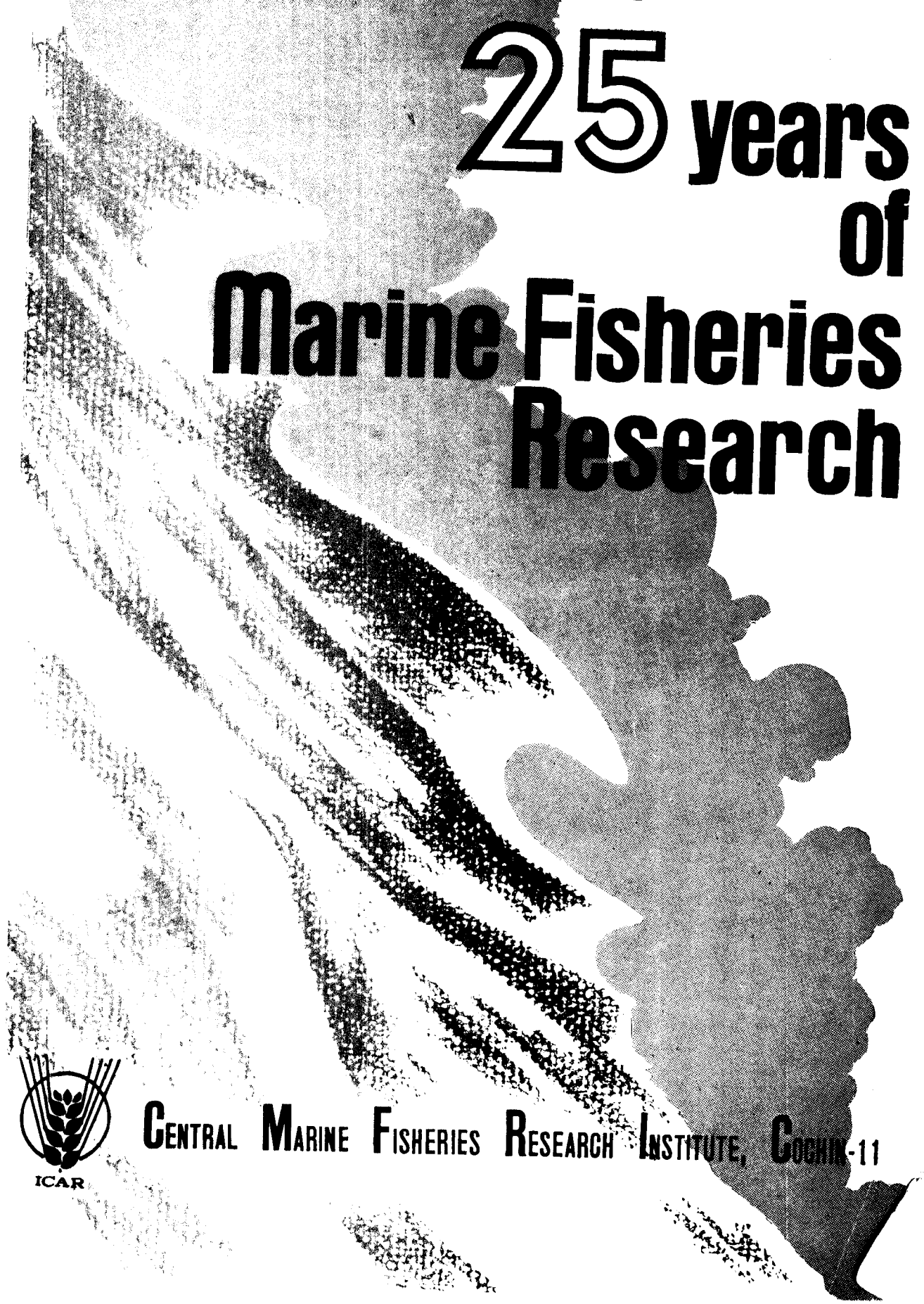
25 years of Marine Fisheries Research



ICAR

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN-11

1947 — 1972:

25 YEARS OF MARINE FISHERIES RESEARCH

— handbook
released on the occasion of the
SILVER JUBILEE
of the
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

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राष्ट्रपति भवन, नई दिल्ली-4.
RASHTRAPATI BHAVAN,
NEW DELHI-4.

November 9, 1972.

I am glad to know that the Silver Jubilee of the Central Marine Fisheries Research Institute, Cochin, will be held in December, 1972. I send my best wishes for the occasion.

V. V. Giri

कृषि मंत्री
भारत सरकार
नई दिल्ली।
MINISTER OF AGRICULTURE
GOVERNMENT OF INDIA,
NEW DELHI.

~~October~~, 1972.
2nd Nov.

MESSAGE

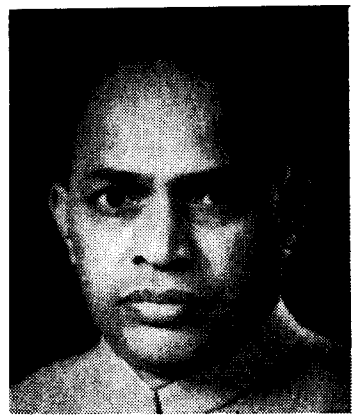
I am happy to learn that the Central Marine Fisheries Research Institute is organizing a Symposium on 'The Pelagic Fisheries Resources of the Seas around India' as part of the Silver Jubilee Celebrations of the Institute.

Increasing attention is being bestowed on vitalizing the fisheries Sector for augmenting production of marine fish and fishery products as it would make a significant socio-economic impact especially on the weaker sections of the society. In this endeavour the Central Marine Fisheries Research Institute has been playing an important role. The contributions made by the Institute in different disciplines of marine fishery sciences have greatly helped in the development of marine fishery in this country. I sincerely hope that the results of researches carried out by the Institute would enable India to occupy a higher position amongst the fishing nations of the world.

I congratulate the Institute for the valuable work done and send my best wishes for the success of the Symposium.

F. A. Ahmed

(F. A. Ahmed)



राज्य मंत्री, कृषि मंत्रालय,
भारत
RAJYA MANTRI, KRISHI MANTRALAYA,
INDIA

New Delhi-1, the 6th November, 1972.

MESSAGE

I am glad to learn that the Central Marine Fisheries Institute, Cochin, is completing 25 years of useful work. During the last 25 years, there have been several significant changes in the pattern of the marine fishing industry in the country. There has been a substantial increase in fish production. Marine products have emerged as an important source of foreign exchange earnings, with considerable potential for further development. Marine products already rank eleventh by value in the list of the country's exports. Mechanized fishing has been established on a basis of self reliance. Surveys have extended the scope of fishing operations, and the infra-structure for a more-wide ranging effort is being slowly but steadily built up.

Many problems still remain and we expect more problems in the future. Estimation of fishery resources, especially the resources of the less exploited and less explored areas, the impact of fishing intensity on the abundance of stocks and the evolution of suitable techniques for culture of valuable marine products will require increasing attention. The Central Marine Fisheries Research Institute, which is now celebrating its silver jubilee, should take up the challenge and provide the necessary guidelines to the fishing industry.

I wish the Institute all success.

Annasaheb P. Shinde

(Annasaheb P. Shinde)

Director General, ICAR, &
Secretary to the Government of India.

Telegram : "AGRISEC"
Telephone : 382629

भारतीय कृषि अनुसन्धान परिषद
कृषि भवन, डा० राजेन्द्रप्रसाद रोड, नई दिल्ली।
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
KRISHI BHAVAN, DR. RAJENDRA PRASAD ROAD, NEW DELHI-1

दिनांक Dated 17th November, 1972

M E S S A G E

I am glad to know that a Brochure outlining the scientific achievements of the Central Marine Fisheries Research Institute is being brought out to mark the occasion of the Silver Jubilee of the Institute.

The potential value of marine resources and the need for providing an adequate foundation of scientific knowledge to exploit these to get the maximum sustained yield have been adequately recognised only in the last few years. India with an extensive coastline and a shelf area of about 0.4 million square kilometres occupies the seventh position among the fishing nations of the world. Recognising the important role of marine fisheries in the national economy as well as in combating protein malnutrition, increasing attention is being bestowed in developing marine fisheries. In this important task, the Central Marine Fisheries Research Institute has been playing a catalytic role. For promoting a rational exploitation of our marine living resources, the Institute has been estimating the resources both qualitatively and quantitatively, locating new and hitherto under or unexploited fishing grounds, generating new resources through mariculture and recommending measures for proper management of the different resources. The results of researches carried out by the Institute during the last 25 years have made a substantial impact on the development of marine fisheries of this country.

I welcome this opportunity to extend personally and on behalf of the Indian Council of Agricultural Research our congratulations to the staff of the Institute for the valuable contributions made and send our best wishes for the continued success of the scientific projects in the years to come.

M. S. Swaminathan

(M.S. Swaminathan)

ORGANISATION OF THE INSTITUTE

ESTABLISHMENT AND GROWTH

Before 1947, fisheries research and development in India were the main responsibilities of the then provinces and states. Except for the "Indian Fisheries Act" promulgated in 1897, the Government of India had no direct interest in fisheries. However, studies on fishes and other aquatic fauna were being carried out by the Marine Survey of India, and the Zoological Survey of India, in addition to the Fisheries Departments and Universities of some of the maritime provinces.

The proposal for the establishment of a Central Fisheries Research Institute in India was first made in 1943 by the late Dr. Baini Prashad, who was, at that time, the Director of the Zoological Survey of India. In his Memorandum on the "Post-war Development of Indian Fisheries" he recommended that a "Central Fishery Research Institute be established by the Government of India on lines similar to those of the Agricultural Research Institute, New Delhi, the Veterinary Research Institute at Mukteswar and Izatnagar and the Forest Research Institute at Dehra Dun". This recommendation was endorsed by the Fish Sub-Committee of the Policy Committee on Agriculture and Fisheries and thus, in their Report of 1945, the need for the establishment of Central Marine Fisheries Research Institute was proposed. The Government of India again sought the advice of the late Lt. Col. Dr. R. B. Seymour Sewell, who had previously been the Director of the Zoological Survey of India, regarding the proposal of the establishment of the Institute. In 1946, Dr. Sewell submitted his "Memorandum on the proposed Fishery Research Institute". Based on his report, the Central Marine Fisheries Research Station (as it was known then) came into existence on 3rd February 1947.

The Institute started functioning at Madras in temporary accommodation provided by the university of Madras. Subsequently, in September 1949, it was shifted to Mandapam Camp and recently (in July 1971) the Headquarter of the Institute began functioning at Cochin.

MAIN OBJECTIVES

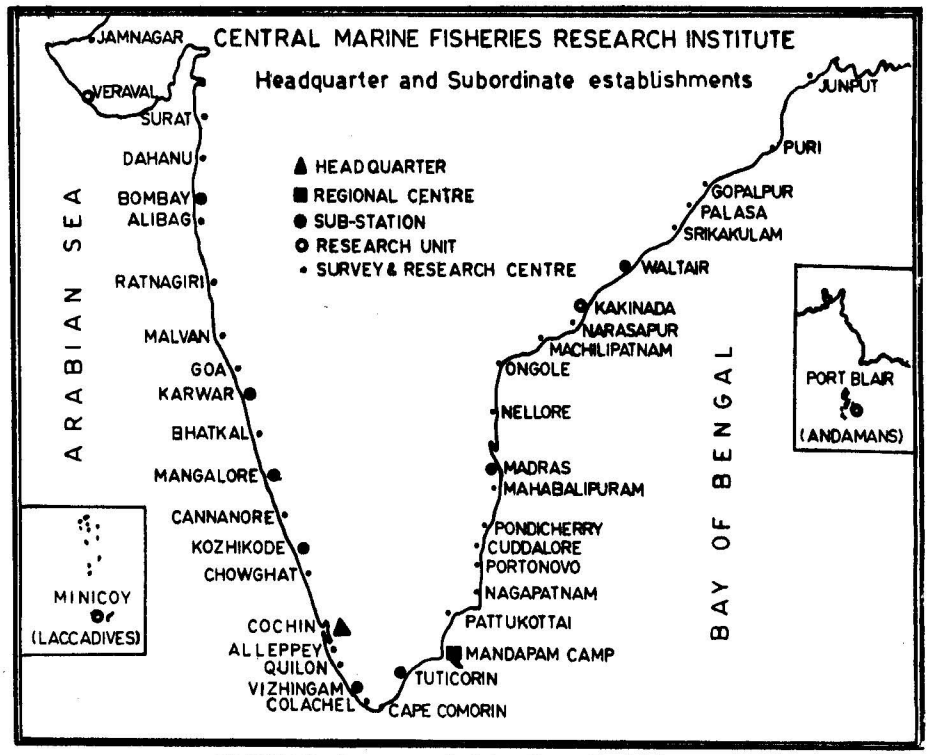
The main objectives of the Institute are :

(i) to estimate the catches of the marine fishes and other animals from the seas around India throughout the year by different types of vessels and gears,

(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; to conduct environmental studies in relation to fisheries; and to generate additional resources by mariculture, and

(iv) to recommend measures for the rational exploitation of the various resources.



CMFRI Headquarter and Subordinate Establishments.

PRESENT SET-UP OF THE INSTITUTE

ORGANISATIONAL

The Institute has three Divisions, namely, Fishery Survey and Statistics, Fishery Biology, and Marine Biology and Oceanography. Besides the Headquarter at Cochin, the Institute has one Regional Centre, a number of Sub-stations, Units and Survey Centres, which tackle problems of regional or local importance. The function of a Centre is to collect data on the marine fish landings on a zonal basis and keep a watch on local fishery trends. The Units are larger establishments and tackle research problems on a zonal basis, in addition to estimating the catches of the zones in which they are located. The Sub-stations are still larger establishments of the Institute and are mainly devoted to researches on fisheries problems of regional interest. The Sub-stations have the staff belonging to the three Divisions of the Institute. The Regional Centre at Mandapam Camp is largely concerned with the research activities of the Institute in the Palk Bay and Gulf of Mannar. After the Headquarter at Cochin, it is the biggest establishment of the Institute.

Central Marine Fisheries Research Institute, Cochin

Established as a Unit in 1951, became a Sub-station in 1957 and the Headquarter of the Institute in 1971.

Purpose and function :

a. Direction, guidance and co-ordination of different scientific work of the Institute carried out by the various establishments of the Institute.

b. Researches on fisheries resources and on the environmental parameters.

c. Collaboration with different national and international agencies and liaison with the fishing industry.

d. Administrative and budgetary control.

The Fishery Survey and Statistics Division at the Headquarter plans, executes and processes the data on fish landings and fishing effort, and estimates the state-wise, region-wise and species-wise production of marine fish. The Division also attends to the work of stock assessment and estimation of potential yields of fish populations.

The Fishery Biology Division handles and co-ordinates the work on fishery biology, which includes food and feeding habits, maturity, spawning and life history studies, age and growth, size and age composition of catches, mortality and migration. A careful watch is maintained by the Division on the changes in marine fish stocks. Cochin being one of the important centres for prawn fisheries in the country, a substantial part of the effort is devoted to investigations on the valuable prawn resources. Studies on the culture of prawns have also

been recently started here. The study of the lobster grounds, including those of the deep-sea lobester, *Puerulus sewelli,* and the assessment of fishery potential of the crabs, *Portunus pelagicus* and *Scylla serrata,* are also being undertaken here.

The Headquarter also handles work on the two most important pelagic fisheries, namely, the oil sardine and mackerel. Particular attention is paid to tagging of these two fishes and their shoaling in the grounds beyond the present fishing limit. An evaluation of the offshore demersal fisheries resources off the south-west coast is being undertaken at present, in collaboration with the other fishery institutions, namely, the Indo-Norwegian Project and the Offshore Fishing Station.

The Division also handles the problems related to mariculture.

The Headquarter is also the main centre for marine biological and oceanographic researches. It plans and co-ordinates the investigations carried out in these fields at the other establishments. Specific projects include studies on food chains, energy flow in selected ecosystems, determination of standing crops of phytoplankton and biomass of zooplankton with reference to individual groups which are of particular interest to fisheries; the deep scattering layer and its biological constituents with reference to their importance as forage for other fishes; seasonal distribution and abundance of fish eggs and larvae, with a view to determining the spawning seasons and spawning grounds of commercially important fishes; and marine environmental damage due to pollution, engineering works and other man-made changes. Special emphasis is given to problems of regional importance such as the formation of mud banks along the Kerala coast and their influence on fishery.

The Headquarter has vehicles and sea going facilities, and will soon have a large research vessel.

CMFRI Regional Centre, Mandapam Camp

Established as Headquarter in 1949, became Regional Centre in 1971.

Purpose and function :

a. Investigations of seaweed resources and corals.

b. Investigations of fisheries resources of the Gulf of Mannar and Palk Bay.

c. Studies on mariculture.

d. Co-ordination of the work on elasmobranchs and silver bellies.

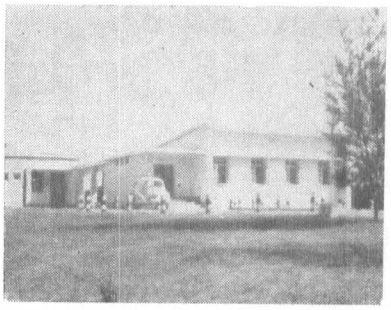
The area around Mandapam Camp is very rich in seaweed resources, and the Regional Centre is the main station for the Institute's work on seaweeds.

CMFRI Regional Centre, Mandapam Camp.

A joint programme on the seaweed resources and seaweed culture has been developed by Central Marine Fisheries Research Institute, Tamil Nadu Government and the Seaweed Research Division of the Central Salt and Marine Chemical Research Institute.

The developing prawn fishery at Mandapam is of much importance to that area. At the Regional Centre, some pioneering studies on mariculture have been undertaken.

Several islands near Mandapam have rich coral growth. The coral stones at present are being used for the cement and carbide industry. In recent years there has been an indiscriminate removal of the coral stones from Mandapam area and much work is needed to develop an understanding of the biology of reef-building corals and to suggest ways for their conservation.



CMFRI Guest House.

The Regional Centre provides both laboratory and housing facilities to guest scientists from India and abroad, and is the most popular resort for visiting college parties from all over India from October to February. The Institute's museum, library and aquarium attract hundreds of visitors every day.

The Regional Centre has a guest house, motor vehicles and boats.

CMFRI Sub-station, Mangalore

Established as a Unit in 1957, became a Sub-station in 1969.

Purpose and function :

a. Similar to those of the Calicut Sub-station, with special reference to the South Kanara coast.

b. Investigations of demersal fishery resources off the South Kanara District.

Mangalore is also located in the most productive fishery zone of the country and emphasis is given to investigations on the oil sardine, mackerel and prawn resources. Hydrographical studies include the qualitative and quantitative abundance of plankton and their influence on the inshore fisheries. The Sub-station has a jeep and a boat.

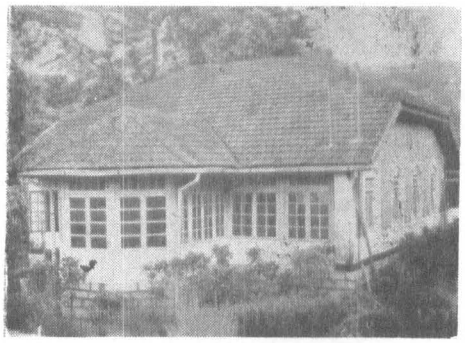
CMFRI Sub-station, Karwar

Established as a Unit in 1948, became a Sub-station in 1965.

Purpose and function :

a. The same as in the two Sub-stations noted above, but with special reference to the North Kanara and Goa coasts.

b. Co-ordination of the Institute's programme on lesser sardines.



CMFRI Sub-station, Karwar.

Karwar is one of the most important centres for the mackerel fishery and the Sub-station has been conducting researches on mackerel right from its inception. Other projects pursued here are on ground fish resources, prawns and lesser sardines. Hydrographical studies are also being undertaken in relation to fisheries. The Sub-station is housed in its own building, and has transport facilities and a boat.

CMFRI Sub-station, Bombay

Established in 1947.

Purpose and function :

a. Studies on the Bombay duck resources.

b. Investigations of the demersal fisheries and prawn resources off the north-west coast of India.

e. Development of cultured pearls.

f. Saltwater culture of fish and prawns.

Underwater exploration by SCUBA diving is the major field of specialisation of this Sub-station. The group is the only one of its kind in the country doing scientific underwater exploration.

Tuticorin is the most important centre for the chank and pearl oyster fisheries in the country and the Sub-station deals mainly with surveys of chank and pearl oyster beds by SCUBA diving. The charting of the beds is undertaken along with ecological studies of these beds.

Work on the culture of pearl oysters and the development of cultured pearl has been initiated recently.

The Sub-station is provided with a jeep and a boat and has saltwater fish farms.

CMFRI Sub-station, Madras

Established in 1947; functioned as Headquarter until 1949, was a Centre until 1953, a Unit upto 1965 when it became a Sub-station.

Purpose and function :

a. Investigations of the 'resources of ribbon-fishes, sciaenids, *Lactarius, Saurida* and prawns.

b. Assessment of offshore fisheries resources.

c. Study of environmental factors of the Bay of Bengal in relation to fisheries.

d. Co-ordination of the Institute's programmes on sciaenids.

Studies on the two most important fisheries in the area, namely, ribbonfishes and anchovies, are being carried out here. Prawn fishery of this area is increasing in importance and a team is studying the potential of prawn resources of Madras area. Seasonal fluctuations in plankton biomass, physical and chemical conditions of the sea and their influence on the fisheries of the area are also being investigated. The Sub-station is provided with a jeep and will soon have its own research vessel.

CMFRI Sub-station, Waltair

Established as a Unit in 1956, became a Sub-station in 1968.

Purpose and function :

a. Evaluation of the offshore demersal fisheries resources off the northeast coast of India.

b. Investigations on anchovy, lesser sardine, silver belly, sciaenid, carangid and prawn resources.

c. Co-ordination of the Institute's programmes on cat-fishes, perches, carangids and lizard fishes.

The Sub-station deals mainly with the offshore demersal resources comprising cat-fishes, perches, sciaenids, silver-bellies, silver-biddies and carangids. The anchovies which form a very important fishery of the area are being intensively studied. Environmental factors influencing the abundance of demersal fishes form a subject of detailed investigation. The Sub-station has a jeep and will soon be provided with a small research vessel.

CMFRI Unit, Veraval

Established in 1963.

Purpose and function :

a. Investigations of the resources of Bombay duck, sciaenids, pomfrets and prawns.

b. Evaluation of offshore demersal fisheries resources.

Gujarat ranks first among the states in the catches of pomfrets and Bombay duck. Major research effort of the Unit is therefore devoted to the study of these resources. The Unit also investigates the sciaenid and prawn resources of the Gujarat coast.

CMFRI Unit, Kakinada

Established in 1965.

Purpose and function :

a. Investigations on the ribbon-fish, prawn and crab resources.

b. Assessment of offshore demersal fisheries resources.

The Sub-station at Waltair and the Unit at Kakinada are carrying out combined work in assessing the inshore and offshore resources of the northern Bay of Bengal. The Kakinada Bay has very good clam beds and researches on the development of this resource are being undertaken at this Unit. In recent years Kakinada has become a place of considerable fishery importance.

CMFRI Unit, Port Blair, Andamans

Established in 1965.

Purpose and function :

a. Study of fishery resources such as mackerel, perches, lesser sardines and anchovies.

b. Hydrography of the Andaman Sea.

The Unit is one of the centres of the Institute's integrated scheme on mackerel. Port Blair area is of particular importance because of the occurrence in

these waters of a second species of mackerel, namely, *Rastrelliger brachysoma,* whose fishery and biology, along with that of *R. kanagurta,* are being studied. Being in a coral reef area, the station is of great value to marine biologists and oceanographers. The reefs around Port Blair are of fringing type.

CMFRI Unit, Minicoy, Laccadives

Established in 1965.

Purpose and function :

a. Study of the tuna resources of the open ocean.

b. Investigation of the distribution, abundance and biology of live-bait fishes.

c. Productivity of the atolls.

d. Hydrography of the Laccadive Sea.

The Unit is situated on an atoll of the Laccadive Archipelago which is well known for its coral reef, lagoon and tunas. The Unit has a picturesque setting and is of considerable interest to oceanographers.

Research Centres

The Institute has also small research centres at Goa, Colachel, Cuddalore, Machilipatnam and Porto Novo, which tackle problems of local fishery importance. The Centres at the first 4 places are working on the prospects of prawn and lobster fishing and the last one on elasmobranchs.

Survey Centres

Purpose and function :

a. To estimate group-wise and species-wise marine fish landings on a regional (and all-India) basis.

b. To estimate the fishing effort for each month.

c. To collect data on the size composition of economically important fishes such as oil sardine, mackerel and prawns.

The coastline of the country is divided into 57 zones and each zone includes 11-30 landing centres. The size of a zone is determined by the intensity of fishing and fishing practices. One person is attached to each zone to collect the desired data. The survey staff is posted at 40 different survey centres.

To estimate the catch the Institute has developed and perfected a stratified multi-stage sampling design, which is the only one of its kind in the world.

ADMINISTRATIVE AND FINANCIAL

Administrative Set Up

The administration of the Institute is divided into two wings—one deals with the administrative matters like recruitment, service records, policy, staff welfare, lands and buildings, expenditure, library, stores etc., and the other deals with the accounts, audit and budget. Among the various subordinate establishments, ministerial assistance is available at the Regional Centre and at all Sub-stations. The Units, Research and Survey Centres are controlled by the nearest Sub-stations. The financial control of each of these small establishments is also taken up by the nearest Sub-station.

Budget

A statement showing the budget allocation for the Institute since its inception, together with the staff strength at five year intervals, is given below :

Budget allocation (in lakhs)

		1947-51	1951-56	1956-61	1961-66	1966-69	1969-74*
(a)	Non-Plan	13.16	17.57	27.41	59.38	58.41	134.40
(b)	Plan	Nil	5.47	34.63	18.36	16.47	89.65
	Total	13.16	23.04	62.04	77.74	74.88	224.05

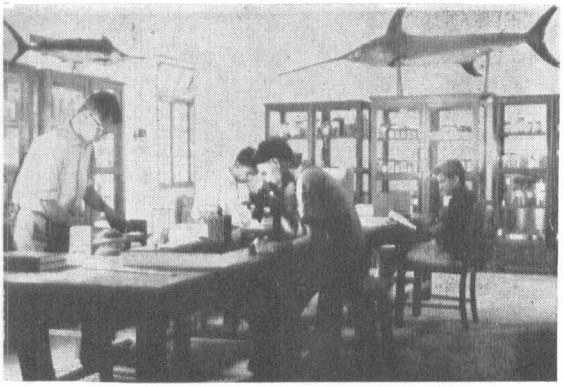
* Figures furnished for 1973-74 are only estimates.

Staff Position

1947-48 (inception)	49
1951-52	90
1956-57	300
1961-62	405
1966-67	484
1971-72	570*

*Actual number as on 31-10-1972.

CMFRI—Reference Collection.



CMFRI Museum at Regional Centre.

MUSEUM

The Institute's museum has a reference collection which includes all new species described by the workers of the Institute. It also has a very large collection of marine fauna and flora. Models of various types of boats and nets have also been exhibited in the museum. The museum also highlights some of the achievements of the Institute.

LIBRARY

The Institute's library is the finest in the country for marine sciences and one of the best in Asia. It includes a wide collection of books, journals, reprints, cruise/expedition reports, microfilms and microcards. The total number of journals currently received through subscription and exchange are about 200. While the bulk of the journals are received at the main library, many of the Sub-stations are also on the free mailing list of a number of foreign journals or receive them on an exchange basis; some of the very important periodicals are subscribed by the Institute. The library also has a documentation service and keeps releasing bibliographies from time to time.

WORK OF THE INSTITUTE

The research programmes of the Institute include both short-term investigations for solving specific problems and long-term researches for giving a proper appraisal of the living marine resources and their judicious exploitation. A certain amount of fundamental research is also necessary for such an applied science as fisheries. The Institute has a project-oriented approach to the problems of marine fisheries of the country.

A. FISHERY RESOURCES SURVEY

The marine fish in our country are landed throughout day and night at about 1300 landing centres spread all along the coastline. Under these conditions, the collection of basic data by complete enumeration is not possible and the adoption of a suitable sampling technique becomes the best alternative. The sampling design thus formulated takes into consideration the collection of biological data also to help understand the relative abundance of various exploitable stocks of fishes which form a prerequisite for estimating the optimum sustainable yield to be derived from these stocks.

Prior to 1947, no attempt was made to collect fishery data on a scientific basis for the estimation of marine fish production for the country as a whole. The first attempt to build up a planned survey of fish catch on an all-India basis was made by this Institute in 1948-49. In the pilot survey conducted at that time, village-wise data were collected all along the coast and the information obtained included the area actually exploited, the number of persons engaged in fishing, the various types of fishing boats and nets in operation, fishing seasons, types of fish caught and the number of fish landing centres. This helped to bring forth a more realistic picture of the fishing activities so necessary for planning a sampling design for the estimation of country's fish production.

On the basis of this survey, fisheries data were collected regularly from 1950 by dividing the entire coastline of India into homogeneous survey zones, which now number 57. The present sampling design involving space-time stratification was first put into operation in the Kerala State in 1959 and was later extended to other areas. To assess the changing pattern of the fishing industry to suit the sampling design a census of fishing villages was carried out during 1957-58 and 1961-62. In 1972-73 another census is being undertaken.

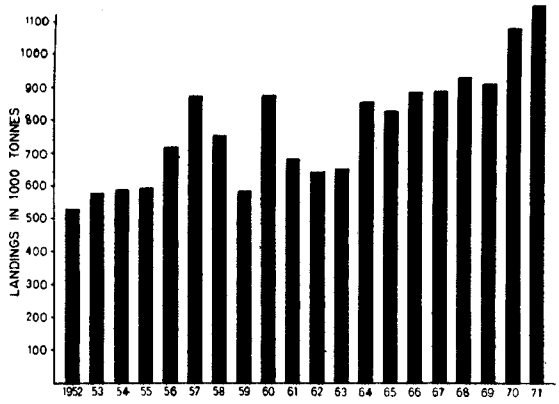
The Institute is providing species/group-wise estimates of marine fish production with seasonal and regional break-ups. Estimates of fishing effort in relation to different types of fishing units and in terms of man-hours are being made. These have helped in the calculation of our gross national income from fisheries which in 1971 was of the order of Rs. 120 crores. India is the only country bordering the Indian Ocean that provides diversified types of data on marine fisheries and these are published regularly by the Food and Agricultural Organisation of the United Nations based on the data supplied by the Institute. The fish production in 1970 (both inland and marine) being 1.75 million tonnes, India ranks 7th among the fish-producing countries of the world. In 1970, for the first time the total marine fish production crossed one million tonnes. During 1971, the total marine fish production continued to increase, reaching 1.15 million tonnes.

Some important facts of the design followed in different maritime states of India, together with the percentage contribution of each state to the total all India marine fish production, based on the Institute's surveys, are given below:

Sl. No.	Name of the State	Approximate length of coast line (in km)	No. of fishing villages	No. of landing centres	No. of space strata	No. of field staff	Percentage catch of each state to the total all India catch
1.	West Bengal & Orissa	680	182	45	4	3	2.36
2.	Andhra	970	321	253	9	9	7.22
3.	Tamil Nadu (incl. Pondicherry)	960	363	361	18	18	14.78
4.	Kerala	560	279	213	9	9	38.58
5.	Mysore	270	131	98	6	6	9.00
6.	Goa	110	—	—	—	—	1.82
7.	Maharashtra	600	265	179	8	8	18.73
8.	Gujarat	1,500	256	107	5	5	7.36
9.	Andamans	—	—	—	—	—	0.05
10.	Laccadives	—	—	—	—	—	0.10
	Total	5,650	1,797	1,256	59	58	100.00

TREND OF TOTAL CATCH IN INDIA DURING THE PERIOD 1952 TO 1971

In the estimates of the total marine fish catch in India, the landings of the mechanised boats and of the big trawlers account for about 20%. The night landings form about 7% of the total marine fish production.



Annual total marine fish landings in India, 1952-71.

Surveys have shown that the total marine fish production in India during 1970 and 1971 has more than doubled as compared to 1952. During the ten-year period 1952-1961 considerable year-to-year fluctuations were seen and the annual average for 10-year period was about 7 lakh tonnes. During the subsequent 10-year period (1962-1971) a consistent increase has occurred and the annual average catch was about 9 lakh tonnes. The increase or decrease in the annual landings during the 20-year period has been mainly due to the success or failure of oil sardine and mackerel fisheries. These two, together with the fisheries of Bombay duck and prawns, contribute about 52% of the total marine fish production in India.

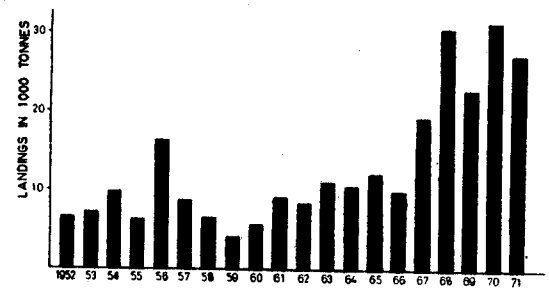
Annual landings of major fisheries

Name of fisheries	1967	1968	1969	1970	1971	Average (tonnes)	Percentage
Oil sardine	256,326	301,641	174,249	226,997	208,982	233,639	23.45
Mackerel	29,445	21,703	91,837	139,206	184,811	93,400	9.38
Bombay duck	74,942	82,501	76,276	78,443	71,415	76,715	7.70
Prawns	94,422	101,436	106,097	121,691	149,968	114,723	11.52
Total of all fishes	891,888	934,611	913,630	1,085,607	1,154,844	996,116	

The large-scale fluctuations in oil sardine and mackerel fisheries are due to "fishery-independent factors". It has also been estimated that no substantial increase in oil sardine landings is possible by a further increase in fishing effort, as long as the fishery is restricted to the inshore waters. For mackerel a further increase in effort may fetch only a nominal increase in the catch.

MAGNITUDE OF MARINE FISH LANDINGS IN DIFFERENT MARITIME STATES

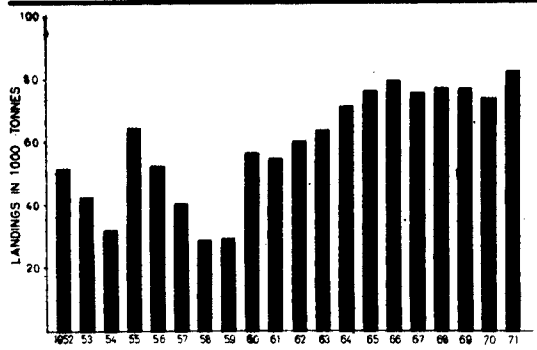
WEST BENGAL AND ORISSA



Annual total marine fish landings—West Bengal and Orissa.

The annual marine fish catch in the states of West Bengal and Orissa fluctuated between 4,221 and 31,403 tonnes during the 20-year period from 1952 to 1971. For the first 10-year period (1952-1961) the annual average catch was 8067 tonnes, whereas for the next 10-year period (1962-1971) the average was over 18,400 tonnes showing an increase of about 2.3 times from the average annual catch of the previous decade. The catch statistics of some of the important fisheries of the past five years are given below:

Name of fish	1967	1968	1969	1970	1971	Average (tonnes)	Percentage
Prawns	7,801	10,918	5,638	3,061	1,679	5,811	22.09
Lesser sardines	1,297	3,079	3,905	3,058	1,909	2,649	10.07
Stolephorus, Thryssa & *Thrissina* spp.	905	1,789	1,134	1,316	623	1,153	4.38
Other clupeids	1,010	2,387	2,737	7,112	6,779	4,005	15.23
Bombay duck	1,247	2,456	1,348	818	932	1,360	5.17
Sciaenids	496	1,795	1,274	2,617	3,065	1,849	7.03
Ribbon fish	736	1,026	581	1,470	1,449	1,052	4.00
Total of all fishes	19,318	30,658	22,879	31,403	27,255	26,303	



Annual total marine fish landings—Andhra Pradesh

ANDHRA PRADESH

The annual marine fish production in Andhra Pradesh fluctuated between 28,846 and 83,289 tonnes during the past 20-year period (1952-1971), with an annual average of 59,794 tonnes. The average for the first 10-year period (1952-1961) was 45,339 tonnes while for the next 10-year period (1962-1971),

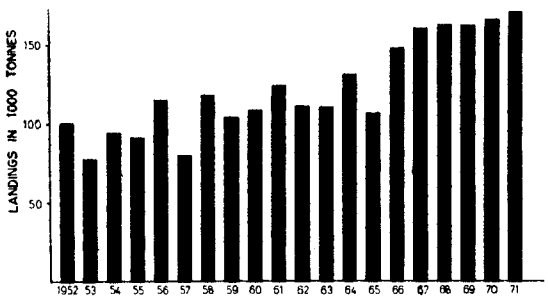
it was 74,248 tonnes. The estimated landings of important fishes for the past five years are given below :

Name of fish	1967	1968	1969	1970	1971	Average (tonnes)	Per-centage
Prawns	8,888	6,126	6,064	6,890	9,036	7,401	9.52
Ribbon fish	7,417	6,366	9,970	6,473	7,255	7,496	9.64
Lesser sardines	9,019	8,907	13,371	19,097	19,949	14,069	18.09
Stolephorus spp., *Thryssa* spp. & *Thrissina* spp.	9,931	6,390	8,190	6,345	2,261	6,623	8.52
Other clupeids	2,482	4,319	4,585	2,685	5,996	4,013	5.16
Elasmobranchs	4,225	8,598	3,969	4,038	4,530	5,072	6.52
Sciaenids	3,232	2,557	6,874	4,091	5,794	4,510	5.80
Cat-fishes	3,657	4,269	3,088	2,346	2,755	3,223	4.14
Leiognathus	5,575	3,199	2,428	2,541	2,068	3,162	4.07
Total of all fishes	76,054	77,429	77,526	74,459	83,289	77,751	

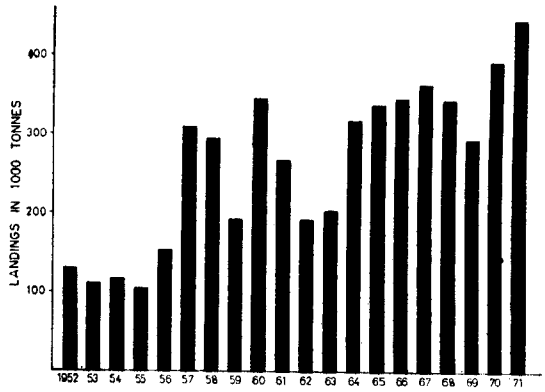
TAMIL NADU (including Pondicherry)

The annual marine fish catch in Tamil Nadu varied between 77,171 and 170,667 tonnes giving an average of 121,899 tonnes for the 20-year period (1952 to 1971). During the first 10-year period (1952-1961) the annual average catch was 100,949 tonnes while for the next 10-year period (1962-1971) it was 142,849 tonnes. The table below gives the data of important fisheries for the past five years.

Name of fish	1967	1968	1969	1970	1971	Average (tonnes)	Per-centage
Prawns	8,018	7,482	6,427	5,711	3,987	6,325	3.85
Silver bellies	24,741	25,040	23,439	27,806	19,162	24,038	14.61
Lesser sardines	13,809	12,662	19,111	18,715	25,370	17,933	10.90
Stolephorus spp. *Thryssa* spp. & *Thrissina* spp.	14,344	12,036	18,069	15,194	11,166	14,162	8.61
Elasmobranchs	9,395	10,622	13,307	19,410	17,768	14,100	8.57
Carangids	13,568	10,682	10,938	8,510	10,968	10,933	6.65
Ribbon fish	10,055	12,701	7,198	7,155	10,995	9,621	5.85
Sciaenids	8,912	10,545	9,481	10,526	5,898	9,072	5.52
Perches	5,834	7,024	7,824	6,109	6,244	6,607	4.02
Cat fishes	5,292	4,623	4,165	7,306	7,522	5,782	3.52
Total of all fishes	160,514	162,551	162,513	166,140	170,667	164,477	



Annual total marine fish landings —Tamil Nadu.



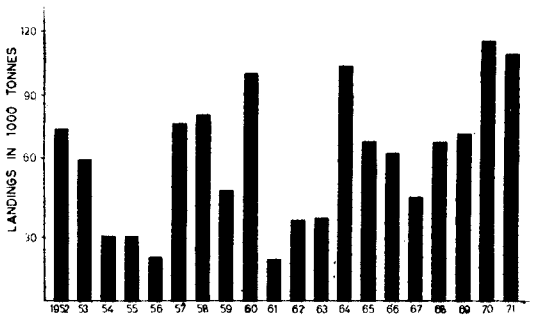
Annual total marine fish landings—Kerala.

KERALA

The annual catch varied from 105,457 to 445,605 tonnes during the 20-year period (1952-1971) and such fluctuations were not encountered in any other State. The annual average catch during the past 20-year period (1952-1971) was 263,592 tonnes. During the first 10-year period (1952-1961) the average annual catch was 202,953 tonnes while for the next 10-year period (1962-1971) it was 324,231 tonnes showing an increase of 121,278 tonnes over the average of the previous decade. The estimated catches of important fishes for the past five years are given below:

Name of fish	1967	1968	1969	1970	1971	Average (tonnes)	Per-centage
Prawns	27,252	25,391	34,368	36,954	32,807	31,354	8.51
Oil sardine	235,410	247,048	139,983	191,683	195,478	201,920	54.79
Mackerel	4,500	3,600	29,981	54,659	95,045	37,557	10.19
Stolephorus spp., *Thryssa* spp. & *Thrissina* spp.	14,391	6,945	11,652	12,558	13,174	11,744	3.19
Lesser sardines	9,038	7,723	9,485	6,139	11,284	8,734	2.37
Soles	3,201	9,495	10,039	10,212	8,464	8,282	2.25
Total of all fishes	364,129	345,301	294,787	392,880	445,605	368,540	

MYSORE

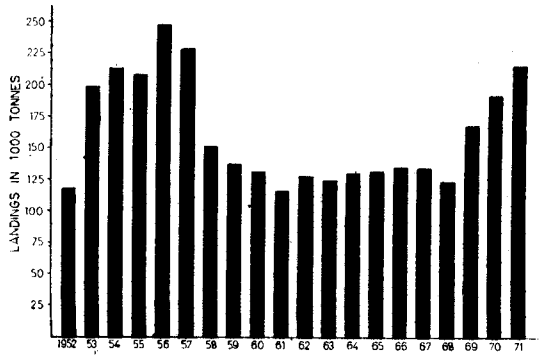


Annual total marine fish landings —Mysore.

The variation in the annual catch in Mysore was from 18,113 to 116,936 tonnes, and the average annual catch for the 20-year period (1952-1971) was 64,905 tonnes. The total landings in the state have been highly fluctuating throughout the 20 years mainly because of the success or failure of the oil sardine and mackerel fisheries. While the average annual catch during the 10-year period 1952-1961 was 54,176 tonnes, it was 75,634 tonnes for the period 1962-1971. The table below gives the data of important fisheries for the past five years.

Name of fish	1967	1968	1969	1970	1971	Average (tonnes)	Per-centage
Prawns	1,260	5,426	3,890	7,539	4,635	4,568	5.27
Oil sardine	20,481	53,727	33,580	33,834	11,903	30,705	35.40
Mackerel	15,050	5,736	13,253	46,337	64,641	29,003	33.44
Cat fishes	1,669	4,472	3,857	9,220	1,317	4,107	4.73
Total of all fishes	49,185	87,822	75,793	116,936	103,978	86,743	

MAHARASHTRA



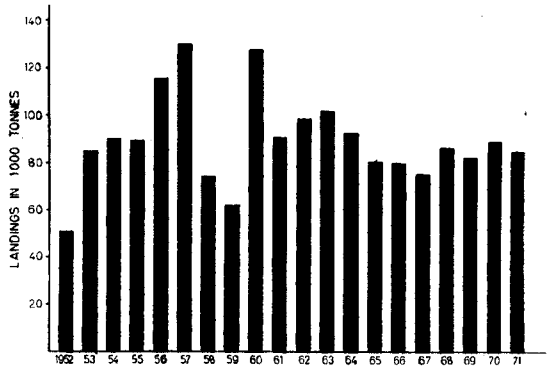
Annual total marine fish landings —Maharashtra.

The total catch fluctuated from 116,225 to 247,323 tonnes during the 20-year period (1952 to 1971) in this State, the average annual catch being 161,816 tonnes. During the 10-year period (1952-1961) the landings fluctuated between 116,225 and 247,323 tonnes while it was between 124,587 and 216,340 tonnes for the period 1962-1971.

The landings of important groups of fishes for the past five years are given in the table below.

Name of fish	1967	1968	1969	1970	1971	Average (tonnes)	Per-centage
Non-penaeid prawns	28,376	30,311	31,235	28,425	74,637	38,597	23.12
Penaeid prawns	8,136	11,296	14,545	28,920	19,490	16,477	9.87
Bombay duck	28,123	25,704	25,171	33,730	33,994	29,344	17.58
Sciaenids	7,581	7,141	10,735	12,906	12,836	10,240	6.13
Pomfrets	15,023	10,492	12,776	4,210	5,450	9,590	5.74
Other clupeids	8,532	8,028	8,342	6,493	8,827	8,044	4.82
Total of all fishes	133,302	123,916	168,720	192,361	216,340	166,928	

GUJARAT



Annual total marine fish landings —Gujarat.

The total marine fish production in Gujarat varied from 50,651 to 130,990 tonnes during the 20-year period with an average of 89,618 tonnes. During the first decade, (1952-1961) the total landings fluctuated between 50,651 and 130,990 tonnes. In the subsequent 10-year period, 1962-1971, the total catch varied from 75,633 tonnes to 102,040 tonnes. The table below gives the estimated findings of important fishes during the period 1967—1971.

Name of fish	1967	1968	1969	1970	1971	Average (tonnes)	Per-centage
Prawns	4,069	3,720	3,273	3,599	3,035	3,539	4.2
Bombay duck	44,806	53,676	49,484	43,618	35,706	45,458	54.3
Pomfrets	5,670	5,781	5,468	7,978	7,819	6,543	7.8
Other clupeids	5,284	5,668	5,111	4,751	3,428	4,848	5.8
Cat fishes	1,843	2,255	2,453	4,021	3,736	2,862	3.4
Sciaenids	1,411	1,496	2,211	3,989	3,770	2,575	3.1
Total of all fishes	75,633	86,585	82,248	89,027	84,941	83,687	

FISHERIES IN UNION TERRITORIES

GOA

The fisheries in Goa in the order of abundance were mackerel, oil sardine, prawns, other clupeids and silver bellies. The landings fluctuated from 12,460

tonnes (1967) to 39,980 tonnes (1971) during the seven-year period, 1965 to 1971.

Year	Landings (tonnes)	Year	Landings (tonnes)
1965	17,186	1969	27,559
1966	24,600	1970	20,736
1967	12,460	1971	39,980
1968	18,888	Average	23,058

LACCADIVES

The average annual catch in the Laccadives during the 11-year period, 1960 to 1970, for which data are available works out to about 700 tonnes, the landings fluctuated between 79 tonnes in 1964 and 1,165 tonnes in 1970. The oceanic skipjack constituted the major part of the catch.

Year	Landing (tonnes)	Year	Landing (tonnes)
1960	509	1966	660
1961	872	1967	883
1962	178	1968	1,120
1963	589	1969	1,193
1964	79	1970	1,165
1965	471	1971	1,190
		Average	742

ANDAMANS

Perches, carangids, anchovies and silver bellies constituted the major portion of the catch. During the 16-year period, 1956 to 1971, the total catch in the Andamans fluctuated from 77 tonnes in 1956 to 569 tonnes in 1971 with an average of about 244 tonnes.

Year	Landings (tonnes)	Year	Landings (tonnes)
1956	77	1964	148
1957	96	1965	224
1958	92	1966	330
1959	123	1967	410
1960	129	1968	341
1961	131	1969	412
1962	155	1970	500
1963	159	1971	569
		Average	244

SEAFOOD EXPORT

The earnings in foreign exchange from the sea food export showed a steady increase from 59 million rupees in 1963 to 392 million rupees in 1971. The data export earnings from the various items during the year 1963 to 1971 are shown below:-

Items		1963	1964	1965	1966	1967	1968	1969	1970	1971
Frozen Prawns	Q:	3,967	5,870	7,028	8,784	11,173	14,397	21,441	22,135	23,181
	V:	21,204	31,518	41,422	88,792	129,808	156,340	262,945	242,515	313,363
Frozen Lobster tails	Q:	53	41	112	81	128	297	529	382	326
	V:	313	371	1,274	1,474	2,357	6,684	11,224	6,021	10,942
Canned Prawns	Q:	1,231	1,074	1,148	1,523	2,200	2,238	1,661	2,578	1,864
	V:	7,576	6,989	9,506	18,656	31,243	26,156	22,104	39,541	29,757
Dried Prawns	Q:	2,809	3,009	1,702	1,163	1,540	1,411	835	1,486	684
	V:	9,325	8,997	5,447	5,271	8,961	7,259	4,840	8,361	3,742
Others	Q:	9,848	11,464	5,467	7,602	6,723	6,467	6,118	10,594	7,977
	V:	20,228	20,614	11,588	21,053	26,917	24,407	29,618	58,921	33,921
Total	Q:	17,908	21,458	15,457	19,153	21,764	24,810	39,584	37,175	34,032
	V:	58,646	68,489	69,237	135,246	199,286	220,846	330,731	355,359	391,725

Q: Quantity in tonnes

V: Value in 1000 rupees

B. FISHERY BIOLOGY

The country's marine fisheries resources chiefly include:

(i) major pelagic resources such as oil sardine, mackerel, seer fish and tuna, and other pelagic resources of regional importance such as the "lesser sardines", anchovies and ribbon fishes;

(ii) demersal resources such as perches, sciaenids, cat-fishes, polynemids, flat-fishes, pomfrets, eels, sharks, skates and rays and fishes which are mainly caught by trawl;

(iii) mid-water resources such as Bombay duck, silver-bellies and horse-mackerels;

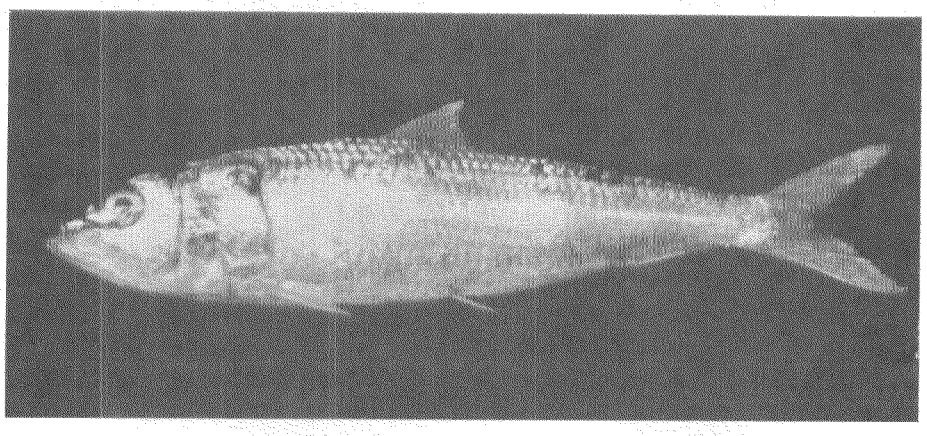
(iv) crustacean resources, namely prawns, shrimps, lobsters and crabs; and

(v) molluscan resources such as chank, oysters, mussels, clams and squids.

Our exploitation in the past has largely been confined to pelagic fisheries. Fishing for demersal resources of sizeable magnitude started only with the mechanisation of fishing craft during the past 12 years.

TELEOST AND ELASMOBRANCH FISHERIES

OIL SARDINE

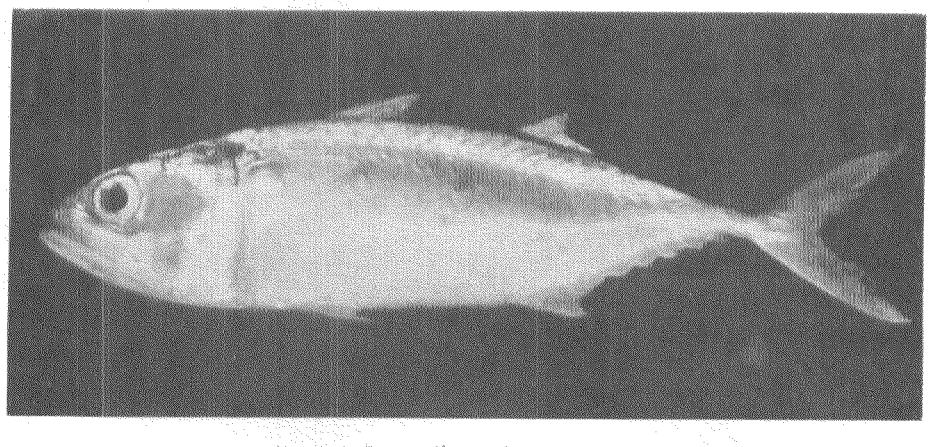


Oil sardine, *Sardinella longiceps*

Taking into account the quantity of catches, the oil sardine *Sardinella longiceps* is the most important marine fish of India. The inshore areas of the west coast between Quilon and Ratnagiri form traditional fishing grounds for oil sardine, although, in the years of plenty, its commercial abundance extends to other sections of the west and east coasts. The main fishing season lasts from August to April, the peak being in October—December.

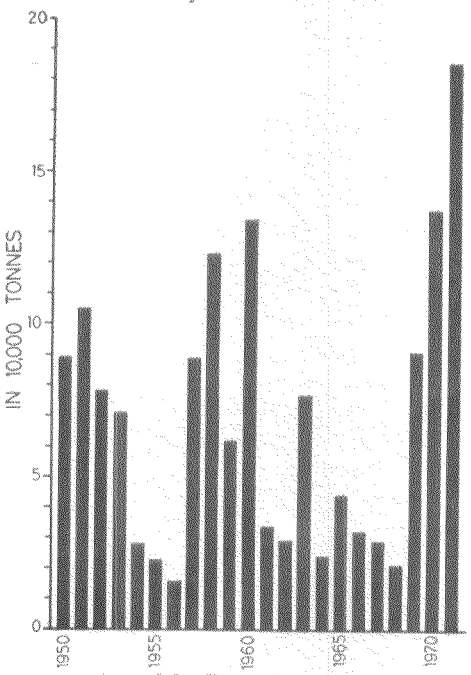
The oil sardine fishery is subject to annual and long-term fluctuations. In the mid-forties, it experienced its worst decline, facing almost near-extinction. But after 1950 the fishery not only registered a remarkable recovery but also touch-

very high magnitude along the west coast, ranking only next to oil sardine in importance. Two other species, *R. brachysoma* and *R. faughni,* also occur in the seas around India. The mackerel fishery is subject to considerable annual



Mackerel, *Rastrelliger kanagurta*

fluctuations; its percentage contribution to the annual marine catch varies from 3 to 23. In the sixties the catches of mackerel declined steeply, leading to considerable anxiety. But the work of the Institute showed that the reason for the decline was not the intensive fishing of earlier years and that the poor catches were mainly due to fishery-independent factors. A revival was expected and the catches began to soar high during the 1969-71 season.



Annual landings of mackerel

Mackerel occurs all along the Indian coast but over 90% of the landings come from the region between Quilon and Ratnagiri along the west coast. The areas around Vizhinjam, Mandapam, Madras and Visakhapatnam are the other regions of commercial importance. *Rastrelliger* species also form important fisheries in several other countries and contribute largely to the fishery wealth of the Indo-Pacific region.

The fishery season on the west coast lasts from September to April. The catches are contributed by fish of the length-range 12-23 cm, which comprise mostly under-yearlings and yearlings.

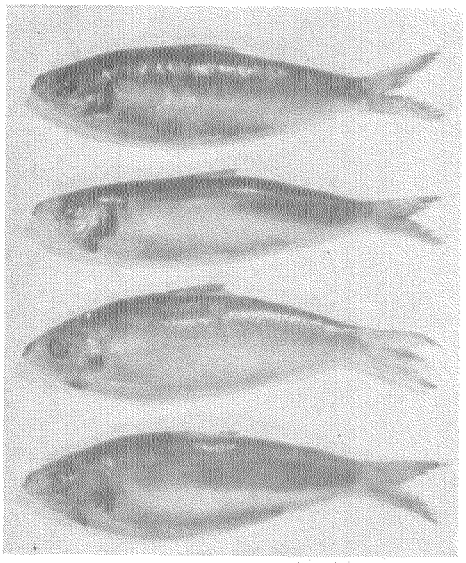
The fish feeds mainly on zooplankton. Studies on food and feeding have suggested a broad correlation between the abundance of planktonic organisms and the availability of shoals in the fishing grounds during the post-monsoon months.

Like the oil sardine, the fish supporting the catches belong to the maturing class. The spawning season on the west coast is long and extends from April to September, the peak being in June-September. Observations made at Vizhinjam have indicated the possibility of two spawning seasons November-March and May-August. Along the east coast, the fish is believed to spawn during the north-east monsoon period. Recently larval and post-larval stages of the mackerel have been identified in the plankton. But the spawning grounds of the species have not yet been delimited. Population studies showed that total mortality of the stock in the fishing grounds may be of the order of 90% every year and that the annual fishing rate may be about 60%.

Tagging of mackerel has been started and the results should give the much-needed information on this valuable resource.

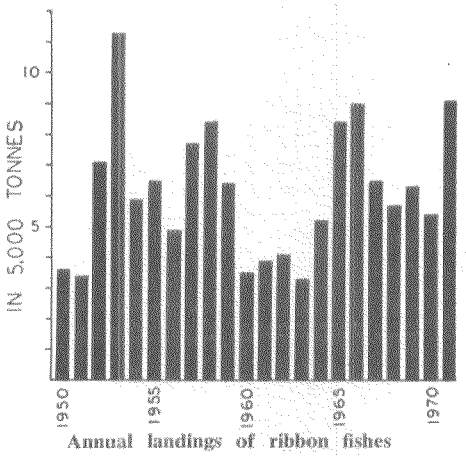
The guts and gills are dried and used as manure and also as cattle and poultry feed. Mackerel is also canned now.

LESSER SARDINES



Lesser sardines. Top to bottom : *Sardinella fimbriata, S. gibbosa, S. albella* **and** *S. dayi*

The lesser sardines are relatively cheap food fishes and are of much commercial importance in several regions, especially on the east and south-west coasts. This group at present gives an annual yield of about 50,000 tonnes, forming 5% of the total marine fish production in India. Since this group is likely to develop as one of the productive pelagic resources of our waters, investigations on all-India basis have been launched recently. The important species are the fringe-scale sardine (*Sardinella fimbriata),* the Indian sprat *(S.gibbosa),* the short-bodied sardine *(S. albella),* the keeled sardine *(S. dayi)* and the spotted sardine *(S. sirm).*



Annual landings of ribbon fishes

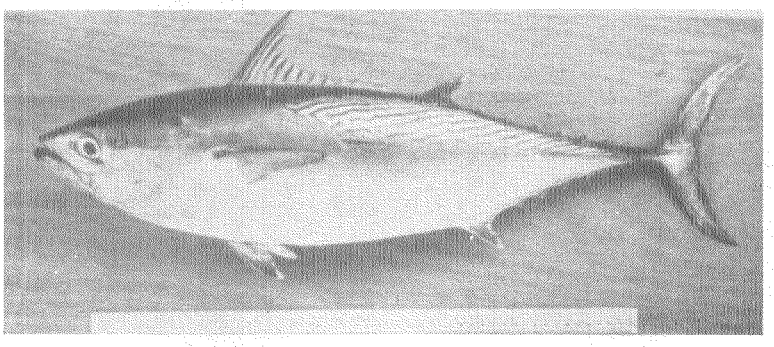
RIBBON FISHES

At present ribbon fish fisheries of some importance exist in the inshore areas along the Andhra Pradesh and Tamil Nadu coasts and in some parts of the west coast, especially Kerala. The constituent species are *Trichiurus lepturus, Lepturacanthus savala, Eupleurogrammus intermedius* and *E. muticus*. The fishery season lasts from July to March although the peak period may vary from place to place. At the height of the season the inshore areas may be heavily occupied by the ribbon fishes to the almost total exclusion of other fishes. They contribute 3 to 5% of the total annual catch of India.

All the species of ribbon fishes are highly carnivorous, predominently piscivorous and often even cannibalistic. *T. lepturus* which is reported to grow to about 1.5 m in length attains about 20, 30 and 45 cm at the end of the first, second and third years of its life respectively. The other species are smaller in size. The fishery has a multi-age group composition. The spawning period extends from February to July.

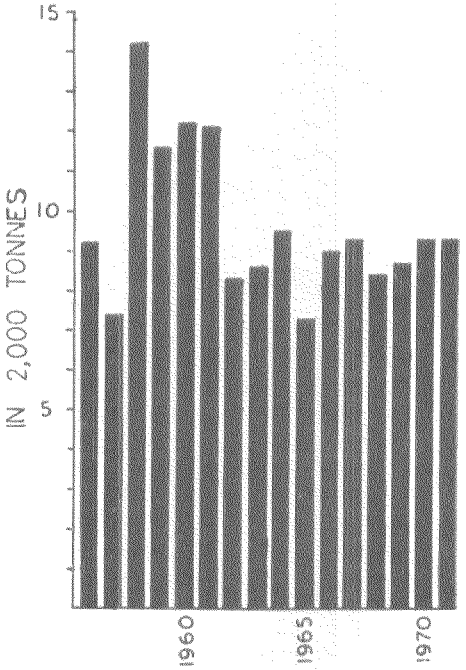
TUNAS

Some localised inshore fisheries for tunas exist in the south-western region of the mainland but a regular fishery for tuna is found in Minicoy and the other



The little tunny. *Euthynnus affinis*

islands of the Laccadives. The tunas form an oceanic resource of very great value. The species forming the fishery in the Laccadives are the skipjack (*Katsuwonus pelamis*) and the yellowfin tuna (*Thunnus albacores*). The coastal



Annual landings of perches

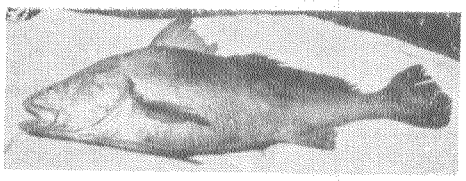
PERCHES

Many perch and perch-like fishes form good fisheries of the inshore and offshore waters along both the east and the west coasts. Important among these are the thread-fin bream *(Nemipterus japonicus)*, the white fish *(Lactarius lactarius)* and karkara *(Pomadaysis hasta)*. The white fish is a priced table fish and occurs in fair abundance all along the Indian coast. The perches contribute 1.5-2% of the annual marine catches.

Good grounds for kalava *(Epinephelus* spp. and *Pristipomoides* sp.) have been located at a depth range 70-130 m off Kerala. Exploitation of this resource has not yet been started.

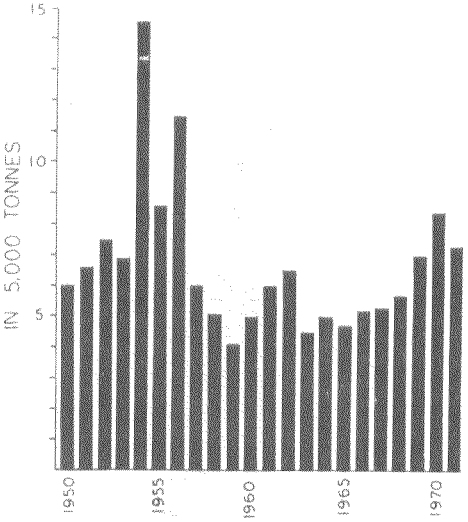
SCIAENIDS

A good part of the trawler landings from the offshore regions is made up of sciaenids. Some of the larger species, such as the ghol *(Pseudosciaena diacanthus)* and koth *(Otolithoides brunneus)*, are high quality fishes and support a sizeable fishery off the Bombay-Saurashtra coasts. The catches of both these are com-



Ghol.

Koth.

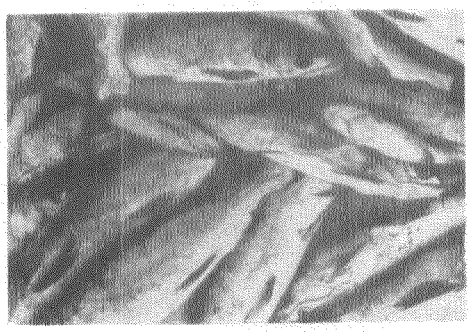


Annual landings of sciaenids

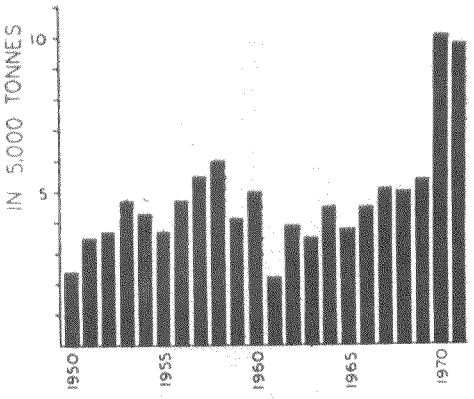
Another important flatfish is *Psettodes erumei,* which is usually caught in trawls all along the Indian coast. The flatfishes form about 2% of the annual marine catch of the country.

CAT-FISHES

Cat-fishes form one of the most promising resources. They are abundant all along the Indian coast. Big shoals have been reported from the Palk Bay. Along the north-east coast, they form nearly 20% of the demersal fish stocks.

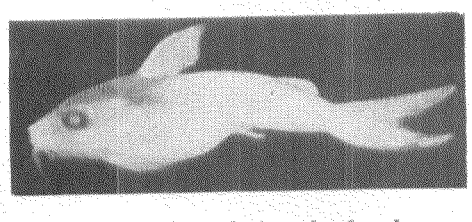


Cat fish,
Tachysurus thalassinus



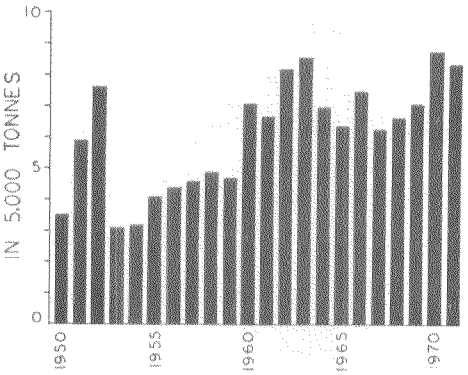
Annual landings of cat fishes

But the level of their exploitation at present is very low. One of the important species, *Tachysurus thalassinus,* is caught commercially both along the east and the west coasts. Other important cat-fishes are *T. tenuispinis, T. jella* and *T. dussumieri.* Many of the species migrate into estuaries and rivers. A very interesting feature of the habits of the cat-fishes is that the males exhibit parental care and usually carry the fertilised eggs in the mouth for weeks together. Presumably during this period feeding is suspended. The eggs hatch and the young are still carried in the mouth until they are able to fend for themselves. Cat-fishes contribute about 5% of the marine fish landings.



Young cat fish from the mouth of male parent

SHARKS, SKATES AND RAYS



Annual landings of sharks, skates and rays.

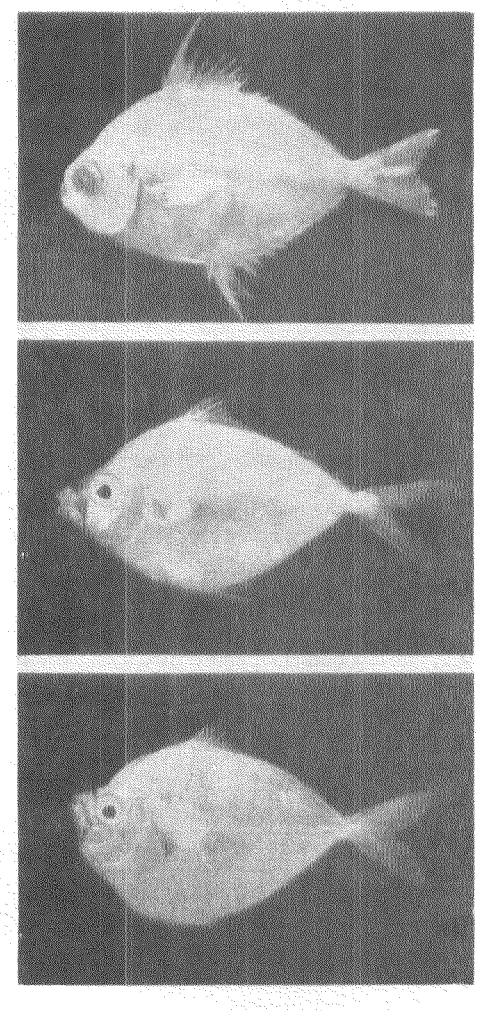
Sharks, skates and rays are one of the important marine fishery resources of our seas; their average annual production during the period 1962-1971 was 37,234 tonnes. The elasmobranchs rank eighth in the order of production, forming 4.3% of the total marine fish landings of the country. Apart from their use as food they also yield liver oils with high vitamin content. The oils from some of the sharks and rays, which do not have medicinal value, are used in the leather industry. The dried shark fins are used for preparing soups and form an item of export. The skin of sharks is used for making leather and is exported. The shark teeth are used for making curios which are highly prized.

Good fisheries for sharks, skates and rays exist all along the coast. Exploratory studies show that the Sand-head regions of the Bay of Bengal are one of the most productive areas for sharks in the country, but these are not yet exploited. The commercially important sharks, skates and rays are *Carcharhinus* spp. and *Scoliodon* spp.; *Rhinobatus* spp. and *Rhynchobatus* spp.; and *Dasyatis* spp. and *Aetobatus* spp.

BOMBAY DUCK

After the oil sardine and the mackerel, the Bombay duck is the most important marine fish of the country and contributes about 8 to 10% of the all India marine fish landings; almost all of it comes from Maharashtra and Gujarat. As for the oil sardine and mackerel the fishery for Bombay duck also is supported by a single species, *Harpodon nehereus*. In the forties, it contributed only about 2% of the total marine fish landings of India but in the fifties, due to mechanisation of fishing craft and improvements in the gears, the landings increased sharply to 1 lakh tonnes. In sixties, however, the fishery has stabilized around 75,000 to 80,000 tonnes. Dried and laminated Bombay duck has a good export market. The fluctuations in the catches of the last 10 years are not very

place throughout the year with a peak from December to March. The breeding grounds of Bombay duck appear to be away from the fishing grounds. The fish is a carnivore and is even cannibalistic. Prawns and teleostean fishes form the main food items of Bombay duck.



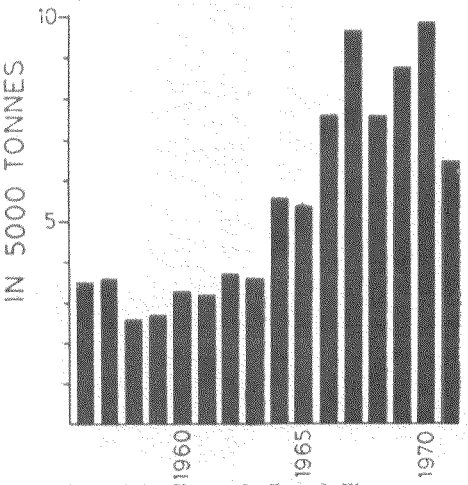
Silver bellies. Top to bottom: *Leiognathus splendens, L. bindus* and *Secutor ruconius.*

The fish grows to about 130 mm in the first year and 210 mm in the second year. The catches are mainly supported by fish measuring 60-270 mm in length, i.e., which are one to two years old.

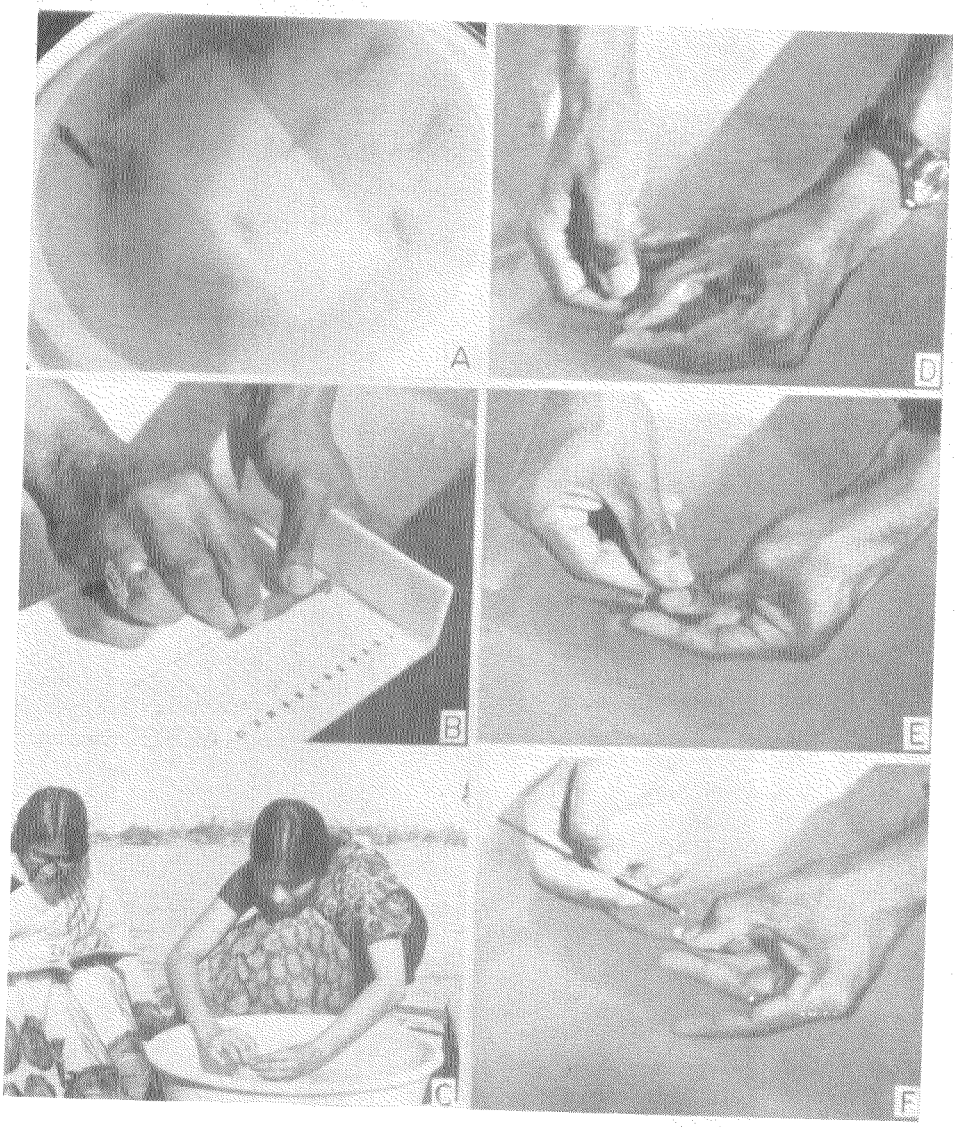
SILVER BELLIES

They go under the scientific name *Leiognathus* spp. and *Gazza* spp. and constitute important fisheries along both the Indian costs, forming 4 to 5% of the total annual catches. Sizeable resource of this group was discovered in the Palk Bay and their exploitation by the trawlers has been intensified.

The catches comprise mostly fish less than one year old (O-group). Their life span seems to be less than 2 years. Only a small part of the



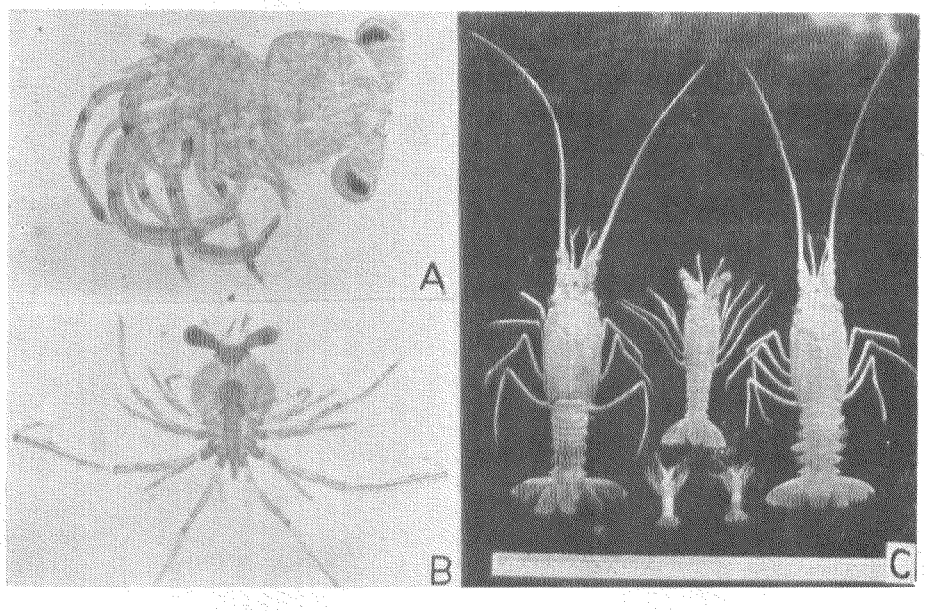
Annual landings of silver bellies



Tagging of prawns. A-live prawns held in tanks for tagging, B-recording length before tagging, C-making incision on first abdominal segment, D and E-introducing the tag, and F-rivetting the disc tag.

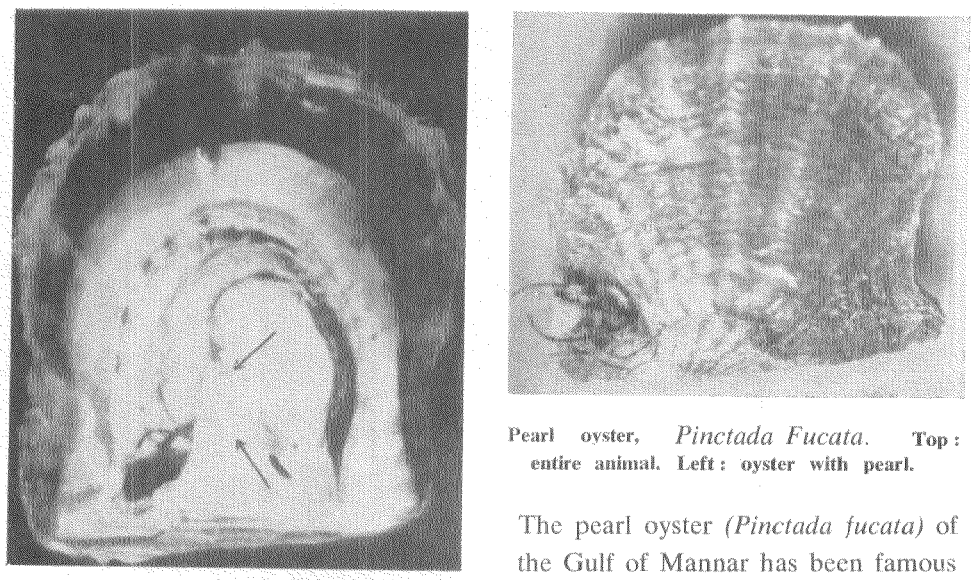
Very good grounds of deep-sea prawns have been discovered off the south-west coast at depth ranging from 160 to 400m. The country has not yet started exploiting these resources.

Lobsters, as another item of export, are coming to the forefront because of high demand in foreign countries. We have good spiny lobster grounds along the southwest and southeast coasts. The important species are *Panulirus homarus*, and *P. ornatus*. The price of lobsters has gone up considerably and a kg of whole lobster fetches a price of Rs. 30 to 40 to the fishermen. The Institute is keeping a careful watch on this resource as the grounds are limited in nature and can easily be depleted.



Deep-sea spiny lobster. A. naupliosoma, B. phyllosoma and C. juveniles and adult.

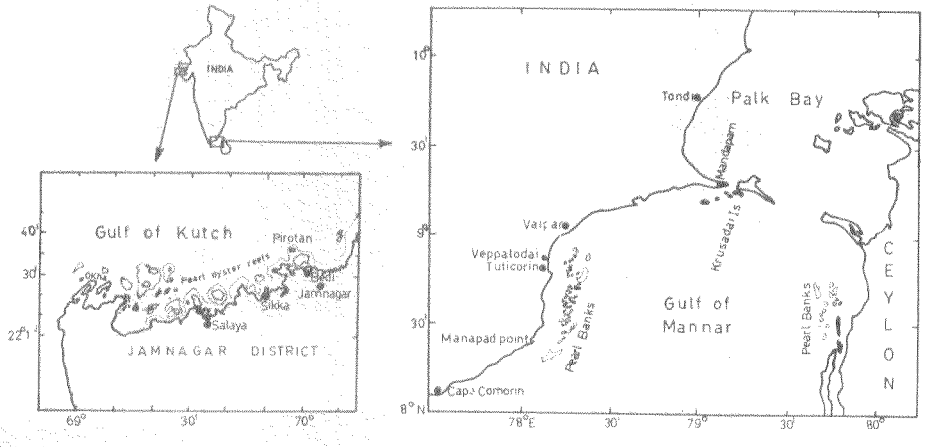
Recently some very rich resoures of deep sea spiny lobster, *Puerulus sewelli*, have been discovered along the southwest and southeast coasts at depths ranging from 180 to 350m. The regional abundance and the biology of the species have been studied. Commercial exploitation of this resource has started.



Pearl oyster, *Pinctada Fucata*. Top : entire animal. Left : oyster with pearl.

The pearl oyster *(Pinctada fucata)* of the Gulf of Mannar has been famous for its lustrous pearls since ancient times. Here again the flesh is not used. It is discarded and if any pearl is found, it is collected. The Gulf of Kutch is another area where the pearl oysters are of common occurrence.

Among the edible molluscs the mussels *(Mytilus* spp.) off the Kerala coast and *Modiolus* of the east coast are very important. The clams *(Meretrix* spp.,



Pearl oyster grounds in Gulf of Kutch and Gulf of Mannar.

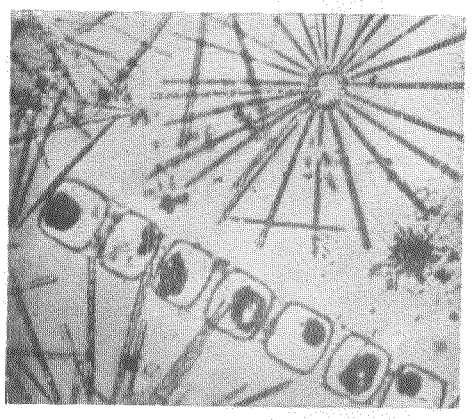
C. ENVIRONMENT IN RELATION TO FISHERIES

PLANKTON

The knowledge of plankton production, their seasonal variation and species composition is fundamental to the study of fisheries of any region. No comprehensive studies on plankton nor any attempt at assessing their production from the Indian seas were carried out until 1947, although some general observations were made by the maritime Universities and Madras Fisheries Department earlier. Systematic investigations on plankton have occupied a prominent place in the research programme of the Institute since its very inception in 1947.

PLANKTON PRODUCTIVITY

Tropical waters had been earlier considered far less productive than the temperate waters. The Institute's works on plankton have shown that our coastal waters, especially along the west coast, are highly productive. Species diversity of phytoplankton has been found to be greater along the east coast than along the west coast, though the fat content of the plankton is higher on the west coast. Regular estimation of primary production using 14 C technique confirmed the earlier observations made at the Institute on a higher rate of production along the west coast as compared to the east coast. The rate of production has been computed for the seas around India. These estimates indicate that the potential sea food harvest could easily be increased by about 2 to 3 times of its present yield in our coastal waters. At Calicut and Cochin extensive studies have been carried out on the qualitative and quantitative distribution of inshore and offshore plankton.



Common phytoplankters.

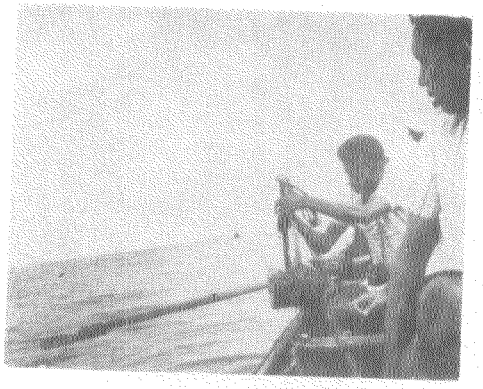
Researches on zooplankton were limited to selected areas in coastal waters of Calicut on the west coast and Mandapam on the east coast. Observations on the plankton from Calicut showed that the post-monsoon season, September to December, is characterised by the abundance of copepods, cladocerans, larval and juvenile decapods and fish eggs and larvae. Active fishery of oil sardine and mackerel along this coast coincided with this period. Observations on the distribution and fluctuations of planktonic larvae from the Gulf of Mannar have proved that there is a relation between phytoplankton production and larval maxima, especially of copepodites. Plankton investigations have recently been extended to different centres like Bombay, Karwar, Cochin, Madras, Port Blair and Minicoy for a proper understanding of the fluctuations in major commercial fisheries and the seasonal abundance of zooplankton. The results of investigations carried out so far showed interesting relationships between the local fisheries and the abundance of different groups of zooplankters of coastal waters.

From 1962 onward the Institute, by making use of the research vessel *Varuna* of the Indo-Norwegian Project, made systematic collections of plankton from the shelf and oceanic waters of the west coast of India from Cape Comorin to Bombay. In all 144 research cruises were made, which covered more than 3600 stations. Plankton samples were collected, along with hydrographic data, from the inshore and offshore waters of the west coast of India. Special surface hauls and deep water collections were made using the Indian Ocean Standard net from the waters of Arabian Sea to study the abundance of fish eggs and larvae and to investigate the vertical distribution of bathypelagic forms. Displacement volumes of zooplankton were measured to assess the standing crop of zooplankton in coastal and oceanic areas of the eastern Arabian Sea and the Laccadive Sea during different periods of the year.

The collection of a large number of samples from vast areas of the Indian seas, enabled detailed taxonomic and biological studies on planktonic organisms and their interrelationship and influence on fisheries. The occurrence and abundance of larvel cephatopods along the south-west coast and the Laccadive Sea have been investigated. Synopses for important zooplankters such as Chaetognatha have been prepared to facilitate the work of planktologists.

Detailed investigations on bioscattering and the Deep Scattering Layer (DSL) were undertaken along the west coast of India and the Laccadive Sea to study the diurnal vertical migrations, areas of occurrence and biological constituents. Some of the biological constituents of the DSL are important as forage for pelagic fishes such as tunas.

The Institute has also participated in the International Indian Ocean Expedition between 1962 and 1965.



Studying the mud banks.

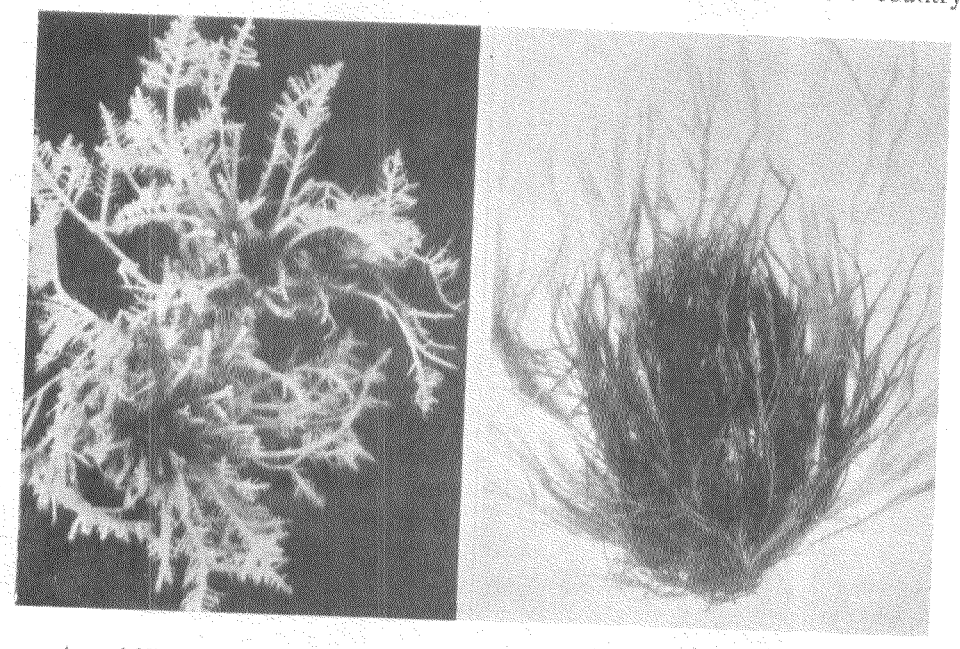
men launch their boats early in the morning between 4 and 5 a.m. and fishing starts in and outside the mud bank area. The catch and the composition varies from boat to boat and from day to day. The boats return to the shore mid-day, either when they are full or when there is not much fish left. The next day starts with fresh catches. On days of good catches some boats may go for a second fishing trip in the afternoon.

The Institute has been studying the mud banks, their formation and their role in the fishery economy of the Kerala State.

Intensive surveys have been carried out in 1971 by a team consisting of oceanographers, chemists, marine biologists and fishery biologists. The mode of formation of the mud banks, hydrography of the area, productivity of the waters, plankton and benthos of the mud bank and the fishery which is so important have been studied.

D. SEA WEEDS

The seaweeds form one of the most important resources of the country,



Agar-yielding sea weeds. Top : *Gelidiella acerosa,* **bottom :** *Gracilaria edulis.*

blishing a seaweed industry in the country. The method developed by the Institute (of a cottage industry type), which has made an excellent impact on the industry, extracts agar from *Gracilaria edulis,* without using either freezing or any other costly equipment to purify the agar at the gel stage, as the impurities affecting the quality of the agar were leached out.

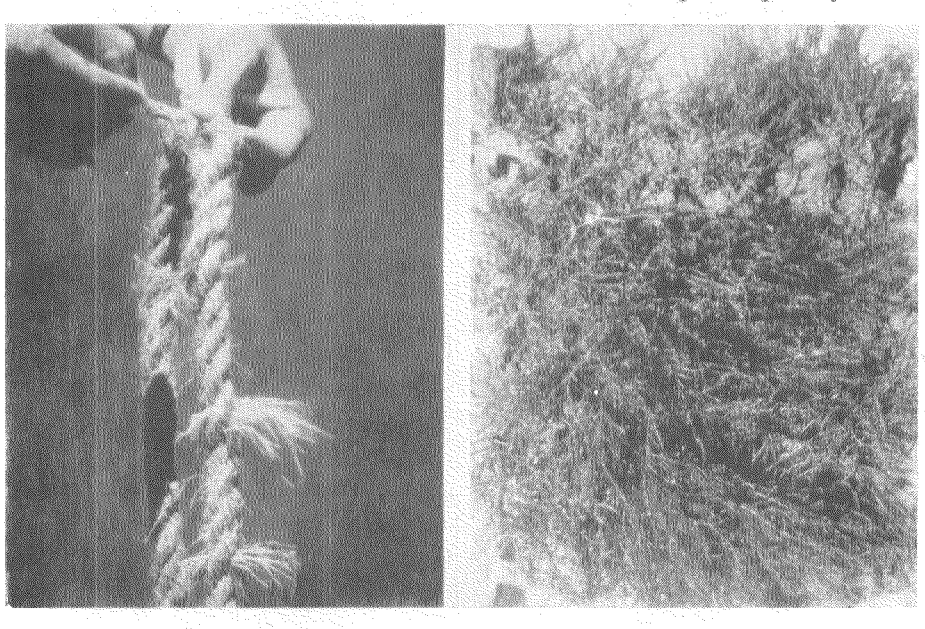
Agar is used as a culture medium in bacteriology and mycology, in sizing fabrics, as a stabilizer and gelling agent in food and confectionary, as backing for photographic films and so on.

The Institute's studies have also revealed that the seaweeds *Sargassum, Turbinaria* and *Cystophyllum* form a rich source of alginic acid. The yield from these varied from 10 to 30% in laboratory experiments. The high-yielding species for algin are *Sargassum wightti, S. swartzii, S. tenerrimum, S. cinereum, S. johnstonii, Turbinaria conoides* and *T. ornata.*

Algin is used where a firm type of gel is not needed such as for sizing textiles, thickening paints, as food stabilizer or gelling agent, or as activator in insecticides, or in industry to prevent scale formation in boilers, in the manufacture of cosmetics or as a creaming agent in rubber industry.

The seaweeds, fresh or dried, are also used as human food. In fact, in some countries they are considered as delicacies. A process has been worked out by the Institute in which *Gracilaria edulis* has been used for the preparation of seaweed meal for human consumption. The meal obtained as a cream-coloured powder, odourless and highly palatable can be used for making porridges, soups etc. When mixed with other foods, it increases their mineral contents.

Seaweeds can also be used as fodder for cattle, sheep and poultry.

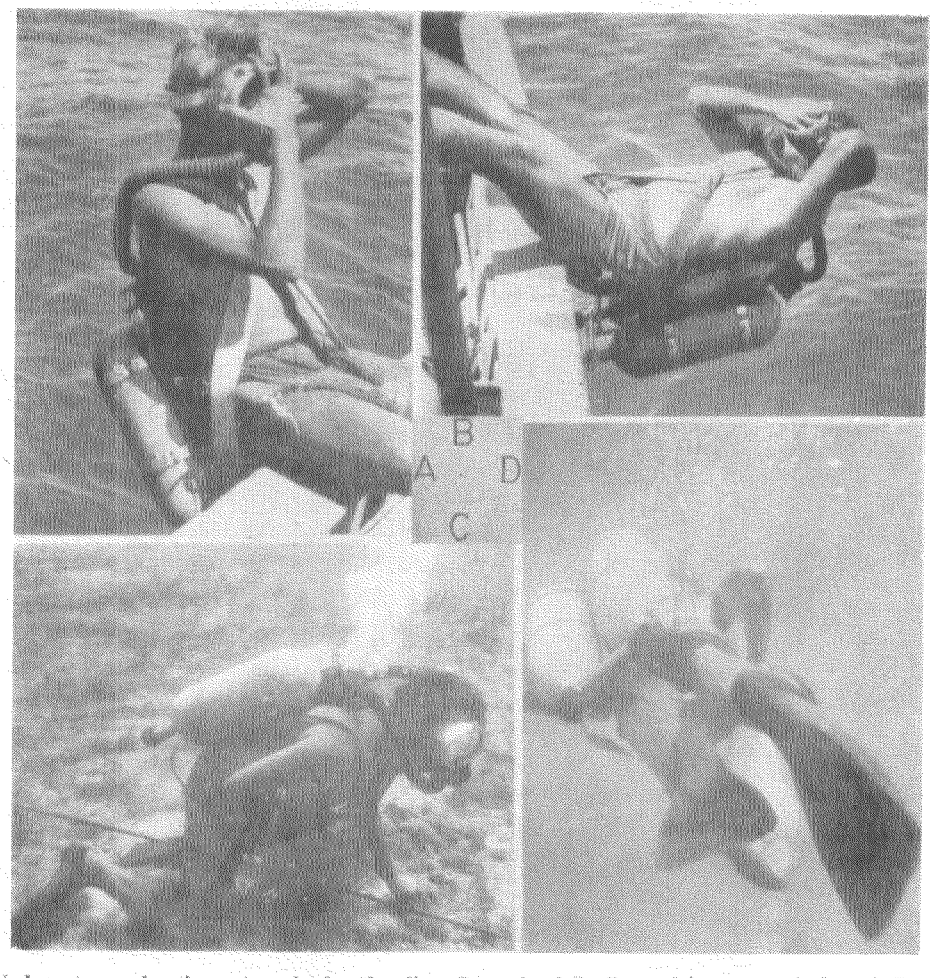


Rope culture of sea weeds. Left: seeding the rope. Right: a crop of sea weed.

Though we have large resources of these commercially important seaweeds, indiscriminate harvesting can easily destroy the seaweed growth and reduce the annual yield considerably. Pollution of water is another factor which has an adverse effect on seaweed resources. For assessing the level at which the resources could be properly exploited, a knowledge of their growth, reproduction and seasonal changes in their chemical constituents is necessary. Biological studies have helped to determine the periods for harvesting the crops of of the algae when their constituents are optimum.

E. UNDERWATER EXPLORATION

Underwater exploration by SCUBA diving is a comparatively new activity for the Indian scientists. There are only a few groups of such scientists in this



Underwater explorations. A-ready for the dive, B-on the fall, C-examining oyster bed, and D-returning to the surface.

F. MARICULTURE

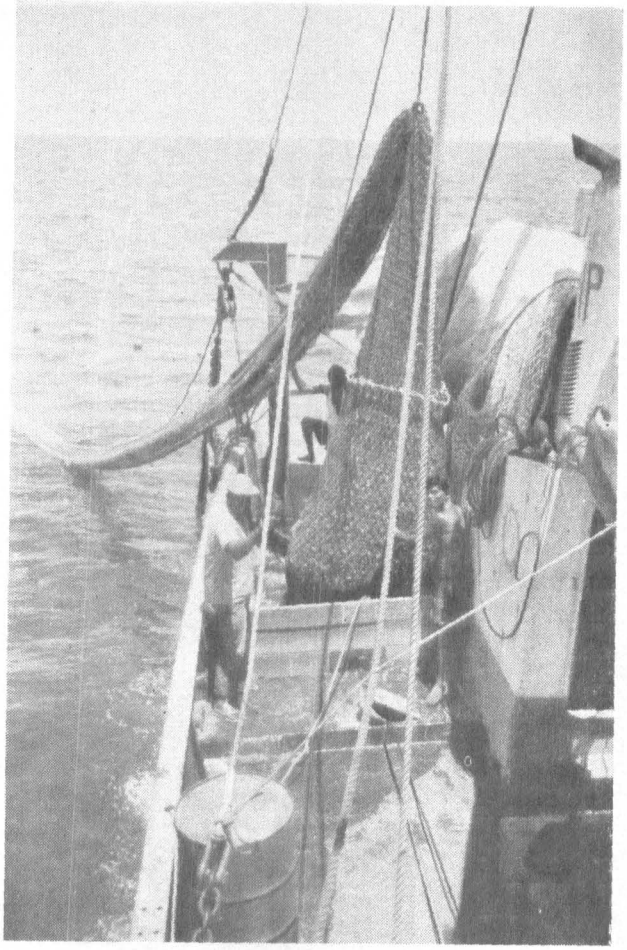
Pioneering experiments in salt-water fish culture were undertaken by the Institute at Mandapam. Vast stretches of low-lying lagoons which are cut off from the sea for a greater part of the year along the south-east coast are re-

Aquaculture—Prawn filtration at Cochin.

maining unutilized. An important finding of the experiments has been that the recurring expenditure on maintenance and management of coastal farm is low, compared with the return from saltwater culture. As a continuation of this work experimental work on the culture of fish and prawn in salt-water pans has started.

Prawn culture practises of a seasonal type have been in existence in some parts of India since ancient time. In Kerala, after the paddy harvest, prawn culture known as "Pokkali culture" is being practised in the paddy-fields from November to April. Nearly 4400 hectares of paddy-fields are being utilised for this purpose. In this type of culture the prawn larvae migrating from the sea into the backwaters are allowed to enter the paddy-fields where they grow very quickly. The annual yield of prawns from such fields is estimated to be about 500-2000 kg/hectare. Full time culture of prawn using artificial feeds in

shelf where rich resources of deep sea prawns, lobsters and crabs have been discovered. The exploratory surveys using acoustic devices have helped in assessing the perch fishing grounds along the south-west coast. These surveys have also shown that purse-seining for the tunas could be carried out successfully in the shelf waters. All these information have been of the greatest value to the country and several commercial organisations have started exploiting the fishery resources. This impact on the industry is reflected in the increasing value of export of sea food from India, which was of the order of Rs. 40 crores in 1971. The major share of it was contributed by prawns. More and more new ventures in the public as well as private sectors are entering into the fishery trade.



Exploratory trawl catch from deep-sea.

Important features of the biology of almost all the commercially important fishes such as oil sardine, lesser sardine, white sardine, mackerel, Bombay duck, Malabar sole, ribbon fishes, Ghol, Koth, sand whiting, Dara, prawns, lobsters, clams and oysters etc. have been worked out by the Institute. Studies on some of the characteristics of exploited fish populations have also been carried out, and estimates are available on the total mortality of oil sardine, mackerel, Ghol and the prawn *Metapenaeus dobsoni*.

The data on prawns of the Kerala coast and on the Bombay duck of the

the Indian Ocean as a whole it can reach 12 million tonnes. The present level of annual fish production from the Indian Ocean is 2.5 million tonnes.

Classical work on hydrography including nutrients and phytoplankton of the Indian seas has been produced by the Institute. Similarly fundamental works on the major constituents of zooplankton such as Copepoda, Chaetognatha, Siphonophora, Euphausiacea, Ostracoda, and pelagic Tunicata have been brought out by the Institute. Bioscattering and the Deep Scattering Layers have been investigated along the west coast and the Laccadive Sea.

The work of the Institute on the biology and chemistry of seaweeds and the development of methods of extraction of agar and algin from seaweeds has helped the nation in establishing seaweed industries. Both agar-agar and sodium alginate, which at one time used to be imported, are now being produced within the country giving a saving of several crores of rupees annually in foreign exchange.

PUBLICATIONS OF THE INSTITUTE

The results of various investigations carried out by the Institute have been published in scientific journals of India and abroad. The total numbers of papers so far published year-wise are as follows:—

Year	No. of contributions	Year	No. of contributions
1948	4	1960	38
1949	7	1961	48
1950	5	1962	78
1951	29	1963	30
1952	18	1964	41
1953	19	1965	70
1954	20	1966	32
1955	17	1967	115
1956	21	1968	147
1957	27	1969	95
1958	42	1970	47
1959	40	1971	75

The Institute publishes the *Indian Journal of Fisheries* for the Indian Council of Agricultural Research, jointly with the Central Institute of Fisheries Technology and the Central Inland Fisheries Research Institute. The Institute also publishes special Bulletins on problems of intrinsic value. So far 24 such Bulletins have been published. The Institute is also publishing "Fisheries and Marine Sciences Abstracts" as a quarterly documentation service.

FUTURE LINES OF WORK

Fishery Resources

Studies on stock assessment of oil sardine, mackerel, Bombay duck and prawns will be intensified and similar studies will be taken up on other fishery resources.

Fishery Data Centre

The analysis of relevant data by computor programming will enable us to draw contour maps of various fisheries in relation to environmental features of the sea, which will ultimately be of much value for the future exploitation of fishery resources. The Data Centre will improve its facilities for giving consultancy service to industry, Fishery Institutes and other Government and semi-Government bodies.

Estimation of Resources Characteristics

Demand of fish is rapidly increasing for both domestic and foreign trade. Moreover, because of the problems associated with pollution in highly industrialised countries the demand of fishes from the Indian Ocean is likely to increase day by day in the international market. The harvest of fishes, crustaceans and molluscs is therefore going to be intensified considerably in future years. Detailed information of all types of marine resources is therefore required if India is going to be among the first few seafood producing countries. The vast coast-line that the country possesses and the increasing pace of exploitation can make this a possibility within the next few years. Increased exploitation, however, will bring in new problems which will have to be tackled by a team of well trained fishery scientists. The Institute, therefore, in future years, hopes to lay considerable emphasis on the effect of fishing on the already exploited stocks and will enlarge its scope of finding more and more resources and shall generate new ideas on the other characteristics of these resources.

The exploration for demersal resources is to be extended to regions deeper than 50 metres and for pelagic resources beyond 15 km from the coast. The fisheries resources of the east coast, on which only scanty information is available at present, will be more intensively surveyed.

Resources Atlases

The Institute will be bringing out resources atlases, giving area-wise information of the exploited and potential resources in relation to environmental factors.

Development of Mariculture Techniques .

In addition to harvesting the natural resources of the sea, it would be necessary to generate additional seafood resources by culturing suitable marine animals. Mariculture is a relatively new development in the world and culture techniques developed elsewhere may not prove to be successful in this country. Moreover, some of the procedures developed abroad are being patented. Therefore, considerable effort is required for the development of mariculture

techniques well suited to our conditions and to the species to be cultured. Oysters, mussels, and prawns, in addition to fishes, are the animals which are fit for culture.

The pearl oyster fishery, confined mostly to the Gulf of Mannar in the Tuticorin area, has been very irregular. In fact there has been no revival of the pearl oyster fishery during the past 10 years. The Institute shall investigate the reasons for the erratic nature of the pearl oyster fishery and, in addition, conduct experiments on the development of cultured pearls.

Underwater Scientific Exploration

There is an urgent need for the expansion of underwater work. More persons are to be trained in this highly specialised field of work, so that first-hand information on the resources of the seas could be gathered by direct observations.

Physico-chemical Features of the Sea

Detailed region-wise studies will be undertaken on the physico-chemical characteristics of the sea and on growth-promoting substances (metabolites). All these parameters influence the production of plankton and thus indirectly affect the fisheries of a particular area. Charts and atlases showing the distribution pattern of these parameters would be prepared and the season-wise and year-wise changes will be shown in relation to fisheries.

Primary Production and Food Chain Studies

The Institute's earlier work has already given some indication of the magnitude of primary production in the coastal waters. Based on these estimates the fisheries potential, on theroetical grounds, of the seas around will be made from time to time. While the studies on primary production would be greatly intensified in the future, essential data on plankton biomass from different parts of the ocean will be collected for the synoptic presentation of the transfer of energy from one trophic level to the other. Estimates will also be made of the secondary and tertiary production rates which form the essential components of the energy pyramid.

Seaweed Resources

Biological and biochemical studies on seaweeds would be intensified and the possibilities of a greater commercial utilization of the seaweeds will be explored. A detailed survey will be made of the seaweed resources along the coasts of India and in Laccadive and Andaman-Nicobar groups of islands.

Attempts would also be made to augment the seaweed production by cultivating the economically important species in suitable seabeds and on ropes. The shallow protected lagoons in the Gulf of Mannar, the Chilka Lake, the Pulicat Lake, and the lagoons of the atolls in the Laccadives would be explored for the seaweed cultivation.

Fish Eggs and Larvae

The work on fish eggs and larvae will be expanded both on the east and west coasts of India and in the Union territories of Laccadives and Andamans. Synoptic charts of the seasonal abundance of fish eggs and larvae of different groups will be prepared. Emphasis will be given on the use of the eggs and larvae as indicator of year to year fishery.

Marine Environmental Damage

With the increasing pace of urbanisation and industrialisation of the country, pollution of the sea and estuaries by industrial and other wastes has become a hazard to local fisheries in many areas. It is feared that marine environmental damage would assume far greater proportions in future years. The Institute will take up detailed investigations on the nature of pollution and its influence on marine resources.

Benthos of the Fishing Grounds

The extended programme of exploration of the sea would make it essential to have information on the benthos of the fishing grounds. Importance will be given to such species of benthos which are of relevance to the commercial fisheries.

Coral Reefs

Coral reefs and atolls form valuable resources of calcium carbonate and these have been exploited indiscriminately in certain parts of the country. Moreover, they also play an important role in the understanding of an ecosystem so typical of the tropics. The coral reef areas and their adjacent waters support important fisheries. Special studies will be initiated in the coming years to understand the ecology of the reefs and the importance of corals as a resource. These investigations will be carried out in the Gulf of Mannar, Andaman-Nicobar waters and the Laccadive Sea.

APPENDIX

Previous Directors of CMFRI

Dr. H. S. Rao 1947—1951

Dr. N. K. Panikkar 1951—1957

Dr. S. Jones 1957—1969

Name List of CMFRI Staff

Director

Dr. S. Z. Qasim

Deputy Director

Dr. R. Velappan Nair

Senior Fishery Scientists

Shri S. K. Banerji
Dr. E. G. Silas
Dr. K. V. Sekharan

Fishery Scientists

Dr. G. Seshappa
Shri K. H. Mohamed
Dr. A. V. S. Suryanarayana Murty
Shri T. Tholasilingam
Shri V. Sadasivan

Junior Fishery Scientists

Dr. S. V. Bapat
Shri G. Venkataraman
Shri G. S. Sharma
Shri K. Nagappan Nayar
Dr. B. T. Antony Raja
Dr. B. Krishnamoorthi
Dr. M. Vasudev Pai
Dr. K. Alagarswami
Dr. V. Balakrishnan
Shri V. Balan
Shri P. V. Ramachandran Nair
Dr. S. Ramamurthy
Dr. M. D. K. Kuthalingam
Dr. P. Vijayaraghavan
Shri S. Mahadevan

Assistant Fishery Scientists

Shri C. Mukundan
Shri K. N. Krishna Kartha
Dr. K. Radhakrishna
Shri S. J. Rajan
Shri A. S. Kaikini
Shri C. P. Ramamirtham
Shri D. M. Punwani
Shri D. Sadananda Rao
Shri P. T. Meenakshisundaram
Shri K. Rangarajan
Dr. M. Umamaheswara Rao
Shri V. S. Krishnamurty Chennubhotla

Assistant Fishery Scientists (Contd.)

Shri Syed Basheeruddin
Shri M. H. Dhulkhed
Shri C. R. Shanmughavelu
Shri K. Venkatasubha Rao
Shri M. G. Dayanandan
Shri N. S. Radhakrishnan
Shri G. Luther
Shri P. Bensam
Shri P. Sam Bennet
Shri V. M. Deshmukh
Dr. K. Satyanarayana Rao
Shri M. S. Rajagopalan
Shri V. Ramamohana Rao
Shri A. Noble
Shri K. A. Narasimham
Shri S. K. Dharmaraja
Dr. (Miss) M. Dharmamba
Shri P. Mojumder
Shri J. C. Gnanamuttu
Shri V. N. Bande
Shri T. Appa Rao
Shri G. G. Annigeri
Shri S. Reuben
Shri M. M. Thomas
Shri R. S. Lal Mohan
Dr. C. S. Gopinadha Pillai
Shri K. Dorairaj
Dr. (Miss) Sumitra Vijayaraghavan

Curator

Shri M. Kumaran

Senior Research Assistants

Shri S. S. Dan
Shri J. P. Karbhari
Shri N. Neelakanta Pillai
Shri G. P. Kumaraswamy Achari
Shri M. Aravindakshan
Shri K. G. Girijavallabhan
Shri K. Y. Telang
Shri P. Dandapani
Shri Kuber Vidyasagar
Shri G. Sudhakara Rao
Shri R. Marichamy
Shri D. Sivalingam
Shri V. Kunjukrishna Pillai
Shri C. K. Gopinathan

Senior Research Assistants (Contd.)

Shri A. K. Kesavan Nair
Shri C. P. Gopinathan
Shri P. Parameswaran Pillai
Shri M. Devaraj
Shri K. J. Mathew
Shri M. K. George
Shri K. M. S. Ameer Hamsa
Shri R. Sarvesan

Research Assistants

Shri P. Devadoss
Shri P. Karunakaran Nair
Shri P. E. Sampson Manickam
Shri M. Srinivasan
Shri K. V. George
Shri V. Sriramachandra Murty
Shri K. S. Sundaram
Shri P. Karuppaswamy
Shri K. Devarajan
Shri G. S. Daniel Selvaraj
Shri M. M. Meiyappan
Shri S. Muthusamy
Shri K. K. Appukuttan
Shri K. V. Somasekharan Nair
Shri Alexander Kurian
Shri T. M. Yohannan
Shri A. Charles Christian Victor
Shri A. Regunathan
Shri G. Balakrishnan
Shri P. Livingston
Shri Varughese Philipose
Shri K. K. Sukumaran
Shri D. C. V. Easterson
Shri T. Prabhakaran Nair
Shri R. Thiagarajan
Shri S. Shanmugam
Shri P. Natarajan
Shri P. Nammalwar
Shri U. K. Satyavan
Shri K. Prabhakaran Nair
Shri P. V. Sreenivasan
Shri S. Lazarus
Shri K. Rajasekharan Nair
Shri A. A. Jayaprakash
Shri Mohamed Jafar Khan
Shri M. Kathirvel
Shri G. M. Kulkarni
Shri K. Rengarajan
Shri S. Krishna Pillai
Shri K. Narayana Kurup
Shri W. Venugopalan
Shri G. Nandakumar
Shri K. Ramadoss
Shri V. S. Rengaswamy
Shri M. Rajagopalan
Shri K. J. Joseph
Shri S. Srinivasarangan
Shri R. Soundararajan
Shri Y. Appanna Sastry
Miss Gopi Kumari Vinci
Shri C. Muthiah
Miss T. S. Naomi
Shri P. G. Jacob
Shri N. Gopinatha Menon
Mrs. B. Prasanna Kumari
Shri P. S. Kuriakose
Shri M. E. Rajapandian
Shri K. Balan
Mrs. V. Chandrika
Shri I. David Raj
Shri C. V. Mathew
Shri N. Kaliaperumal
Shri Pon. Siraimeetan
Shri P. N. Radhakrishnan Nair

Computors

Shri Varughese Jacob
Shri G. Krishnankutty Nair
Shri P. Sivaraman
Shri S. Ponpandi
Miss K. Vijayalakshmi
Shri V. Rajendran
Miss V. P. Annam
Miss Krishna Kumari Amma
Shri B. K. Gurumoorthy
Miss N. Vasantha

Junior Scientific Assistants

Shri K. Ramachandran Nair
Shri S. Kandaswamy
Shri A. C. Sekar
Shri P. S. Sadasiva Sarma
Shri C. T. Rajan
Shri P. Karunakaran Nair
Shri P. K. Mahadevan Pillai
Shri K. N. Rasachandra Kartha
Shri R. Reghu
Shri K. Ramakrishnan Nair
Shri R. Bhaskaran Achari
Shri N. Retnaswamy
Shri A. Agastheesa Pillai Mudaliar
Shri K. C. Yohanan
Shri T. Girijavallabhan
Shri R. Gurusamy
Shri Babu Philip
Shri A. A. Thankappan

Shri K. Nandakumaran
Shri S. Siddalingaiah
Shri N. P. Kunhikrishnan
Shri S. Manivasagam
Shri P. Ananda Rao
Shri A. Chellam
Shri Kunhi Koya
Shri M. V. Somaraju
Shri M. Ayyappan Pillai
Shri M. Badrudeen
Shri V. K. Balachandran
Shri M. Mohamed Sultan
Shri T. G. Vijaya Warrier
Shri Jacob Jerald Joel
Shri R. Packirisamy
Shri A. Hanumantha Rao
Shri A. Bastian Fernando
Shri V. Suresh
Shri P. K. Kunjuraman
Shri C. V. Seshagiri Rao
Shri V. Gandhi
Shri S. G. Vincent
Shri K. K. Balasubramanian
Shri D. Narayanaswamy
Shri P. M. Aboobacker
Shri K. V. S. Seshagiri Rao
Shri S. Kalimuthu
Shri A. Raju
Shri K. Soman
Shri D. Kandasami
Shri K. N. Gopalakrishnan
Shri E. K. Raveendran
Shri S. B. Chandrangathan
Shri R. Vasantha Kumar
Shri G. C. Lakshmaiah
Shri I. P. Ebenezer
Shri C. K. Krishnan
Shri Jethalal L. Oza
Miss K. Koumudi Menon
Shri M. Shriram
Shri M. Vijayakumaran
Shri K. S. Krishnan
Shri K. Asoka Kumaran Unnithan
Shri P. Ramadoss
Miss S. Lakshmi
Shri S. K. Balakumar
Mrs. C. Nalini
Shri P. Ramalingam
Shri S. Dharmaraj
Shri K. Thulasidas
Shri A. Ganapathy

Laboratory-cum-Field Assistants

Shri B. Narayana Rao
Shri C. Kasinathan
Shri Joseph Xavier Rodrigo
Shri K. Ramasomayajulu
Shri K. P. Viswanathan
Shri C. Thankappan Pillai
Shri Joseph Andrews
Shri K. Chittibabu
Shri S. Russel Conrad Samuel
Shri N. Jayabalan
Shri P. Radhakrishnan
Shri V. Selvaraj
Shri K. Dhanaraju
Shri V. A. Narayanan Kutty
Shri C. Balasundaram
Shri K. Muniandi
Shri L. Jeyasankaran
Shri N. Sundaram
Shri N. Sadanandan
Shri S. Vijayabaskar
Shri V. Sivaswamy
Shri N. Palaniswamy
Shri V. B. Babar
Shri K. Muthiah
Shri M. Karuppaiah
Shri K. Ramadoss Gandhi
Shri L. Chidambaram
Shri M. Manickaraja
Shri T. Chandrasekhara Rao
Shri N. Chandrasekharan
Shri K. Chandran
Shri K. Balachandran
Miss C. M. Allikunju
Miss A. Kanagam
Shri A. Deivendra Gandhi
Shri O. M. M. J. Habeeb Mohamed
Shri D. Sundararajan
Shri D. Vincent
Shri J. R. Ramalingam
Shri A. Srinivasan
Shri M. Selvaraj
Shri R. Thangavelu
Shri. S. K. Karunakaran

Artists

Shri K. L. K. Kesavan
Shri A. Muniyandhi

Draughtsman-cum-Photographer

Shri P. Raghavan

Senior Library-cum-Documentation Assistant

Shri P. G. Krishnanmoorthy

Senior Library Assistant
Shri K. Kanakasabapathy

Junior Library Assistant
Shri E. Johnson

Museum Attendant
Shri M. Alimanikfan

Senior Administrative Officer
Shri S. Rajagopalan

Administrative Officer
Shri S. Swaminathan

Accounts Officer
Shri S. Subramanian

Superintendents
Shri P. Ramamurthi
Shri S. Pl. Sethu

Stores Officer
Shri S. Subramanian

Junior Accountant
Shri R. S. Guruvel

Senior Store-Keepers
Shri A. Sethubaskaran
Shri A. K. Balakrishna Pillai

Head clerks
Shri M. P. Lakshmanan
Shri M. Subbiah

Senior Stenographer
Shri L. Krishnaswamy

Junior Stenographers
Shri K. M. Surendran
Miss R. Sugantha
Mrs. K. M. Fathima Beevi
Shri T. S. Raveendranathan

Cashier
Shri S. R. Narayanan

Senior Clerks
Shri D. M. Victor Gnanaraj
Shri R. Narayanan
Shri G. V. Pednekar
Shri M. Selvadhas
Shri R. Kuppuswami
Shri S. Subramanian
Shri P. Aithappa Naik
Shri K. Gopalakrishnan Nair
Shri N. Rajamuniswamy
Shri V. M. Mariappan
Shri R. Dorairaj
Shri M. Ramakrishnan
Shri V. Chemutty
Shri A. Narayanaswamy
Shri K. M. Karuppiah
Shri S. Mangalam
Shri M. J. John
Shri K. L. K. Padmanabhan
Shri A. Kajendran
Shri Joseph Melchior Vaz
Shri K. Nagarajan
Shri P. K. Sakkarai

Senior Store Keeper Clerks
Shri P. Ganesan
Shri C. Balamamundinathan
Shri A. Narayana Gokhale
Shri G. K. Kudalkar
Shri D. Gnanajebamani
Shri V. G. Baby

Senior Caretaker
Shri P. Muthu

Caretaker
Shri R. Subramanian

Junior Clerks
Shri S. Nagarajan
Shri N. Sivaramakrishnan
Shri T. Babu Zachariah
Shri K. Maragathavadivelu
Shri B. Devadasputhran
Shri R. Appa Rao
Shri S. Jeyachandran
Shri M. Velu
Shri S. B. Tambe
Shri S. Abdulla
Shri J. Uthamanambi
Shri V. S. Subramanian
Shri K. Kalanjiam
Shri V. Chandran
Shri V. M. Dharmarajan
Shri I. Parameswaran
Shri B. Koragu Naik
Shri S. Pitchai
Shri C. Johnson
Shri G. Lakshminarasimhan
Shri S. K. Murali
Shri S. Balasubramanian
Shri K. Arumugam
Miss T. Madhavi
Shri David Joseph
Miss C. Kamalakshi

Shri V. V. Lakshminarayanan
Mrs. M. O. Leela
Shri K. Mohamed Abdulla
Miss P. Subhadra
Miss T. K. Ponnamma
Shri C. Yohannan
Miss S. Bhanumathi
Miss Prabhavati Laxmanbhat
Miss K. Lalitha
Shri B. Vijayakumar

Store keepers

Shri P. Selvaraj
Shri M. Sivasankaran

Junior store keeper clerks

Shri B. Bavanandam
Shri K. P. Chandrasenan

Driver-cum-serang

Shri P. A. Abdul Rahman
Shri P. Pathrose

Motor Drivers

Shri M. Alagarswamy
Shri K. Karuppiah
Shri P. C. Appukuttan
Shri A. Kondan Chettiar
Shri K. P. Velu
Shri P. K. Raghavan
Shri Janardhan Singh
Shri J. Williams
Shri K. G. Krishnakutty Nair

Painter-cum-Polisher

Shri R. Marimuthu

Serang

Shri M. Mustaffa
Shri Shankar Gopal Kulgutkar
Shri C. K. Dandapani

Carpenter

Shri C. Ebinezer

Laboratory Attendants

Shri P. Thomas
Shri G. Karunakaran
Shri K. Sankaran
Shri P. K. Haridas
Shri K. O. Dhamodaran
Shri K. G. Damodaran
Shri G. Devarajulu
Shri C. G. Kurian
Shri K. Raman
Shri K. Ramakurup
Shri K. Parameswaran Nair
Shri A. Muniandi
Shri S. J. Thiagarajan
Shri B. Satyanarayana
Shri V. M. Kanaran
Shri K. T. Malsekar
Shri P. Abdurahiman
Shri R. Vijayaraghavalu
Shri V. Ramachandran
Shri Bhima T. Talpade
Shri C. K. Keshavdas
Shri E. Jesudassan
Shri G. Durairaj
Shri K. Kathiresan
Shri P. Sukumaran
Shri A. Santhanam
Shri S. Mahabul Hussain
Shri V. K. Ramachandran
Shri M. Vythilingam
Shri M. Krishnan
Shri S. Abdul Rahman
Shri A. Sreedhara Menon
Shri N. Nagalingam
Shri A. Ramasamy
Shri A. Alagarswamy
Shri P. Gopalan Nayar
Shri V. Ratilal Kanji
Shri K. V. Sankaran
Shri P. Krishnan Nair
Shri P. Kuttappan Pillai
Shri P. Thillairajan
Shri S. M. Yusuf
Shri K. Muthuramalingam
Shri S. Jaganathan
Shri P. A. Vasudevan
Shri P. Etty Murugesan
Shri T. B. Harikantra
Shri V. Subbiah
Shri P. Krishnan
Shri R. G. Nadig
Shri C. Mohamed Koya
Shri A. Francis
Shri S. M. Seeni
Shri G. Natarajan
Shri K. Vellayan
Shri M. Enose
Shri K. Muniandi
Shri A. P. Balakrishnan
Shri A. Pitchai
Shri C. K. Sudhakaran
Shri N. Chinnathambi
Shri J. Ansalam
Shri R. Vellayan
Shri V. Kalimuthu

Fieldmen

Shri K. P. Raghavan
Shri T. Madhavan
Shri K. K. Narayanan
Shri P. Viswanathan
Shri Mohamed Moideen
Shri S. B. Harkantar
Shri Narayan Marba Nayak
Shri A. Ammoru
Shri M. S. Syed Ahmed
Shri D. Kojan Koya
Shri C. John
Shri E. Karuppan
Shri E. Vellayan
Shri P. A. Vasu
Shri P. Nagan
Shri A. C. Ghosh
Shri M. Mohamed Kasim
Shri M. K. Peethambaran

Khansama

Shri S. Kaliappan

Jamadar

Shri K. Gopalakrishnan

Binder

Shri U. S. Ramakrishnan

Khalasi

Shri T. A. John
Shri V. A. Surendran

Daftry

Shri M. Ramadoss
Shri P. Krishnan

Cook

Shri M. Rengan

Peons

Shri M. Chinnasamy
Shri G. Soundararajulu
Shri V. Mohana Rao
Shri Muthuramalingam
Shri A. Muniasamy
Shri K. P. Joseph
Shri N. Ravindranathan Nair
Shri M. Ramadassan
Shri N. Raveendran Andi
Shri M. L. Antony
Shri K. K. Abdul Rahim
Shri S. Chelliah
Shri K. Kunju Kunju
Shri K. Narasimhamurty
Shri K. Rama Naik
Shri A. Subramanian
Shri K. S. Vaidyalingam
Shri J. Balasubramanian
Shri A. Appa Rao
Shri A. Ayyappa Das
Shri Ramachandra Bhikaji Bhangare
Shri A. P. Sebastian
Shri V. C. Antony

Watchmen

Shri Pullen Munian
Shri P. Alagarswamy
Shri O. Muthukaruppan
Shri Ganapati Mari Korar
Shri A. Raman
Shri S. Periasamy
Shri K. Raju
Shri M. Ibrahimsa
Shri R. Perumal
Shri S. Mani
Shri Waman Shetty
Shri S. Pitchai
Shri C. H. Kunhiraman
Shri V. Ponnuswamy
Shri K. Kharma Rao
Shri R. S. Ugale
Shri T. K. Thankappan
Shri G. Pankajakshan Nair
Shri P. Mahalingam

Lascar

Shri O. M. Jainulabdeen
Shri H. Vasu
Shri Ganapati Vithu Naik
Shri M. Ibrahim
Shri S. Mohideen Meerasa
Shri D. Motcham

Oilman

Shri P. M. Michael
Shri V. Vedanayagam
Shri Selvaraj Gomez
Shri H. Rajaram
Shri M. Mohideen Abdul Kader
Shri V. K. Krishnan Kutty
Shri V. Maria Alwaris

Sweepers

Shri R. Nagan
Shri N. Vellaichamy
Shri M. Lakshmanan
Shri M. Vellayan
Shri R. Ayyakannu
Shri K. Gurusamy
Shri K. Kumaran

Shri Rohidas Kuppa Shiralikar
Shri K. Kuruvan
Shri V. Santhanam
Shri K. Muthiah
Shri R. Sevugan
Shri M. Muthu
Shri K. Chandran
Shri A. Mari
Shri R. Alagan
Shri M. Ramu
Shri P. Karuppiah
Shri Vali Mohamed

Sweeper-cum-Mali

Shri M. Raman
Shri K. Muniasamy
Shri S. Mani

Sweeper-cum-Sewerlineman

Shri M. Vellayan
Shri G. Saivadurai

Sweeper-cum-Gardener

Shri R. Sonai

CO-ORDINATED RESEARCH PROJECT FOR STUDIES ON MARINE PRAWN BIOLOGY AND RESOURCES.

Junior Fishery Scientists

Shri M. Mydeen Kunju
Dr. (Mrs.) P. V. Kagwade
Shri M. S. Muthu
Shri P. Vedavyasa Rao

Senior Research Assistants

Shri N. Surendranatha Kurup
Dr. P. A. Thomas
Shri D. B. James
Shri C. Suseelan
Shri K. N. Rajan
Shri V. Thangaraj Subramanian

Computor

Shri A. Kanakkan

Senior Clerk

Shri M. Ganapathy

Fieldmen

Shri A. Kathavarayan
Shri R. Thankappan

Messenger

Shri M. K. Abdulla

MEMBERS OF STAFF OF CMFRI AT PRESENT SERVING ELSEWHERE

Dr. R. Raghu Prasad	Assistant Director General (Fisheries) at ICAR Hqrs.
Dr. M. S. Prabhu	Professor of Fisheries in Calicut University.
Shri P. R. S. Tampi	Scientist (FS) at ICAR Hqrs.
Shri M. J. George	Scientist in National Institute of Oceanography, Cochin.
Shri D. Chakraborty	Scientist in UNDP Pelagic Fishery Project, Cochin.
Shri K. Venkatanarayana Rao	Scientist in UNDP Pelagic Fishery Project, Cochin.
Dr. N. Radhakrishnan	Scientist in UNDP Pelagic Fishery Project, Cochin.
Dr. P. S. B. R. James	Professor of Fisheries in the University of Agricultural Science, Bangalore.
Shri K. C. George	Scientist in UNDP Pelagic Fishery Project, Cochin.
Shri G. Subba Raju	Scientist in UNDP Pelagic Fishery Project, Cochin.
Shri S. T. Nagarathinam	Statistical Officer in the Indian Statistical Institute.
Dr. P. K. Talwar	Zoologist in the Zoolgoical Survey of India, Calcutta.
Shri R. M. Dhawan	Scientist in the National Institute of Oceanography, Goa.
Dr. T. A. Mammen	Assistant Commissioner (Fisheries) in the Ministry of Agriculture.
Shri K. Raman	Fishery Scientist in the Central Inland Fisheries Research Institute, Madras.
Shri D. Sudarsan	Assistant Director in the Deep Sea Fishing Station, Waltair.

Shri T. S. Krishnan	Superintendent in the National Sample Survey Organization, Cuttack.
Shri G. V. Kowtal	On other duty in the Central Inland Fisheries Research Institute, Calcutta.
Shri R. Sathiarjan	Chief Instructor in Central Institute of Fisheries Operatives, Cochin.
Shri P. Srinivasa Rao	Senior Research Assistant in Central Institute of Fisheries Technology, Cochin.
Shri C. P. Aravindakshan Nair	Technical Assistant in Central Institute of Fisheries Operatives, Cochin.
Shri Rajeswar Dayal	Administrative Officer in Geological Survey of India, Calcutta.
Shri K. M. Mathai	Administrative Officer in Central Plantation Crops Research Institute, Vittal.
Shri V. Somanathan	Administrative Officer in Central Plantation Crops Research Institute, Kayamkulam.
Shri K. Algarswamy	On other duty in Structural Engineering, Madras.
Shri Veraswamy	On other duty in Central Institute of Fisheries Operatives, Madras.

Addresses of CMFRI Headquarters, Regional Centre, Substations & Units

Central Marine Fisheries Research Institute,
Post Bag 1132,
Cochin. (Kerala).
Tel: 33214

Regional Centre of CMFRI,
Marine Fisheries P. O.,
Mandapam Camp. (Tamil Nadu).
Tel: 3 & 16

CMFRI Substation,
West Hill,
Calicut-5. (Kerala).
Tel: 3622

CMFRI Substation,
22-330-B Karkara Compound,
Mangalore-1. (Mysore State).
Tel: 4152

CMFRI Substation,
Post Box No. 5,
Karwar. (Mysore State).
Tel: 71

CMFRI Substation,
Botawalla Chambers, 2nd Floor,
Sir P. M. Road,
Bombay-1. (Maharashtra).
Tel: 263504

CMFRI Substation,
Vizhinjam Post,
Trivandrum. (Kerala).
Tel: 24

CMFRI Substation,
93, North Beach Road,
Tuticorin-1. (Tamil Nadu).
Tel: 274

CMFRI Substation,
Red Bungalow,
9 Commander-in-Chief Road,
Madras-8. (Tamil Nadu)
Tel: 812053

CMFRI Substation,
C/o Department of Zoology,
Andhra University,
Waltair. (Andhra Pradesh).
Tel: 2193

CMFRI Unit,
Block No. 39-40,
Commercial Buildings,
Veravel. (Gujarat).
Tel: 65

CMFRI Unit,
C/o Central Institute of Fishery Technology Substation,
Jagannaikapur Post,
Kakinada-2. (Andhra Pradesh).

CMFRI Unit,
Port Blair,
Andamans.
Tel: 446

CMFRI Unit,
Minicoy,
C/o Postmaster, Calicut. (Kerala).

Telegraphic address for these CMFRI establishments: CADALMIN.