kg/hr.). The EFP vessels caught 145603 kg of fish in 1265.75 hr at 15–55 m depth, the catch rate working out to 115.03 kg./hr.

TUTICORIN

The trawlers, *Meena Niryantak* and *Meena Saudagar*, fished, mainly in square 8–78, to land 117.178 tonnes of fish for an effort of 1665 hours, at the rate of 70.30 kg/hr. Perches and rays constituted the main portion of the catch. The 1974 figures were 68.238 tonnes for the total catch and 110 kg/hr for the catch rate. This shows an increase, in 1975, of nearly 49 tonnes in annual catch, due obviously to the greater effort of both vessels fishing for the whole year in 1975, while in the previous year *Meena Saudagar* joined fishing only in December. However, there has been a fall of nearly 40 kg/hr in the catch rate during the current year, indicating a decline in abundance of demersal fishes in the grounds.

KAKINADA

The three types of trawlers (Pablos 20–40 hp; Pomfrets and Royyas-45–60 hp; and Sorrahs-over 60 hp) fished in Kakinada waters to catch a total of 6399 tonnes (including 1625 tonnes of prawns). The figures for the previous year were 5029 tonnes for the total catch and 28.36 kg/hr for the catch rate. This shows an increase in total catch of 1370 tonnes (including 193 tonnes of prawns) this year, which could be attributed partly to the increase in effort - 25957 units operated in 1975 in place of 23253 units in 1974. At the same time there was an increase in the relative abundance of fishes also as evidenced by the fact that the catch per hour rose to 34.21 kg in 1975 from 28.34 in the previous year Prawns dominated the catches this year, followed by *sciaenids Nemipterus*, ribbon fishes, silver bellies, sole and rays.

VISAKHAPATNAM

The tralwers, *Meena Shodak* and *Meena Jawahar*, fished along the Andhra-Orissa coast and brought in a total catch of 1,23,081 kg, at the catch rate of 71.8 kg/hr. The corresponding figures for 1974 were 1,26,009 kg and 83.6 kg/hr. This shows a slight decline in total catch, of 2928 kg and in catch rate of 11.8 kg/hr. Obviously there was a decline in the relative abundance of demersal fish in the region this year. Though, during the year, the catches of *Meena Jawhar* were slightly higher than that of

previous year, the relatively much lower catches of *Meena Shodak* contributed to the fall in the total landings this year. In the catches the "miscellaneous-small" group of fishes predominated, the second rank being held by catfishes in most of the months and by prawns/rays in the others.

PORT BLAIR

During the months January to October, *Meena Khojini* operated trawls (except in August) and, in addition, also used Kalava-lines in April-July, while *Meena Prayas* operated trolling and long lines in February-May. An estimated total of 15033 kg of fish was caught by trawls for an effort of 127.26 hours, thus giving a rate of 118.13 kg/hr for the period. The catch by kalava-lines amounted to 577 kg during the period for an effort of 104.06 kg/hr, the catch rate working out to 5.54 kg/hr. The catch rates for these two gears during the previous year were 123.92 and 2.76 kg/hr. The current data, covering as they do the January-October period, do not indicate any significant changes.

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Studies on the resources of Flat fishes and pomfrets (FB/DR/5).

Flat fishes: The total catch of the Malabar sole *Cynoglossus macrostomus* at Vellayil (Calicut) was about 420 tonnes in 1975 as against 360 tonnes in 1964. However the annual catch rate per unit of gear was higher in 1974. The best monthly catch rates were obtained in November in both years. The size range of the fish in the catch was 50–179 mm. The landings were composed mainly of one year old fish; two year-old fish were particularly dominant in the fishery in September. The juvenile of the year's post-monsoon brood appeared first in the catches in December whereas in 1974 they had appeared even in November itself. Fish in the stage V of maturity were common in February-April and November December, and spent specimens in January, April and May. Spawning had obviously started in October-November and to some extent even earlier.

Other Flat fishes: The total landings of the large tongue sole *Cynoglossus dubius* at Vellayil was 2.3 tonnes against 8.9 tonnes in 1974. The size range of the fish was 40–369 mm, with some beraks in the intermediate groups of the size distribution. Spawning in this species had also obviously started in October and perhaps much earlier. The occurrence of *Cynoglossus quinquelineatus* (Day) and *C. dispar* (Day) was recorded off Kerala during this year.

Pomfrets: The fishery of the silver pomfret, *Pampus argenteus* was poor at Veraval. The catch per unit of effort of the fish in gill nets varied from 11 kg in March to 1.0 kg in December. The percentage of fish in the catch also varied from 5 in March to 1 in December. The size range in the catch was 201–335 mm with 311–315 mm as the dominant group.

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Mariculture-Culture of marine fishes and crustaceans (FB/MISC/6)

Culture of eels in running water

In the first half year, measurements of length and weight of young eels cultured in running water at Mandapam were taken three times. The eels which in February ranged between 267 and 354 mm in length and between 36 and 96 g. in weight had the length range of 291–381 mm and weight of 44–115 g. in June. In the middle of July the young eels in the eight fibre glass tanks were sorted out according to their size and restocked in different densities. The total weight of the eels in different tanks was 608–4068 g in July, 1975 and 1200–6310 g in January 1976, the percentage of increase in weight in different tanks varying from 6 to 96. The overall half yearly increase in weight worked out to 38%. The total weight of young eels in all the tanks taken together amounted to 20.1 kg on 21 January 1975 and 30.8 kg on 12th January 1976. The overall weight increase in one year is about 11 kg which works out to about 53% of the initial stocking weight. Experiments on conversion factors of 7 types eel feeds which have been in progress for the last one year were terminated in June and the data are being analysed.

During elver resources survey conducted in December 1975 the glass eels of both *Anguilla bicolor* and *A. bengalensis* ranging

in length from 45 to 72 mm and in weight from 0.2 to 0.7g. were collected from Athankarai estuary (near Mandapam).

Fish Culture in the salt pan area at Tuticorin

A large pond 92 x 31 m extent was excavated. Minor repairs to the bunds of the four smaller ponds as well as to the sluices were undertaken at the beginning of the year. The biological cover grew well in the ponds and showed the presence of *Pleurosigma, Navicula, Nitzschia*, green algal filaments and nematodes. The *Chanos* fry season during 1975 was a failure in this part of the country. Experimental fry collections in the nearby Kallar estuary yielded mullet seed during June. The 3 ponds, A, B and C were stocked in 3 densities with the seed of the mullet, *Mugil macrolepis*. The modal sizes of the seed were 35–45 mm and the modal weight 0.25 g. After a period of 6 months the fish have registered growth increments of 60–100 mm and weight increment of 12–49 g.

The pond D was utilised in June-July '75 for taking up an experiment on the growth and survival of the crab *Scylla serrata* stocked in indvidual cages in June-July, 1975. Most of the 51 specimens used in the experiment have survived the 6 months period, moulting once and rarely twice and registering increments in carapace width upto 25 mm and weight upto 61 g.

Sillago culture: Fingerlings collected from Coondapore estuary ranging in size from 45 to 80 mm were released in 4 small ponds adjoining the Netravati estuary at Mangalore in January 1975. A few were also tagged with loop tags. The experiment lasted till April 1975. The growth rate of the fish was very encouraging. Another interesting finding was of the abundance of *Sillago* seed in the Netravati estuary itself.

Suitability of a site at Bhimunipatnam for mariculture:

The tidal amplitude in the region ranged from 0.7 to 1.6 m, the water temperature from 22.0° C, pH from 7.6 to 8.2, dissolved oxygen from 3.0 to 7.1 ml/l. and salinity from 19.3 to 34.3‰. Low salinity and pH were recorded during the northeast monsoon period. Plankton production was good from January-June and from November to December. Good resources of seed of molluscs (especially *Meretrix* spp) locally untilised in the lime industry, and rock oysters, the flesh of which is used for poultry feed;,

prawns (*Penaeus indicus, P. monodon* and *Metapenaeus monoceros* and fishes (especially *Mugil* spp., and *Therapon* spp.) were recorded in the area. During the northeast monsoon period the tidal water appears to be detrimental to the growth and survival of the flora and fauna of the area. Nevertheless the area appears to be good for mariculture.

Laboratory spawning of marine prawns

Mature specimens of four species of marine prawns namely, *Metapenaeus dobsoni, M. affinis, Parapenaeopsis stylifera,* and *P. acclivirostris* were collected from the sea and kept in suitable containers with fresh sea water. All spawned in the night of the same day and by next morning the nauplii hatched out at room temperature of 29.2°C. The post larval stage I of the first 3 species was obtained in 14 days; the larvae of the other species did not survive beyond protozoea III.

Similarly *Metapenaeus monoceros* collected from the sea also spawned in the laboratory; however all the larvae died before reaching mysis I stage. Another experiment on the laboratory spawning of *M. affinis* was successful and the larvae were reared with negligible mortality up to the post larval stage, when these were used for experiments with artificial prawn feeds. This time the diatom *Thalassiosira* sp. was used for feeding the protozoea and it was found to be much better as food than the algae used in previous experiments.

Artificial prawn feeds: At Cochin during the second quarter post larvae of *M. affinis* were used in the experiment with the feed No. 12 for 2 months; the over all increase in total length was 7.4 mm in the first month and 8.2 mm in the second month. Two more feeds (No. 14 and 15) using the same ingredients (Tapioca, rice bran and fish meal) but with a higher protein content were also compounded and fed to juveniles of *M. dobsoni* of size 15–33 mm (the average length 22.5 mm). The prawn had a growth rate of 18.4 mm with feed No. 14 and 25 mm with feed No. 15 in the first month followed by slight decrease in growth increments during the succeeding months.

Natural food production for prawn larvae:

Since experiments showed that the diatom *Thalassiosira* sp: was the best natural food for the prawn in the Protozoeal

stage it was cultured in a medium to which Miquel's solution was added, under natural and artificial illumination. Sufficient quantities of culture could be obtained within a week's time.

Since *Artemia* eggs obtained from the market failed to hatch satisfactorily, a series of experiments were conducted to find out the optimum conditions required for their proper hatching. It was found that the percentage of hatching increased slightly when temperature was raised slightly above that of the room. With aeration, the percentage of hatching was 50 and above although time taken for complete hatching was more (up to 5 days as against the usual 1–2 days). It was also noticed that the variation in salinity would affect the hatching rate.

Laboratory hatching and rearing of crabs:

Berried specimens of *Portunus pelagicus, P. sanguinolentus* and *Charybdis cruciata* were kept in glass and fibre glass aquaria containing fresh sea water. All the crabs shed their eggs within a few days. Some of the mature eggs were isolated and kept in troughs with fresh filtered sea water and aerated frequently. But the eggs failed to hatch.

Another attempt was also made with a berried specimen of *Charybdis lucifera*. Even though this crab also shed part of the eggs, some of these developed and the larvae hatched out. The zoea were kept in separate troughs. However, they died within two days as they could not be fed properly.

Prawn culture at Mangalore: Seeds of *Penaeus indicus* ranging in size from 50–70 mm were released in a pond adjoining the Netravati estuary in January, 1975. Free tidal flow was ensured by fixing a cement pipe with nylon netting (0.3 mm mesh) at both ends. A few seeds were marked with disc tags and released in a cage set in the middle of the ponds. The experiment was terminated in the first week of April. The prawn in the pond measured 71–116 mm at the end of the experiment. An average growth of about 6 mm per month was registered.

Prawn culture at Neellarevu: Prawn culture work was taken up in a 0.8 ha salt pan pond. About 8000 juveniles of *Penaeus mondon* of size range 37–112 mm (mean size 72 mm) were stocked during the period 9th to 22nd August 1975. A sluice gate was installed in the last week of September. On 6th September the

size of the prawn varied from 71 to 126 mm (mean size 98 mm). By the end of October, due to heavy rain fall there was flooding of the brackish water creek which resulted in the breaching of the bund, and flooding of the pond. Therefore the experiment had to be abandoned in November. The study had also shown that the seed of *P. indicus* had entered the ponds during high tide, before the sluice gate was installed.

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RESEARCHES CONTEMPLATED

The resource oriented investigations in respect of major fisheries will be strengthened during the coming year. Large scale tagging of oil sardine and mackerel, with a view to studying among another things, the movement patterns and growth of these fishes, will be undertaken. It is proposed to prepare fishery atlases of oil sardine and mackerel and reports on the present status of these fisheries as also of the fisheries of the anchovies incorporating data of interest to the fishing industry. The question of possible over-fishing of the Bombay duck of Maharashtra and Gujarat and silver bellies of the Palk Bay will receive greater attention than hitherto. At the same time the exploratory surveys with a view to finding new and latent resources will be intensified in collaboration with the other Government of India Organisations. The development of techniques for culturing marine fishes will receive increased attention during the coming year.

CRUSTACEAN FISHERIES DIVISION

Studies on the prawn resources of Indian Seas (FB/MF/3).

The crustacean landings in India showed considerable improvement from those of the previous year. Of the total catch of 2.44 lakh tonnes, the penaeid prawns formed 58.2% while the non-penaeid prawns and other crustaceans accounted for 32.4 and 9.4% respectively. The state-wise landings are given in table 5.

A heavy decline in the penaeid prawn landings was experienced in Andhra Pradesh, while substantial increase was noticed in all other States. In the case of non-penaeid prawns also the catch was better than in 1974 and this was mainly due to the increased landings in West Bengal, Orissa, Andhra Pradesh and Tamil Nadu. Landings of other crustacean (lobsters and crabs) were better in all the states except Kerala, Andhra Pradesh, West Bengal and Orissa.

The fishing effort on the east coast was observed to be comparatively more than at the centres of the west coast. The catch/hr on the west coast varied from 10.3 kg at Calicut to 29.6 kg at Bombay whereas it varied from 4.2 kg at Mandapam to 8.7 kg at Kakinada on the east coast. Night fishing by trawl for *Metapenaeus monoceros* at Kakinada increased considerably during this year. At Ambalapuzha the offshore prawn catch suffered a further set-back during this year. At Mangalore and Goa the decline was only marginal. Calicut and Karwar witnessed better landings this year. At Bombay the inshore fishery registered a substantial increase. The occurrence of large sized penaeid prawns in good quantities was a significant feature of the 'dol' net fishery especially at Versova. On the east coast, substantial improvement was observed at Tuticorin and Mandapam. However, a decline to the extent of over 50% was noticed in the inshore prawn catch at Puri.

The principal component of the offshore fishery was *Parapenaeopsis stylifera* on the west coast except at Goa, Mangalore and

Table 5 *State-wise landings of Crustaceans (In tonnes)*

State	Penaeid prawns		Non-Penaeid prawns		Other Crustaceans		Total	
	1975	1974	1975	1974	1975	1974	1975	1974
West Bengal & Orrissa	2920	2322	2787	1165	8	45	5715	3532
Andhra Pradesh	7152	9857	3523	2842	707	934	11382	13633
Tamil Nadu	11460	8060	573	46	14361	9752	26394	17858
Pondicherry	62	27	2	2	285	201	349	230
Kerala	77207	59815	755	1014	1828	2886	79790	63715
Karnataka	3074	12659	–	1	2552	1742	5626	14438
Goa	1762	1448	–	–	233	86	1995	1534
Maharashtra	24653	14712	69012	50025	795	973	94460	65710
Gujarat	13395	5970	2386	149	2115	44	17896	6163
Andaman	28	28	–	–	–	–	28	28
Lakshadweep	–	–	–	–	–	–	–	–
Total	141713	114934	79038	55244	22884	16663	243635	186841
Percentage	58.2	61.5	32.4	29.6	9.4	8.9		

Cochin where *Metapenaeus dobsoni* was dominant. Mangalore witnessed heavy landings of *M. dobsoni* (830 tonnes) in September by the trawlers, representing nearly a third of the year's catch of total prawns. At Bombay, *M. brevicornis, M. affinis* and *M. monoceros* also formed a sizeable fishery in the offshore waters. The total absence of *M. monoceros* at Karwar was an unusual feature whereas it formed the second important species during 1974. *Penaeus indicus* was landed in fair quantities at Mangalore and Calicut. A significant feature of the fishery of this region was the failure of *M. affinis* to appear in the postmonsoon months. *Acetes indicus* and *Palaemon tenuipes* were the chief constituents in the inshore catches at Bombay. On the east coast at Tuticorin, Madras and Puri, *P. indicus* was the major species landed. *P. merguiensis* also formed a fishery at Puri accounting for 42% of the catch. At Mandapam *P. semisulcatus* formed the main fishery and to a less extent at Tuticorin also. At Kakinada, several species of *Metapenaeus, P. monodon* and *P. indicus* contributed to the fishery.

About 1.9 tonnes of juvenile prawns mostly composed of *M. monoceros* and *M. dobsoni* were landed by the sluice-gate nets in the estuarine area at Dongri (Goa). Salt pan survey indicated the presence of juveniles of *M. monoceros, P. monodon* and *Macrobrachium idella* (in berried stages too) in good numbers. The stake net fishery in the Korapuzha estuary (Calicut) accounted for about 53 tonnes of juvenile prawns during the first half of the year and was mainly contributed by *M. dobsoni, M. monoceros* and *P. indicus*. In the backwaters at Cochin an estimated 1500 tonnes of juvenile prawns were landed by stake nets, *M. dobsoni* formed (77.6%) of this catch. The stake net catch during 1974 was 1550 tonnes. In the Ennore estuary (Madras), 11.2 tonnes of juvenile prawns were landed by cast net and stake nets. The catch was chiefly composed of *P. indicus*.

The prawn catch in the backwaters of Kakinada stood at 338 tonnes netted by drag and stake nets. *M. monoceros* comprised over 60% of the catches with peak landings during the last quarter. *P. monodon* contributed to 10% of the catch with peaks in April and December. Try-net collections were continued in the Cochin backwaters to assess the abundance of immigrating and emigrating juvenile penaeid prawns. When compared to 1974, there was a reduction in their abundance. Over 92% of the juveniles belonged to *Metapenaeus*. Intensive recruitment of *M. dobsoni* into the nursery areas was noticed during April-June

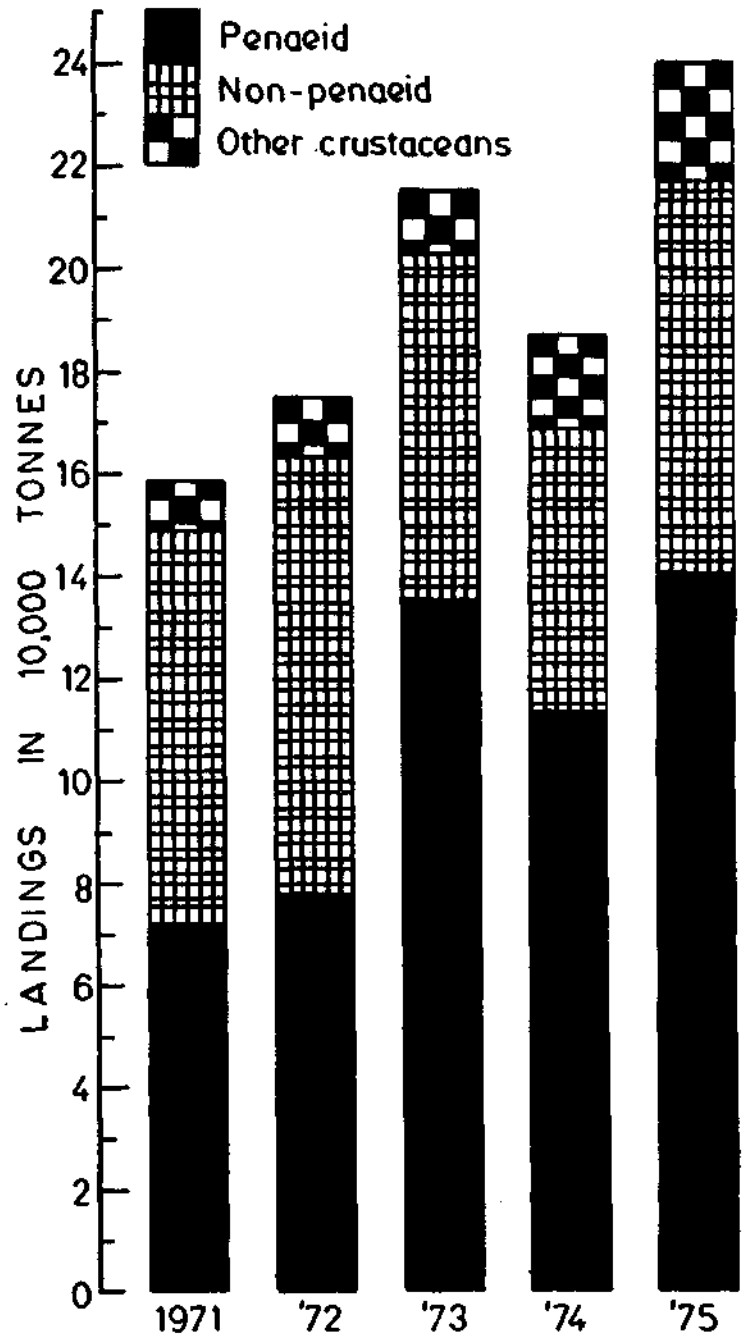

Fig. 6 Crustacean landings in India during the years 1971 to 1975

and September-October, while moderate recruitment of *M. affinis* took place during June-July. The emigration of juveniles was continuous but the peak was in November. The occurrence of larval penaeids in the inshore region at Cochin was very poor during the current year when compared to last year. The postlarval abundance in the Cochin backwaters was also lesser than during 1974 indicating poor recruitment during the year. The departmental shore-seine operations in the Mangalore estuary indicated comparatively poor recruitment of penaeid prawns in the estuary during 1975.

Biological details

Penaeus indicus: This species was caught during the first half of the year at Mangalore and Calicut in fair quantities. Size groups above 130 mm dominated the fishery at Calicut in most of the months. Spent ones were encountered during February-March. In the Korapuzha estuary the size range was 70–130 mm, the 78–98 mm groups dominating. At Tuticorin this species formed over 90% of the prawn catch and was landed mostly during June-October. The mode at 141–145 mm in April had shifted to 196-200 mm in November. Spent females were noticed in more numbers during the third quarter. At Madras the modal size varied from 121 to 190 mm for males and from 111–205 mm for females. Percentage of mature females was high in January and August. New recruits entered the fishery in September. The fishery in the Ennore estuary was composed of 46–110 mm groups, the smaller groups dominating during the second half of the year. At Kakinada, *P. indicus* supported a sizeable fishery, especially during April-July. At Puri, it constituted over 50% of the catch with peaks during November-December, the dominant size groups being 156–190 mm. Mature females occurred in more numbers during February-March and November-December. The estuarine fishery was mainly during June-July and was largely supported by the 76–120 mm groups.

P. merguiensis: This was of commercial importance only in the inshore regions of Puri and to a certain extent in the Goa region. October-November was the peak season at Puri and was supported largely by the 156–190 mm groups. Mature females were recorded in large numbers in all the months indicating year-round spawning with peaks during February-March and November-December. At Karwar, there was a sharp decline in the catch. This species was caught by trawl nets in May and by shore-seine

and gill nets during July-August. The prominent mode varied from 107 to 156 mm in the shore seine catch.

P. semisulcatus: At Mandapam, it formed 95% of the prawn fishery with peak landings during January-March. The modal size for males and females ranged from 101 to 145 mm and 96 to 185 mm respectively. Recruitment of smaller size groups was noticed mainly during May-June, August and November-December.

P. monodon: This was caught in commercial quantities only in the Kakinada region where it formed 9.3% of the prawn catch. The best catches were taken during July-September. Males of 151–230 mm and females of 161–280 mm formed the mainstay of the fishery. During November-December the smaller size groups dominated. Ripe and spent females occurred almost throughout the year indicating year-round spawning. In the backwaters of Kakinada, *P. monodon* in the modal length range of 70–130 mm was caught by drag nets and stake nets, with peak landings during December and April.

M. dobsoni: It formed the predominant constituent of the prawn catches at most of the centres between Goa and Cochin on the west coast and at Kakinada on the east coast. A three fold increase in the catch was recorded at Karwar as compared to 1974. The inshore mud-bank fishery of the Cochin region was of a great magnitude during this year. At Calicut, the landing by boat seines were comparatively poor.

The modal size composition at most of the centres varied from 63 to 98 mm for males and 63 to 118 mm for females. Bigger size groups contributed to the fishery during July-October. At Mangalore, the modal size at 73 mm for males in January was seen to have shifted to 103 mm in November and for females from 83 to 123 mm during the same period. At Madras, the mode at 73 mm for males in January progressed to 98 mm in September whereas for females an identical mode in February had shifted to 103 mm by August.

The mean length in mm of *M. dobsoni* at Calicut and Mangalore was calculated to be as follows. These values showed a somewhat increasing trend as compared to 1974.

	Males	*Females*
Calicut	80.1	94.0
Mangalore	85.2	99.3

However, a notable feature in the size composition of *M. dobsoni* at Cochin was that the fishery was mainly constituted by 83–88 mm modal groups in the offshore as well as in the inshore catches. The bigger size groups were conspicuously insignificant even during the monsoon months. A similar phenomenon appears to be evident at Karwar, too. A close watch on the mean size of the population at these centres would therefore, seem to be necessary.

The estimated instantaneous mortality for *M. dobsoni* at Mangalore was 44.41 and 3.55 for males and females respectively.

Recruitment appeared to take place mainly during November-December and to a lesser degree during February-March, as evident from the entry of smaller size groups (53–68) into the fishery. Ripe and spent females were recorded throughout the year at many of the centres, but in more numbers during February, March, August and October-November.

In the estuarine prawn catches at Dongri (Panaji), *M. dobsoni* contributed to about 33% and was landed mainly during the first half of the year. The modal size ranged from 41 to 70 mm. In the estuary at Mangalore this species was caught in more numbers during February, April and December and the modal size varied from 38 to 53 mm. Landings of juvenile *M. dobsoni* were high in May in the Korapuzha estuary (Calicut) and were mostly composed of 36–40 mm group during the first half of the year.

M. affinis: This species was commercially important in the Bombay and Kakinada regions. Fair quantities were also landed in the area between Goa and Calicut. The fishery at Mangalore and Calicut, however, did not revive in the post-monsoon months. At Bombay, the modes at 113 mm and 108 mm for males in February and August had respectively shifted to 133 mm in June and 123 mm in December. For females, the modes at 133 mm in February and 113 mm in July were seen to have moved to 148 mm in May and 143 mm in December. An intensive recruitment into the trawler catches appeared to have taken place during July-

August and to a moderate extent aduring February-April. There seemed to be three intensive breeding periods, February-March, May-June and December. At Goa, the modal size ranged from 86 to 125 mm for males and from 86–145 mm for females, the bigger size groups of either sexes occurring during March-April and October. Mature females were more during April. Recruitment was observed twice in May and December. At Karwar, the modal size varied from 111 to 130 mm for males and 125-135 mm for females. At Mangalore, the mode was between 103 and 118 mm. Recruitment of juveniles was conspicuous in April. The mean size for the year showed a decreasing trend compared to 1974, the values for males and females for the current year being 97.4 and 105.8 mm as against 104.2 and 111.5 mm in 1974 respectively. At Puri, the fishery was composed of a large size class between 113 and 158 mm. Peak spawning was during February-March and November-December.

M. monoceros: This species was caught in commercial quatities in the Bombay and Kakinada regions. In the former area, bulk of the catch was made in January. It was observed that the mode for males at 113 mm in February and 128 mm in March had respectively shifted to 158 mm in December and 153 mm in September.For females, the modes at 133 mm in February and 118 mm in March had progressed correspondingly to 158 mm in June and 173 mm in December. Recruitment appeared to take place during March, August and December. Mature and spent females were more during March, June-September and December. At Kakinada, most of the catch was during January-April and the fishery was supported mainly by the modal sizes 103 to 123 mm for males and 98–138 mm for females. The mode at 103 mm in February for males could be traced to 138 mm in July and for females, the mod at 108 mm in January to 163 mm in July. During September-December, smaller prawns (61–90 mm) dominated. Ripe and spent females were seen more frequently during March-May. In the backwaters of Kakinada, the best catch was made during the fourth quarter. Prawns of size 28–53 mm dominated the landings.

M. brevicornis: As in the case of *M. monoceros,* the commercially exploited regions for *M. brevicornis* were Bombay and Kakinada. The productive period at Bombay was February-March. The mode at 78 mm for males in February was traced to 98 mm in June and for females from 108 to 128 mm during the same period. February-March and September-October appeared to

be the periods of intensive recruitment. Mature and spent females were more during January-March; July-August and December. At Kakinada, this species was observed in the catches in considerable quantities during April-December with a peak in August. The fishery was mainly supported by the females of 101–140 mm.

P. stylifera: This is one of the principal species of prawns on the west coast between Bombay and Cochin. It failed to appear at Tuticorin. At Kakinada it was caught in fair quantities during June-August. Bulk of the catch on the west coast was made during the first half of the year except at Karwar which witnessed more than a two-fold increase with heavy catches during October. At Mangalore, the catches dwindled by 33% whereas it constituted the predominant species at Calicut forming 60.2% of the catch. The modal size composition of the fishery at most of the centres ranged from 76 to 90 mm for males and 91–105 mm for females, the bigger size groups dominating during February-March. Recruitment appeared to take place mainly during April-May and to a lesser extent during November-December.

The mean length in mm of *P. stylifera* at Calicut and Mangalore are given below.

	Males	*Females*
Calicut	75.4	73.6
Mangalore	81.3	93.2

An increasing trend in the mean length was observed as compared to 1975.

S. indica: In the Bombay region this species ranked next to *P. stylifera* in abundance among penaeids in the 'dol' net catches and formed about 9%. February and November represented the peak period of the fishery and was largely supported by the size groups 53–68 mm for males and 53–83 mm for females. November-December and April appeared to be the intensive period of spawning.

Acetes indicus: It formed 40.6% of the 'dol' net prawn catches at Bombay. The landings were better during January, April-May and December. The size groups 16–22 mm for males and 21–34 mm for females contributed to the fishery. Maturing females were observed during April and November.

Palaemon tenuipes: This contributed to about 22.0% of the 'dol' net prawn fishery. The mode at 43 mm contributed to the fishery. Mature and berried stages dominated during February. The peak season for the fishery is normally April-May. But during the current year the landings were comparatively poor than in the earlier years which could be attributed to the lack of bulk recruitment of juveniles into the inshore fishery during November-December 1974. On the other hand, the recruitment of juveniles during December 1975, was noticed to be considerable and hence it is likely that the fishery during 1976 would improve.

Larval and juvenile stages of prawns

In the Korapuzha estuary at Calicut, plankton samples during the first half of the year showed relatively higher level of abundance of the post-larval penaeids compared to 1974. *P. indicus* was the principal constituent with maximum incursion during April and February. The peak recruitment of the post-larvae of *M. dobsoni* was during January and February. Tow-netting from surf area at Calicut during the second half of the year revealed the abundance of post-larvae of *M. dobsoni* (in early stages) in September whereas of *P. indicus* in October. In the Ennore estuary near Madras, post-larvae of *P. indicus* and *M. dobsoni* were encountered in large numbers in July.

Laboratory rearing:

Mature females of *M. dobsoni* collected from the sea were spawned in the laboratory at Cochin and the eggs have been successfully mass cultured to the post-larval stage in a very inexpensive way.

Complete larval history of *H. ensirostris* and *Caridina gracilirostris* has been traced. Nine well defined zoeal stages for the former and six stages for the latter have been observed and it took forty three and nine days respectively for the first zoea to develop into a post-larva.

Experiments on the survival of *M. dobsoni* in the size range of 14–55 mm under varying salinity conditions showed that it was 100% in media above 10‰, the survival rate decreasing with progressive dilutions. In the lowest medium of 2 to 3‰, the average survival rate was 4–6 days. The survival in lower salinity media was relatively better among smaller individuals. In most cases the mortality occurred at the time of moulting.

Personnel:

P. V. Kagwade, JFS; M. M. Kunju, JFS; M. S. Muthu, JFS; S. Ramamurthy, JFS; M. Aravindakshan, SRA; N. Neelakanta Pillai, SRA, K. N. Rajan, SRA; P. E. Sampson Manickam, SRA; G. Sudhakara Rao, SRA; N. Surendranatha Kurup, SRA; C. Suseelan, SRA; V. Thangaraj Subramanian, SRA; P. A. Thomas, SRA; K. Y. Telang, SRA; K. V. George RA; K. Devarajan, RA; M. Kathirvel, RA; G. Nandakumar, RA; S. Shanmugam, RA; K. K. Sukumaran, RA; T. M. Yohannan, RA; K. N. R. Kartha, JSA; K. N. Gopalakrishnan, JSA; K. Koumudi Menon, JSA; S. Lakshmi, JSA; C. Nalini, JSA; and M. Manickaraja, LFA.

Studies on other Crustacean resources (FB/MISC/1).

Deepwater lobster: The exploratory fishing for the deep-water lobster *Puerulus sewelli* by the vessels of the Integrated Fisheries Project, Cochin was confined to the first quarter and the landings amounted to 2.1 tonnes with a catch rate of 19.8 kg/hr. The size of the lobsters ranged from 86–197 mm with a modal size at 151–160 mm for males and 141–150 mm for females. Percentage of berried females was high (16.3-88.9%) with stage I predominating.

Shallow-water lobster: The fishery for the spiny lobster, *Panulirus homarus* registered nearly a two-fold increase in the Kanyakumari district (Tamil Nadu) and accounted for 37,929 numbers as against 19,397 during 1974. Peak landings took place during October-November.

The estimated lobster landing in the Tuticorin region was 6.5 tonnes of which 89% was constituted by *P. homarus* and the rest by *P. ornatus.* Peak season was from September to December The size of *P. homarus* ranged from 116 to 265 mm with a modal size at 156–160 mm for males and 186–190 mm for females. Berried females were common during January, April and August-September. Spent ones occurred almost throughout the year but in more numbers during April and September.

The lobster fishery at Thikkoti (Calicut) was estimated to be 4.92 tonnes (14,027 numbers). *P. homarus* accounted for 68% of the landing and *P. polyphagus* for the remaining part. The main fishing season was from January to April. *P. homarus* ranged in length from 116–260 mm with majority of them between

175–205 mm. *P. polyphagus* had a size range of 190–280 mm, majority of them belonging to the 220–250 mm groups. Berried females were relatively more during January-March among *P. homarus* and in December among *P. polyphagus.*

Crabs:

Scylla serrata: The estimated catch at Kakinada amounted to 3.6 tonnes with better landings during August-September. At Cochin, 3.4 tonnes of this species were landed from one observation centre. The fishery was supported mostly by the 81–90 mm (across the carapace) groups. Berried females were encountered in the catch during the first quarter of the year.

Portunus pelagicus: At Kakinada the species formed 86% of the annual crab net catches. The estimated landing was 28.8 tonnes with crabs of 150–180 mm dominating the fishery during January-April and September-December periods and smaller groups (125–150 mm) predominating during the other months. Berried females were more during August. At Mandapam 146.6 tonnes of this species were landed by trawl and gill nets. Most of the catch was made during May-June and October-November. The size ranged from 75 to 195 mm. Bulk of the catch was composed of 136–140 mm groups for both the sexes. Berried females were common during the last quarter. At Cochin 6.9 tonnes of this crab were recorded from one observation centre. The size range was between 41 and 153 mm with 101–120 mm groups predominating. Berried females were abundant during the 1st quarter of the year. At Mangalore, 286.0 tonnes of *P. pelagicus* were landed by the trawlers—all during the first half of the year. The size ranged from 72 to 143 mm with the prominent mode varying from 96 to 125 mm and from 91 to 120 mm for males and females respectively. Berried females were seen during the first quarter.

Portunnus sanguinolentus: At Mangalore, 428.0 tonnes of this species were landed by the trawlers - all during the first half of the year. The size ranged from 61 to 142 mm with 91–110 mm groups for either sexes, dominating the catches. Berried females were more during the first quarter.

Personnel:

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MOLLUSCAN FISHERIES DIVISION

Studies on the resources of commercially important molluscs (FB/MISC/2).

Cephalopoda

MADRAS: An estimated 201.5 tonnes of cephalopods consisting of cuttlefish, squids, and octopods were landed by the mechanised boats of this centre. This represents about 2.5% of the total marine catches landed during January to December period. The overall catch per unit effort (catch per hour CPH) amounted to 1.7 kg. The CPH for the period ranged from 0.6 kg (in May) to 5.7 kg (in August). The total yield of all cephalopods landed during 1975 was slightly higher than that landed in the previous year. The highest catches were usually landed in August and this had been observed from 1972 to 1975. Generally better yields of cephalopods particularly cuttlefishes, which contribute more to the catches, come during July, August and September. Thus there was a definite season for cephalopods in the third quarter of the year.

The cephalopod fishery of this centre was mainly supported by cuttlefishes, consisting of *Sepia aculeata, S. pharaonis, S. thurstoni, Sepiella inermis* and among squids by *Loilgo duvaucelli* and *Octopus dollfusi, Cistopus indicus* among octopods. All other species were less important. For the entire period cuttlefishes formed about 80%, Squids 18% and the rest by Octopods of the total catch.

Size frequency: From the size frequency distribution studies it was seen that in certain months there are two modal groups in *Sepia pharaonis*, three groups in *S. aculeata* and *Sepiella inermis*, two in *Loligo duvacvelli* and *Sepia thurstoni*, which form the exploited population of Cephalopods.

Apart from the above work periodically samples were drawn from the commercial catches for biological and taxonomic work on cephalopods. During March and April morphometric measurements of a few specimens of *Sepia drashadi*, relatively a rare species were taken. Preliminary analyses were also made on species of *Loligo* other than the common *L. duvaucelli* to evaluate their identity. Regular samples were collected for detailed biological data on *Sepiella inermis, Loligo duvaucelli,* and *Sepia thurstoni.* The samples consisting of *S. inermis* analysed ranged from 86 to 165 mm, and *S. thurstoni* from 14 to 75 mm length. Female *S. thurstoni* measuring up to 54 mm were all in immature or maturing stage and those exceeding 55 mm were all in mature stage. The males seem to be in mature condition when the length and breadth of testes measure 11 mm and 8 mm respectively over a length of 60mm. The food of *S. thurstoni* consisted of fish, crabs and prawns. Material for biological studies on *S. pharaonis* and *S. aculeata* were also collected and studied.

MANDAPAM

Fishery and Biology of Cephalopods: The fishery and biology of Cephalopods of Mandapam area were studied. The total cephalopod catch of trawlers based at Mandapam during the year 1975 was estimated to be 18,656.40 kg. The annual catch was lesser compared to 26,855 kg of last year. The best catches were obtained in the months of May, June and from October to December. *Sepia aculeata* was the dominant constituent of cephalopods got in trawl catches except in February when *Sepiella inermis* was the dominant species. *S. aculeata* formed 45 to 79% of the catches. The rest comprised of *Sepia pharaonis, Sepiella inermis, Sepia winckworthi, Sepioteuthis arctipinnis* and *Loligo duvauceli.* The C. P. U. E. of *Sepia aculeata* was low, 0.14-1.50 kg in Palk Bay in the first half of the year but it was higher in the period July-September, being 1.83-2.20 kg and maximum in in November-December when it was 3.28-4.37 kg. The C. P. U. E. for the species in Gulf of Mannar was only 0.40-1.15 kg in January and November-December.

The biological aspects of *Sepia aculeata* were studied. Study of the size frequencies showed that a mode observed at 65 mm in January 1975 could be traced to 105 mm in April and 135 mm in August. Another mode seen at 65 mm in March could be traced to 85 mm in June and 95 mm in July. A mode is seen in November. In December four modes were seen at 65 mm, 95 mm, 125 mm and

145 mm. Males were found to be the dominant sex in January, July and November and in other months females were proportionately more. Cuttlefish in maturing, ripe and partly spawned stages were observed in all periods of the year indicating that there is breeding of the species throughout the year. Study of the stomach contents of *Sepia aculeata* showed that prawns were the common food item during January-June. Fish and stomatopods were next in importance. Stomatopods and fish were the common food items recorded in stomachs of the cuttlefish in July, stomatopods, prawns and fish in August and fish and prawns in September. In the quarter October-December fish and prawns were the dominant food items and stomatopods and crabs were found in the stomachs of some cuttlefish.

Meretrix meretrix: Madras: The clams were grouped in sizes with class intervals of 3 mm. The length frequency distribution based on samples of the clam, obtained from the Courtallayar estuary for the period February to June 1975 showed two modes in February at 49 (mode A) and 40 (mode B) mm respectively. The mode B moved to 49 mm by March and the mode A disappeared from the population. In March two new modes viz. C at 40 mm and D at 31 mm occurred. The two modes shifted to 43 and 34 mm by April. The mode B was not represented in April. And C at 43 mm in April remained stationary till June, 1975. The mode D grew to the size of C by May and merged with the larger groups of clams of the population. A fresh mode at 28 mm 'E' emerged in the population in June. The growth increment recorded from February to March and from March to April by the two different groups of clams was 9 mm and 3 mm respectively. The average growth of the clam was 6 mm per month. Assuming the same rate of growth in younger clams it can be concluded that the clam *Meretrix meretrix* reaches 31 mm in 5 months time.

Age composition of commercial catch: On the basis of the growth rate observed it was inferred that the clams enter the fishery when they are about 5 months old at a size of 28–30 mm. '0' year class and 1+ age groups are exploited in moderate numbers during the period. The largest size groups observed was 57–59 mm.

Spawning: The occurrence of spent or partially spawned individuals of both sexes throughout the period indicated that the spawning was continuous. It was seen that the reproductive activity attained its peaks in certain months of the year. In the

month of February the percentage of spent clams were more when compared to other months.

Crassostrea madrasensis: MADRAS: The edible oyster, *Crassostrea madrasensis,* attain a marketable size of 100–110 mm within a years time. Spawning of the oysters has been observed from January to February and from June to July. The spat settlement commenced from January and continued till the end of the investigation (September). The pests like *Cliona, Polydora* and *Thais* were not considered a serious threat to the oyster beds.

TUTICORIN

Studies were initiated during the year to estimate the population of the edible oyster beds in the salt-pan creek near Tuticorin. The creek extends to a distance of 4 km west of the sea front and there is a regular tidal flush in the creek. Two beds were noticed at depths of 0.5 m. to an area of 500 sq. m. each with thick concentration of oysters. 60 oysters could be counted in one sq. m. area. The size of the oysters ranged from 60–75 mm in a majority although a few were in the size range from 30–50 mm.

An expanse of inter-tidal muddy sand flat of an area of 0.5 sq. m. on the western side of this was sparsely populated on either side. The density was 20–30 nos. per sq. m. but the effective area of oyster ground was only 1/3 of the flat. A fourth bed was located near the railway bridge (western most) contiguous with the flat, where the concentration of oysters was dense to an area of 500 sq. m. and 40–60 oysters per sq. m. could be counted. The size range was greater with individual oysters growing upto 215 mm. length.

Biological studies: Analysis of the monthly samples from the creek was started from September. Two modes, 1 in 70 mm and second at 140 mm were seen in September. Oysters between this range particularly those above 100 mm showed fully ripe condition of the ovary. Examination of gonads of the samples brought in October revealed spent condition for the same size range. Determination of the shell meat relationship showed that the ratio was 15:1 before spawning whereas after spawning it went down to 20:1.

Study of the plankton samples collected every week revealed that the phytoplankton over the beds consisted mainly of *Rhizosolenia* sp., *Navicula* sp., *Oscillatoria* sp., *Nitzschia* Sp. and *Chlorella* sp.

Further work is in progress.

Mytilus: KOZHIKODE: Regular field observations were made to estimate the total mussel landings of Calicut, Elathur and Thikkotti area. Details regarding the mussel landings at different centres are given below.

Details regarding the mussel landings at different centres (Catch in kg)

Months	Calicut Total catch (Total catch per person)	Elathur Total Catch (Total catch per person)	Thikkotti Total Catch (Total catch per person)
January	74,400 (1450)	–	–
February	53,880 (1600)	–	–
March	–	75,600 (1600)	–
April	–	81,820 (1800)	–
May	–	63,640 (1600)	–
June	–	–	–
July	–	–	–
August	–	–	8,100 (1200)
September	–	24,360 (1200)	46,276 (1800)
October	–	40,950 (1800)	53,884 (1920)
November	–	42,200 (1590)	132,552 (1350)
December	–	30,552 (1200)	137260 (1800)
TOTAL	138,280	358,922	378,072

In Calicut the mussel fishery was only for two months viz., January and February. March, April and May are the best fishery season observed from Elathur. There was a continuous fishery from Thikkotti except for two months, June and July.

Biology: (i) Growth rate studies: Fortnightly samples were collected from Elathur for growth rate studies. The mussels appear

Mariculture-Culture of molluscs at Tuticorin and Calicut (FB/MISC/5)

(a) *Experiments on transportation and transplantation of mussel seeds:*

Mussel transplants were brought from 3 places viz. Cuddalore (east coast), Cape Comorin (east coast) and Colachel, as vast stretches of naturally settled mussel population exist in these places. The work began in 1974 itself and continued during 1975 also since the stock transplanted to the farm site suffered mortality now and then due to various factors.

Experiments were carried out at different times by following different techniques of transportation to ascertain the survival rate and survival period of mussel outside the natural beds.

(1) Mussels were kept submerged in seawater filled in 3 litre polythene cans, wide mouthed glass containers and wide mouthed earthern pots. The size range of mussel seeds for the above was 25.55 mm and only 100 numbers were put in each container. Upto 4 hours there was no adverse effects, but afterwards gradual mortality was noticed in all the above experiments. Also because of other inherent difficulties in road transport it was considered unsafe to follow the above methods.

Nylon-meshed iron frame cages of $40 \times 40 \times 12$ cm., size covered on all sides with blue cloth and gunny were employed.

In another trial similar cages with cotton swab bed and wood shavings beds were also tried. The mussels inside the cages were always kept wet by constantly sprinkled sea water by a siphon attached to polythene casques. Mortality rate was studied every hour. The minimum survival period before mortality could be observed was 9 hours in all the cages. But even after 19 hours the mortality was only 9%. The medium survival period when 50% mortality was noticed ranged from 25–27 hours.

It was therefore decided as safe to follow one of the above methods for transporting the mussels by road.

Standardization of the rope attachment technique was attempted with success. Nylon, polypropylone and coir ropes of 10 mm width were used, each rope was of 5 meters length. Wooden plugs were wedged at intervals of 25 cm to prevent slipping of

mussels. Mosquito nets of 1 metre x 25 cm width was used to keep the mussels around the rope in tact till byssal attachment. This method gave satisfactory results to give the seed mussels initial attachment to the ropes. Seeded ropes were hung in the farm area in such a way that they did not get fouled due to rough weather. Seeding the nylon rope appeared to be safe and more dependable although mussel attachment to the other ropes also was equally effective.

Standardization of the raft for the culture work and the cages for stocking in the farm was also achieved. $16 \times 12'$ raft lashed with teak wood poles employing $3'x2'$ size sealed empty oil drums as floats anchored with 2 numbers of 40 kg anchors proved satisfactory. The longivity of the raft was more than 18 months.

Table 6 shows the intensity of stocking of mussels in the farms.

Studies on the growth rate of the farm mussel

Plastic baskets: Monthly sampling of the Cape mussels was done from the farm area out of the stock brought in March 1974. Analysis of the data collected for 12 months revealed that the growth of the mussels kept in plastic baskets was stunted recording only an increment of 1.5 mm per month. The poor growth may be attributed to the inacessibility of planktonic food due to the clogging of the slots in the basket, inspite of the fact that frequent brushing was resorted to.

Rope seeded mussels: Similar observations were made for a 12 month period starting from January 1975 on the mussels seeded on ropes. Initial minimum size at stocking was 19 mm and the growth progressed to 55 mm in 9 months period recording an average of 6 mm growth. The increase in weight recorded was 25 gms on an average. There was a predominance of indeterminate stage, in the gonadial conditions even in the size up to 55 mm. During the next 3 months the growth rate was maintained at 4 mm per month.

Examination of plankton samples collected from the farm area indicated a predominance of zooplanktonic organisms and the paucity of phytoplankton. Perhaps this might have had adverse effects on the fattening of the mussels tissues thus inhibiting gonadial maturity. Farm mussels did not at any size show

Table 6 *Intensity of stocking mussels in the farms Cape Comorin*

Consign-ment	Total weight	Approx. No. per kg	Total No. of mussels	Size range	Total ropes prepared	Stocked mussel
1.	3 kg.	180	540	30–35	1 rope	granite rocks
2.	35 kg.	150	5250	20–40	2 ropes (3 kg/rope)	6 plastic baskets
3.	15 kg.	260	3900	15–40	–	1 cage
4.	85 kg.	150	12750	20–60	7 ropes (1 to 3 kg. per rope)	–
5.	15 kg.	130	1950	25–65	–	8 plastic buckets
6.	40 kg.	170	6800	15–40	7 ropes (4 kg/ 2 ropes, 2 kg/2 ropes, 1 kg/3 ropes)	–
7.	3 kg.	–	–	30–35	1 rope	–
8.	15 kg.	150	2250	20–40	2 ropes (3 kg/1 rope)	–
9.	13 kg.	260	3900	22–45	–	3 plastic buckets
10.	85 kg.	270	22950	16–42	2 ropes	Rest in iron framed cages
11.	60 kg.	–	–	35–55		for biological studies
12.	18 kg.	–	–	35–45		
13.	40 kg.	139	5400	16–42	7 ropes	

Table 6 (Contd.)

Colachel

Consign-ment	Total weight	Approx. No. per kg	Total No. of mussels	Size range	Total ropes prepared	Stocked mussel
1.	5 kg.	170	850	9–39	1 rope	–
2.	8 kg.	140	1120	18–32	–	Plastic baskets

Cuddalore

1.	200 gm.	–	–	65–90		
2.	80 kg.	480	6400	31–65	8 ropes (2 kg - 2 ropes) (3 kg – 2 ropes) (4 kg – 2 ropes) (5 kg – 2 ropes)	4 box type cages (5 kg in each)

gonadial maturity. Meat to shell weight ratio indicated that the shell weight increase was pronounced thus reducing the edibility percentage of the meat.

Monthly samples of mussels from natural beds at Cape Comorin were also brought and analysed to compare the values. In the natural beds the growth rate was uniformly maintained at 5 mm for every 30 days. Fully developed gonads were seen in specimens of size 45 - 60 mm and spawning appeared to have taken place during July-September. Intraovarian egg diameter measurement of 0.08 mm was recorded for fully developed ova. Meat shell relationship was uniformly maintained and the percentage of edibility was as much as 40 during July and August in size range 40–50 mm.

Edible Oyster Farming:

(a) *Spat collection experiments:* 400 lime coated country tiles stacked and fastened together were laid throughout the length and breadth of the creek during October spawning season and good number of oyster spat were collected. In addition to this empty oyster shells were spread over the muddy bottom to catch the spat. The results were more encouraging. As many as 6-7 spat were found settled over each shell.

(b) *Farming:* 20 nylon meshed iron frame cages each with 200 oysters of 25 mm size were kept on platforms erected at 2 metre depth in the creek. Samples of oysters in the farm were measured and weighed to record their growth. Since the work started late in the year it is too early to draw any conclusion.

At Calicut:

Experimental culture of the common green mussel *Perna viridis* in the open sea was started for the first time in India at Calicut on 10th November, 1975. A raft has the dimension of 25 feet x 20 feet has been successfully floated in the open sea about 1.5 km away from the shore at a depth of 5.5 metres due west of C. M. F. R. Substation building. It was constructed with teakwood poles, bamboo poles and wooden planks, lashed together with coir and nylon ropes. The raft was mounted over five oil barrels of 200 litre capacity. The wooden planks offered working space on the raft. The raft was anchored to the bottom by three admirality type anchors each weighing 100 kg.

Young seed mussel collected from the natural mussel beds of Elathur and Thikkotti are used for the experiments. The seed mussels are wrapped upon the ropes with fine meshed mosquito nettings, that disintegrates within several days. During this time the young mussels have attached themselves by their byssus to the ropes. A total of 75 ropes each having a length of 5.5 metres, seeded with young mussels were suspended from the raft about 3 feet apart. Nylon ropes and coir ropes of 1/2 inch and 1 inch diameter respectively were used for the experiments.

For studying the growth of young mussel *Perna viridis* from the experimental raft in close relation with some environmental parameters, the fluctuating physico-chemical and bio-chemical properties of the sea water at the site of the culture were regularly studied.

Fortnightly growth rates of the seeded mussels were determined by sampling from a few ropes distributed along and across the raft. The procedure consists of sampling 35 mussels per rope at three different departments. The results obtained from the culture experiment are presented in the table given below, showing the average length, breadth, thickness, total weight, shell weight and meat weight of the seed and growing mussels from the culture raft.

Date	Length in mm	Breadth in mm	Thickness in mm	Total weight in gms	Shell weight in gms	Meat weight in gms
15–11–75 Initial	26.6	14.1	0.87	1.48	0.84	0.63
29–11–75	29.6	15.7	0.98	2.31	1.23	1.08
15–12–75	34.31	17.23	11.07	3.35	1.73	1.62
1–1–76	40.63	20.13	12.6	5.08	2.53	2.51

The results of the experiment showed that seed mussels of average length 26.7 mm and average weight 1.48 gms collected from the natural mussel bed of Elathur transplanted on 15th November, 1975 in the culture farm at Calicut grew to an average length of 40–63 mm and average weight 5.08 gms within the period of 46 days. The average growth rate calculated was at a rate of 4.8 mm and average weight 1.2 gms per fifteen days.

With a view to studying the growth rates of the mussel seed from the natural bed and in the culture farm fortnightly samples of the young mussels were collected from Elathur and their growth rate studied. Results showed that the growth rates of the young mussels from the natural bed was very slow and it was at an average rate of length 3 mm and weight 0.9 gms. per fifteen days.

A very interesting result obtained from the culture experiment was the sudden development of gonads of all the culture mussels. Observations showed that during the time of seeding 90 per cent of the seed was in the neuter (0) stage (there was no sign of gonad development), only 10 per cent of the seed was in the developmental stages II and III. Observations after 40 days showed that 100 per cent of the culture mussels as bearing fully riped gonads. The ova and spermatozoa separated for microscopic examinations showed that they were very active for fertilisation. The gonads of the young mussels collected from the natural bed revealed that only 15 per cent in the developmental stages II, III and IV.

Personnel: K. Nagappan Nayar, JFS; S. Mahadevan, JFS; K. Ramadoss, RA; P. S. Kuriakose, RA.

VIZHINJAM

Fishery and biology of mussel: (FB/Misc/2)

A total of 64075 kg. of mussel was landed from January to December 1975. No mussel landing was recorded during May to August. Maximum landings of 27512 kg. was recorded in December and minimum landings of 1675 kg. in September. The percentage of mussels above 60 mm. size exploited commercially was found to be 13.77 in October and 30.00 in February. The entire catch of mussel during September was constituted by mussels below 60 mm. size. This indicated that the fishery was mainly dependent on mussels below 60 mm. size.

Rope culture of mussels: (FB/Misc/5)

Rope culture experiments were continued to study the effect of transplanting retarded mussels from the exposed intertidal area. Seed mussels with an average weight of 1.99 grm. per mussel transplanted in October (Previous year)grew to an average weight of only 13.076 grm. in August and majority of mussels

were found to drop away from the rope and as such the production per metre of rope decreased to a level of 3.045 kg., 2.467kg 2.292 kg. and 2.222 kg. respectively in April, May, June and August. While attempting commercial culture, seed mussels which show signs of retardation in growth are to be avoided in order to obtain best results and the transplantation work also is to be restricted before the end of September, so that mussels of stunted growth can be easily eliminated from the commercial transplantation.

Three additional bamboo rafts were made. 34 mussel ropes were prepared in September using seed mussel 5 to 39 mm. (15 to 29 mm. – 72%). The mussels grew to a size of 35–59 mm. (dominant size 45–49 mm.). in December. In addition to the nylon ropes, mussels were transplanted in December on coir ropes (28 ropes). Since large size seed mussels were used they dropped off from the ropes. Therefore success in trnsplantation work depends also on the size of the mussels.

Personnel : G. P. Kumaraswamy Achari, SRA

MARINE BIOLOGY AND OCEANOGRAPHY DIVISION

Environmental studies-Physical and chemical aspects (MBO/ES/1)

All Regions: The temperature distribution patterns of the waters of the West coast of India prepared at various isobaric levels from surface to 150 m. depth showed interesting features. The distribution patterns in the mixed layer are more or less uniform down to about 50 m length. From the top of the thermocline downwards there appears to be sharp gradients in the temperature distribution in the horizontal, indicating the presence of possible divergence and convergence zones. The area off Mangalore seems to be affected maximum during southwest monsoon season.

A study of seasonal and yearwise variation of the dynamic structure of the region Cochin to Cape Comorin is contemplated and work is under progress.

Regional Studies:

Karwar: During the year 183 sea water samples were collected from Karwar Bay. Average annual values of the parameters at surface and bottom are as follows:–

Parameter	Temp. °C	Salinity ‰	Dissolved oxygen ml/l	*Nutrients* ug at/l inorganic phosphate	nitrite	Silicate	pH
Surface	27.3	26.52	4.1	0.35	0.14	32.0	8.2
Bottom	27.2	32.56	2.5	0.98	0.46	28.2	8.4

Mangalore: At the 4 fathom station, temperature and salinity values showed increasing trend from January to April. Oxygen content was high during November and silicates during October. At the 8 fathom station similar trend was noticed except that silicates were high during December.

Calicut: Sea water sample collections were made from 5 m and 10 m depth stations off West Hill. No samples could be collected during monsoon period. The salient features were as follows:-

At both the stations the surface temperature rose from annual minimum in January to annual maximum in April. The minimum and maximum at 5 m. station were 27.6°C and 30.5°C respectively. Similarly at 10 m. station the minimum and maximum were 27.2°C and 30.0°C respectively. The surface water salinity fluctuations were much. The lowest values of 25.05‰ at 5m stations and 22.79‰ at 10 m. station were recorded during November. The dissolved oxygen content of the surface waters at 5 m station was maximum (5.8 ml/l) in April and minimum (3.8 ml/l) in January. At the bottom the minimum value of oxygen recorded was 1.6 ml/l at 5 m station and 1.9 ml/l at 10 m station. Very low oxygen content was observed from both the stations in a particular instant in October.

Mandapam Camp: During the year hydrological studies were started at Mandapam Camp (Gulf of Mannar and Palk Bay) from July, 1975 onwards.

The surface water temperature at Gulf of Mannar varied from 28.5°C in December to 32.1°C in August and at Palk Bay the variation was from 29.1°C in December to 31.8°C in July. The salinity of the surface waters at Gulf of Mannar varied from 27.99‰ (December) to 35.40‰ (August) and at Palk Bay the variation was from 27.04‰ (December) to 33.94‰ (September). Dissolved oxygen content at Gulf of Mannar varied from 3.8 ml/l (October) to 4.7 ml/l (September) and at Palk Bay the variation was from 2.8 ml/l (August) to 4.8 ml/l (December).

Tuticorin: Surface temperature was highest during April and Salinity during November.

Madras: Water samples were collected from the areas off Nochikkuppam and Koraloy in the south of Madras City and Ennore in the north where the depth ranged from 25 m to 40 m.

Salinity was highest during May and Oxygen content during December.

Backwater and Estuaries: Envionmental studies were continued from six stations in the Vembanad Lake and connected estuarine waters during the year. The distribution and abundance of zooplankton in the estuary were found correlated with the salinity. It was also observed that primary production was not a limiting factor for secondary production.

Observations of salinity, dissolved oxygen, nutrients and pH values were carried out from July onwards from five stations in Athankarai Estuary near Mandapam Camp.

Personnel: A. V. S. Murty, FS; C. P. Ramamirtham, AFS; K. N. Krishna Kartha, AFS; D. Sadananda Rao, AFS; V. S.K. Chennubhotla, AFS; N. S. Radhakrishnan, AFS; G. G. Annigeri, AFS; P. Mojumdar, AFS; K. G. Girijavallabhan, SRA; R. Marichamy, SRA; V. Kunjukrishna Pillai, SRA; K. J. Joseph, RA; S. Muthuswamy, RA; M. M. Meiyappan, RA; S. Krishna Pillai, RA; Pon Sirai Meetan, RA; K. V. George, RA; N. P. Kunhikrishnan, JSA; R. Vasanthakumar, JSA; P. M. Aboobaker, JSA; D. Vincent, LFA; C. M. Allikunju, LFA.

Environmental studies—Circulation and related aspects (MBO/ES/2)

The circulation pattern in the Maldive region of the Indian Ocean was studied. It is observed that a large cyclonic gyre existed in the northern region and an anticyclonic one in the southern region, mainly in the subsurface layers.

The south-bound currents along the west coast of India are conspicuous during July in the year 1964 and a noticeable variation in the intensity of the current patterns are observed from year to year. The incursion of the offshore subsurface waters into the coastal regions during upwelling is observed to a much greater extent during 1964.

Personnel: G. S. Sharma, JFS; A. V. S. Murty, FS; C. P. Ramamirtham, AFS; K. P. Viswanathan, LFA.

Investigations on the mud banks of the Kerala coast and their influence on fisheries (MBO/Misc/3).

During May, investigations on the diurnal variations in the ecological and biological aspects with special reference to the currents were made for 44 hours continuously in the mud bank region at Purakkad on board the vessel 'Cadalmin'. This set of observations was the first of its kind from the mud bank regions. During the south west monsoon season the mud bank moved south from Purakkad to Chenankara near Thottapalli. A second diurnal survey (for 26 hours) was therefore conducted at this place in August. And this time the observations were made by a novel technique of using boats tied together and anchored in the middle of the mud bank.

During May the currents were southerly all through the period of observations. During August northerly components of tidal flow were also noticed. Surface temperature during May showed a maximum at 1500 hrs on both days of osbervations (29.0° to 29.7°C). The bottom temperature were more or less uniform and were around 28.4°C. Various species of zooplankton were correlated with the strength of currents and the study was comprehensive over a tidal cycle. In August' cycle of diurnal observations phytoplankton was in abundance rather than zooplankton.

Mud sample analysis revealed that foraminifers and nematodes were major components of the benthos while the other groups were trace in their occurrence.

Personnel : A. V. S. Murty, FS; D. Sadanand Rao, AFS; K. J. Mathew, SRA; C. P. Gopinathan, SRA; A. Regunathan, RA & V. K. Balachandran, JSA.

Studies on Phytoplankton productivity (MBO/ES/3).

Work done: Productivity studies were carried out in the Vembanad Lake between Cochin and Pathiramanal. Forty ^{14}C measurements were made. Unlike in the marine environment, maximum production was observed during the pre-and postmonsoon periods except in the southern-most region where high production was observed during the monsoon. The average rate was between 52 and 85 mg C / m^3 / hr which is a comparatively higher rate than usually observed in the marine environment.

The mud bank at Ambalapuzha was studied in detail with reference to the diel variation of phytoplankton productivity. The peak value was attained during the forenoon falling to the lowest rate by about 3 p. m. The maximum diel production observed was in August (10.00 hrs) when the rate of production at surface was 200 mgC/m³/hr. The standing crop in terms of chlorophyll 'a' and phytoplankton cell counts coincided with the trend observed in the ^{14}C uptake. Altogether 48 species of phytoplankters were recorded of which diatoms predominated, and dinoflagellates forming a significant component while Cyanophyceae, Silicoflagellates and Coccolithophores forming a rare component.

At Calicut, routine measurements on light penetration and measurement of standing crop were carried out in the inshore area at 10, 15 and 25 m depth.

At Mangalore, monitoring of the standing crop of phytoplankton was carried out. Moderately rich standing crop of diatoms was observed during February and March. The dinoflagellate component was rare during the first half while it increased by November. The occurrence of *Trichodesmium* was observed during April.

At Tuticorin, phytoplankton investigations were initiated at Punnakayal madai and SPIC outlet. The common phytoplankters have been developed into mixed cultures for feeding the molluscs in the experimental tanks.

Work at hand: Fortnightly observations on productivity parameters in the fishing grounds off Cochin were started in order to determine the magnitude at each trophic level. Observations on the benthic productivity are also being carried out from the same area using a modifed ^{14}C technique. Intensive studies on these lines are also to be conducted at Tuticorin, Madras, Pulicat estuary, Calicut, Mangalore and Bombay.

Work contemplated: In view of the importance of mangrove swamps in and around Cochin as potential source of fish larvae, a detailed investigation on the primary production of the benthic flora and the ambient water is being planned. This is expected to provide a rough idea of the quantum of the basic food available for the feeding of the larvae. The study of the

chlorophyll using thin layer chromatography and photosynthetic characteristics of the species of phytoplankters maintained in cultures and their optimum nutritional requirements are also contemplated. This would enable a proper understanding of the productive potential of each species and the factors affecting their succession and periodicity. Large scale experiments on culture for feeding of molluscs and fishes at Tuticorin and crustaceans at Narakkal prawn culture farm will also be undertaken.

Personnel: P. V. Ramachandran Nair, JFS; K. G. Girijavallabhan, SRA; C. P. Gopinathan, SRA; K. J. Joseph, RA and V. K. Balachandran, JSA.

Studies on Secondary production and related aspects (MBO/PL/1)

Work done:

Affinity indices of 31 species of calanoid copepods from the neritic waters of the west coast of India and the Lakshadweep Sea have been calculated and recurrent and nonrecurrent 'Species-groups' in the copepod community identified. Investigations on the diversity of the trophic groups in copepods revealed that herbivorous forms dominate the community during transition and south-west monsoon period, whereas the carnivorous forms were dominant during north-east monsoon period. Omnivorous copepods evinced uniform pattern of distribution throughout the year. Studies on the breeding and larval distribution of copepods indicate that the breeding activity of neritic forms is more or less continuous, with intensities varying during different months. Post-naupliar developmental stages of *Euchaeta wolfendini* A. Scott, a common shelf water calanoid copepod have been identified from the plankton and the larval stages described. Various aspects of the dynamics of zooplankters in the estuarine waters around Cochin have been investigated and the food potential of zooplankton for plankton-feeding fishes and fish larvae have been critically examined.

Studies on the quantitative distribution of Siphonophores and Euphausids were continued. Five more new records of siphonophores were made mostly from the Lakshadweep region. Siphonophores of the plankton collected from the mud bank area at Ambalapuzha have also been studied and four species were identified from the collections.

At Bombay, zooplankton studies in the fishing grounds of the offshore waters were continued. The biomass values varied from 2.4–81.0 ml. The richest haul from the fishing ground was obtained in January with a diplacement volume of 81.0 ml brought about by the large scale occurrence of salps and medusae. Eggs of cuttle fish were observed in the zooplankton during December. An unusual abundance of mackerel in July was noticed in the offshore catches, but due to the absence of zooplankton data no positive correlation with the environmental conditions could be made.

Routine monitoring for the variations in the displacement volume and occurrence of the different species of zooplankters were conducted off Ullal (Mangalore) at two nearshore stations. Fish eggs in small numbers were observed during October-November period. Copepods with their larvae were moderately abundant during March-April and October-December. Cladocerans were present in good numbers during the last quarter of the year. Eggs and larvae of penaeid prawns and bivalves were sparingly recorded during the period.

At Calicut, zooplankton investigations were carried out at three inshore stations. The biomass estimation included apart from displacement volume, wet and dry weights and organic carbon. From the middle of October to the middle of December, was found to be the period of abundance for zooplankton production with a peak in November, recording 10.749 gms of dry weight.

At Madras, the displacement volume of plankton varied from less than 10 ml to just over 50 ml, with the peak occurring during July-August, with the copepods constituting the major components. During the period of zooplankton abundance, chaetognaths and pelagic tunicates were found to occur in maximum numbers.

At Tuticorin, the zooplankton was generally low during March-May and in December, the peak production was observed in the fishing ground during June-July with a maximum of 350 ml, and a minimum as low as 1.3 ml. near Hare Island in March. The poor production was associated with high turbidity.

Work at hand:

For evaluating the quantum of output in terms of secondary production from the primary level, a detailed scheme of investigations has been drawn up and the work commenced at a fishing ground off Cochin. The conclutions drawn on the production and turn over of the secondary producers could be extrapolated to other demersal fishing grounds as well. In addition, monitoring studies will be conducted at all the important centres of the west and east coasts.

Work contemplated:

Biochemical investigations on the different zooplankton groups in relation to their regions of occurrence and food preferences is proposed to be undertaken. The variations in the relative proportions of Carbon, protein and lipids, will be determined for major components during different seasons.

Personnel: E. G. Silas, Director; K. G. Girijavallabhan; SRA; P. Parameswaran Pillai, SRA; K. J. Mathew, SRA; R. Marichamy, SRA; M. M. Meiyappan, RA, K. Rengarajan, RA, S. Krishna Pillai, RA and Pon Siraimeetan, RA.

Studies on fish eggs and larvae from the plankton (MBO/PL/2)

Work done:

A comprehensive report on the larvae of the Indian mackerel *Rastrelliger kanagurta* from the west coast of India was completed. The distribution of the larvae, their occurrence by day and night, relative abundance on the continental shelf and oceanic waters and in different latitudes, frequency of occurrence of different size-groups and relationship to the environmental conditions were discussed in detail for the first time with detailed illustrations and descriptions.

Identification of fish eggs and larvae from the zooplankton of the Cochin backwater has been carried out. The eggs and larvae were grouped into four different types. The observations made so far revealed that eggs of engraulids and gobbies and larvae of *Ambassis* dominate the collection.

At Tuticorin, fish eggs and larvae were collected from 4 inshore stations including one at a point of discharge from SPIC.

The samples were also collected from fishing grounds 8–78/3C, 4C, 5C, 6C, 4B and 5B. Fish eggs occurred in good numbers during March-April and in August. From September to January they formed less than 5% of the total. Fish larvae were fairly common in January-February and May, constituting 2–13% of the total components. They were rare during June-August and November.

At Madras, eggs of *Anchoviella* sp. and *Caranx* sp. occurred in plankton samples during June and August respectively. Myctophid eggs were also recorded off Madras.

Work contemplated:

Live eggs and larvae collected from the inshore regions of Cochin and from the prawn culture ponds at Narakkal will be reared to ascertain their correct identity, food preferences and rate of growth with a view to strengthening aquacultural practices.

Personnel: E. G. Silas, Director; V. Kunjukrishna Pillai, SRA; K. G. Girijavallabhan, SRA; G. S. D. Selvaraj, RA; M. M Meiyappan, RA; K. Rengarajan, RA; M. Rajagopalan, RA; Pon Siraimeetan, RA and P. Karuppasamy, RA.

Survey & culture of economically important seaweeds (MBO/Misc/1)

Work done:

Seaweed survey was continued in the IVth and Vth sections between Thiruchendur to Cape Comorin and from Cape Comorin to Melamidalam. A total of 42 stations were covered.

Culture of economically important seaweeds like *Gracilaria edulis* and *Gelidiella acerosa* was continued from January to April (at tidal and subtidal level), in submerged and semisubmerged floating conditions. *Gracilaria edulis* showed good growth in submerged condition (at sub-tidal level). *Gelidiella acerosa* introduced in submerged condition also showed some growth after which it started decaying. In January *Gracilaria edulis* cultured at tidal level was harvested after 45 days of growth and a total yield of 7.94 kg (fresh weight) was obtained for an initial 1.42 kg of seed material introduced. During April, *Gracilaria edulis* cultured at sub-tidal level was harvested after 60 days growth and the yield was very less, being 2.56 kg (fresh weight) for an initial 0.46 kg introduced.

Culture of *Gracilaria edulis, G. corticata, Gelidiella acerosa, Sargassum* sp., *Turbinaria conoides,* and *T. decurrents* was carried out from July onwards at two stations in Athankarai estuary (one near river mouth and another in the upper reaches of the estuary) and in Palk Bay. A total of 11 frames were introduced in Athankarai Estuary and 7 frames in Palk Bay. A Culture frame with a mixture of the above seaweeds also was introduced with a view to study the effect of grazing, if any on these individual seaweeds. *Gracilaria edulis* and *Gelidiella acerosa* were cultured at subtidal and tidal level in Palk Bay. *Gracilaria edulis* cultured near river mouth of the estuary showed good growth than that in the upper reaches of the estuary and Palk Bay, but the seaweed was found to be healthier at Palk Bay than that in the other two cases. *Gelidiella acerosa* in the culture frames introduced in the estuary has degenerated after growing for some time. *Sargassum* and *Turbinaria* sp. after few weeks growth indicated that they can be cultured if the holdfast is given a proper support in the coir rope while introducing.

The grazing behaviour of some fishes on *Gracilaria edulis* was studied. Seasonal changes in the growth rate and reproduction were studied in 8 species of red and brown algae. Studies on the variations in the chemical constituents during the different seasons were carried out on *Padina.* The alginic acid content was found to be between 10% and 25% with the maximum yield in March. Mannitol content, was in the vicinity of 1 to 2% with the maximum in December. Studies on the fruiting cycle and oosphore output in two species of *Turbinaria* were conducted. Studies on the seasonal periodicity of different seaweeds occurring at Kilakkarai and Pudumadam were also carried out using quadrats in the intertidal zone.

Work at hand: Proceessing of the data on seaweed resources in the Tamil Nadu and south Kerala zones will be carried out. Culturing of seaweeds using oospores in order to ascertain the relative yield with that of vegetative reproduction will be carried out. Further work on the chemical composition of different agarophytes and alginophytes will be carried out at Mandapam.

Personnel: V. S. K. Chennubhotla, AFS; N. Kaliaperumal RA and S. Kalimuthu, JSA

Investigations on deep water fishes (MBO/Misc/2)

Work done: Investigations on the deepwater fishes were continued. The biological data on the deepwater flatfish *Chascanopsetta lugubris* were processed. Pooling the entire data collected so far the percentage composition–month-wise and year-wise with reference to sex and maturity of the species was calculated. Juveniles were found to occur almost throughout the year except in December when the juveniles, maturing and fully matured specimens were found equally distributed.

Ruvettus pretiosus was recorded from the upper continental slope along the south west coast of India and *Negaprion odontaspis* from the Laccadive Archipelago.

Investigations on the biology of the deepwater fish *Cubiceps natalensis* were continued. Studies on the meristic counts, morpho metric characters, analysis of length frequency, sex ratio and length weight relations were completed.

Personnel: E. G. Silas, Director; M. S. Rajagopalan, AFS; G. S. D. Selvaraj, RA; M. Rajagopalan, RA; I. David Raj, RA and K. Nanda Kumar, JSA.

Energy flow in some selected ecosystems (MBO/Misc/5)

Work done: Feeding response and conversion efficiency to different artificial diets were tried with *Mugil cephalus* and *Etroplus suratensis*. The cattle feed pellets available in the market was tried and the fishes did not show good response. Further, the pellets were found to have poor stability in water.

The fishes showed good feeding response to the pellets made by mixing tapioca flour, rice bran and fish meal (4: 2: 1).

Feeding experiments with *Ambassis gymnocephalus* to ascertain the gross and net growth efficiencies were also conducted.

Personnel: P. V. Ramachandran Nair, JFS; D. C. V. Easterson, RA; C. V. Mathew, RA and Vijayakumaran, JSA.

Marine environmental damage (Pollution, engineering works and other man-made changes (MBO/Misc/6)

Work done: Monitoring studies on marine environmental damage were conducted in the Cochin Backwater and the Alwaye Industrial belt. The intensity of sewage pollution from human and animal wastes was minitored by the determination of indicator organisms and BOD measurements. The relationship of micro-organims to the sediment structure was also investigated.

Studies on the oil degrading bacteria of the Kiltan waters following the oil spill were made. The relationship of the bacteria with that of phytoplankton organisms and bacteriological studies on a deepsea fish were also conducted.

Toxicity experiments in order to determine the LC-50 using crude oils and their volatile fractions were conducted. Phyto-toxicity measurements were also made in the laboratory. Monitoring works on indicator organisms of faecal pollution, pathogens such as *Salmonella* and BOD measurements in the Cochin Backwater to be continued.

Work contemplated: Toxicity studies will be carried out in the laboratory using various potential pollutants of the environment in order to determine their lethal dose on different species of crustaceans and fishes. Bacterial flora of some normal and diseased marine fishes will be studied. Studies on the coliform levels in aquaculture ponds and in offshore sea water and sediments will also be carried out.

Personnel : E. G. Silas, Director: P. V. Ramachandran Nair, JFS; M. S. Rajagopalan, AFS; V. Kunjukrishna Pillai, SRA; C. P. Gopinathan, SRA; S. Muthuswamy, RA; V. Chandrika,RA; and C. Thankappan Pillai, LFA.

Benthos of the fishing grounds (MBO/Misc/7)

Work done: Benthic samples from 6 stations (from Cochin to Pathiramanal) in the Vembanad Lake using grab and dredge were analysed. The nature of the epifauna and infauna was investigated. The relative abundance of each group in the fishing grounds was determined. The distribution of 23 species of polychaetes was studied and it was found that polychaetes constitute the most abundant group in the benthic community. The biology and ecology of the black clam *Villorita cyprinoides* (Gray) was investigated. The benthic fauna of the fishing ground off Cochin was

also studied and it was observed that foraminifera formed the dominant group.

Work at hand: The effect of the construction of the Thanneermukkam bund on the benthic community of the area is being studied. Further, the ecological and biological aspects of the clam beds in the Vembanad Lake are also being investigated.

Work contemplated: The benthic fauna and flora of the fishing grounds off Manassery and Narakkal in relation to hydrography and fisheries upto 50 m depth zone will be investigated. Benthic productivity in relation to the food chain will also be investigated.

Personnel: E. G. Silas, Director; V. Kunjukrishna Pillai, SRA; C. P. Gopinathan, SRA; A. Regunathan, RA; and M. Bhaskaran, RA.

Investigations on Coral reef and turtle resources (MBO/Misc/8)

Work done: Further observations on the reefs of Kiltan islands which were affected by the oil spill during September - October 1974 were conducted. Studies involved were (1) the presence and intensity of oil, (2) morphological changes in the flora and fauna (3) physical conditions of the reef (4) composition of the bacteria and (5) recolonization of animals where heavy mortality took place. In general it was found that the effect of oil pollution had lessened considerably and the reef fauna were gradually returning to normalcy.

Observations on the Manoli and Rameswaram reefs with reference ot the composition of the fauna and the zonation of various species showed that the reef at Rameswaram island has not been disturbed by quarrying.

Investigation on marine turtles were carried out at Tuticorin, both at the market and in pens. On an average 50–60 turtles were caught at Tuticorin in each month. The dominant size was between 65–70 cm across the plastion. The females predominated the catches. *Lepidochelys olivacea* and *Eretmochelys imbricata* were very rare and *Dermochelys coriacea* were completely absent in the catches.

At Mandapam, 237 turtles were landed weighing 12371 kg. The maximum catch was in April and the minimum in August.

Attempts were made to rear Ridley turtles from egg stage and observations on its incubation survival rate, diet, conversion efficiency and specific growth rate were also studied.

Personnel: C. S. Gopinadha Pillai, AFS; A. A. P. Mudaliar, JSA; and Bastian Fernando, JSA.

Mass culturing of plankters (MBO/Misc/9)

Work done: Ten species of unialgal cultures were maintained in the laboratory which were used for feeding experiments and to study the effect of nutrient concentration and growth parameters. An incubator chamber has been designed and fabricated for effective incubation (artificial) of the culture at controlled light intensity. Feeding experiments with *Artemia* using *Synechocystis salina* showed that the feeding relation between the two is negative.

Experiments on the mass rearing of rotifers were conducted in the laboratory. *Brachionus* individuals measuring 103–268/μ were isolated and reared in the laboratory. Feeding experiments on *Acetes* sp. and decapod larvae were conducted using detritus containing high concentration of rotifers. Investigations on the production and growth of ciliates were carried out in view of their significance as nutrient regenerators. Ovigerous females of the harpacticoid copepods *Nitocra* sp. and *Harpacticus* sp. were isolated from the plankton and three generations were also carried out to investigate the lower limits of their salinity tolerance.

Work at hand: Maintenance of the already isolated forms, observations on their feeding and growth parameters, isolation of further groups of zooplankters from plankton, rearing of fish larvae and investigations of their food preference.

Work contemplated: Field experiments at Prawn Culture pond at Narakkal on feeding the prawns and fishes with micro and macroplankters, studies on growth kinetics and nutritional requirements of the phytoplankton cultures and the determination of the most economically viable period of harvest and also field trials in feeding will be undertaken.

Personnel: E. G. Silas, Director; P. V. Ramachandran Nair, JFS; P. Parameswaran Pillai, SRA; K. J. Mathew, SRA; D. C. V. Easterson, RA; K. J. Joseph, RA; and V. K. Balachandran,JSA.

significance as nutrient regenerators. Ovigerous females of the harpacticoid copepods *Nitocra* sp. and *Harpacticus* sp. were isolated from the plankton and three generations were also carried out to investigate the lower limits of their salinity tolerance.

Work at hand: Maintenance of the already isolated forms. observations on their feeding and growth parameters, isolation of further groups of zooplankters from plankton, rearing of fish larvae and investigations of their food preference.

Work contemplated: Field experiments at Prawn Culture pond at Narakkal on feeding the prawns and fishes with micro and macroplankters; studies on growth kinetics and nutritional requirements of the phytoplankton cultures and the determination of the most economically viable period of harvest and also field trials in feeding, will be undertaken.

Personnel: E. G. Silas, Director; P. V. Ramachandran Nair, JFS; P. Parameswaran Pillai, SRA; K. J. Mathew, SRA; D. C. V. Easterson, RA; K. J. Joseph, RA; and V. K. Balachandran, JSA.

LIST OF PUBLICATIONS OF THE STAFF OF C. M. F. R. I.*

1971

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Shri M. Aravindakshan
Shri K. Y. Telang
Shri G. Sudhakara Rao
Dr. P. A. Thomas
Shri C. Suseelan
Shri K. N. Rajan
Shri V. Thangaraj Subramanian
Shri K. M. S. Ameer Hamsa
Shri P. E. Sampson Manickam
Research Assistants :
Shri K. V. George
Shri K. Devarajan
Shri K. K. Sukumaran
Shri M. Kathirvel
Shri G. Nandakumar
Junior Scientific Assistants:
Shri K. N. Rasachandra Kartha
Shri K. K. Balasubramanian
Shri K. N. Gopalakrishnan
Miss. K. Koumudi Menon
Miss. S. Lakshmi
Mrs. C. Nalini
Laboratory -cum- Field Assistant:
Shri M. Manicka Raja

IV. Molluscan Fisheries Division

Junior Fishery Scientists:
Shri K. Nagappan Nayar
Shri S. Mahadevan
Assistant Fishery Scientists:
Dr. K. Satyanarayana Rao
Shri K. A. Narasimham
Senior Research Assistants:
Shri G. P. Kumaraswamy Achari
Shri Kuber Vidyasagar
Shri D. Sivalingam
Shri R. Sarvesan
Research Assistants:
Shri K. S. Sundaram
Shri K. K. Appukuttan
Shri T. Prabhakaran Nair
Shri K. Prabhakaran Nair
Shri K. Ramadoss
Shri S. Srinivasa Rangan
Dr. P. S. Kuriakose
Junior Scientific Assistants:
Shri C. T. Rajan
Shri A. Bastin Fernando
Shri K. Asoka Kumaran Unnithan
Shri P. Ramadoss
Shri B. Narayana Rao

Laboratory-cum-Field Assistant:
Shri A. Srinivasan

V. Marine Biology and Oceanography Division

Fishery Scientist:
Dr. A. V. S. Murty
Junior Fishery Scientists:
Dr. P. V. Ramachandran Nair
Shri C. Mukundan
Assistant Fishery Scientists:
Shri C. P. Ramairtham
Shri D. Sadananda Rao
Shri V. S. K. Chennubhotla
Shri N. S. Radhakrishnan
Shri M. S. Rajagopalan
Shri P. Mojumder
Shri G. G. Annigeri
Dr. C. S. Gopinadha Pillai

Senior Research Assistants:
Shri K. G. Girijavallabhan
Shri R. Marichamy
Shri V. Kunjukrishna Pillai
Shri C. P. Gopinathan
Dr. P. Parameswaran Pillai
Shri K. J. Mathew

Research Assistants:
Shri P. Karuppaswamy
Shri G. S. Daniel Selvaraj
Shri M. M. Meiyappan
Shri S. Muthuswamy
Shri A. Regunathan
Shri D. C. V. Easterson
Shri K. Rengarajan
Shri S. Krishna Pillai
Shri M. Rajagopal
Shri K J. Joseph
Mrs. T. S. Naomi
Mrs. V. Chandrika
Shri I. David Raj
Shri C. V. Mathew
Shri N. Kaliaperumal

Junior Scientific Assistants:
Shri A. Agasthesa Pillai Mudaliar
Shri N. P. Kunhi Krishnan
Shri Kunhi Koya
Shri M. Ayyappan Pillai
Shri V. K. Balachandran
Shri P. M. Aboobacker
Shri S. Kalimuthu
Pon. Sirameetan
Shri R. Vasantha Kumar

Laboratory-cum-Field Assistants:
Shri K. P. Viswanathan
Shri C. Thankappan Pillai
Mrs. C. M. Allikunju
Miss A. Kanagam
Shri D. Vincent
Shri J. R. Ramalingam
Shri M. Selvaraj
Shri M. Najmuddin

VI. I. C. A. R. Schemes

1. Scheme on Pearl Culture, Tuticorin:

Principal Investigator: Dr. K. Alagarswami (Fishery Scientist)

2. Marine Prawn Culture and Propagation Scheme, Cochin.

Principal Investigator : Dr. E. G. Silas (Director)

VII. Technical Cell

Junior Scientist: K. N. Krishna Kartha

VIII. Museum

Curator: M. Kumaran

IX. Administration

Senior Administrative Officer: S. Rajagopalan

Administrative Officer: S. PL. Sethu

Accounts Officer: D. Raghava Kurup