Reprinted from 'Progress of Fisheries Development in India' (1956)

MARINE FISHERIES RESEARCH IN INDIA

By

N. Kesava Panikkar, M.A., D.Sc., F.A.Sc., F.N.I.

MARINE FISHERIES RESEARCH IN INDIA

by

N. Kesava Panikkar, M.A., D.Sc., F.A.Sc., F.N.I.

Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

Sea fisheries of India have been exploited for centuries. They came within administrative control of the Government during the beginning of this century. Early efforts to investigate them were made by the Departments of Fisheries established in Madras and in Bengal about fifty years ago. A real impetus to fisheries and marine research was provided by the publication of the Reports on the Pearl Oyster Fishery of Ceylon (1903-'06), the starting of the Marine Experimental Station at Ennore (1908), the opening of the Madras Aquarium (1909) and the Field Collecting Station at Krusadai (1928) by the Madras Government. The Biological Station at West Hill, Calicut, which was opened by the Madras State, did pioneer work on the biology of sardines. Investigations, although of a less specialized type, were also carried out under the auspices of the Departments of Fisheries of Bombay and Bengal. The opening of Biological Departments in Indian Universities gave further encouragement to studies on fisheries and investigators at the Universities of Madras, Travancore and Bombay pursued problems on aspects of Marine Biology and Fisheries.

The first step in establishing research on the sea fisheries of India on an organized scale was taken in 1947 when the Union Ministry of Agriculture established the Central Marine Fisheries Research Station. The work of studying the resources of sea fisheries of India was slowly developed at this Institute from different scientific angles. Fisheries being a subject which requires study at centres where different types of fishes are landed in large quantities, work cannot be done at one place alone. The Institute at Mandapam has, therefore, sub-stations and research units to deal with specific problems. The sub-station at Calicut, which is a centre of a great fishing industry, principally, of the sardines and the mackerel, deals with the complex biological problems pertaining to the fisheries of that area. A research unit at Karwar makes special study of the Indian mackerel; a research unit at Cochin is studying the practice of prawn fisheries and prawn farming in the coastal waters of the Cochin area. A research unit at Bombay is responsible for the scientific studies of the catches obtained by the deep sea fishing vessels operating from Bombay. A research unit at

Madras is pursuing the problems of oyster and clam fisheries. It is proposed to open two new units : one to deal with the sea fisheries of the Andhra coast at Waltair and the other with the deep sea fisheries now being opened up for exploitation from Calcutta. The organization of marine research by the Central Marine Fisheries Research Station is outlined below.

The primary basis for developing a fisheries research programme would naturally be a closer appreciation of the fishery resources of the country. Reliable data on the amount of sea fish landed in India have not been available. The Institute, at the very outset, took up a programme of fisheries survey by developing appropriate sampling techniques aimed at assessing the amount of fish landed at the various fishing centres of the vast coastline of India. This has enabled the computation of fish landing statistics on an all-India basis, which has been achieved for the first time in this country. For the past five years fairly reliable figures have been obtained on the quantity of fish landed at various centres, the composition of the catches according to different times and according to different species. One important aspect of study of sea fishery resources is to know the trend of the fish catches. Even if there is increase in production it is possible that there is actual decrease in the amount of fish stocks and any scientific investigation of the resources would involve a careful analysis of the yield of fish in terms of unit of effort. Such figures for the major centres and for the principal species are being slowly gathered so that, in course of time, it will be possible for us to know whether the actual fishing effort could profitably be increased or would require some kind of restriction. It is natural that in countries like ours, where fishing is largely limited to the narrow inshore belt, the principal need is substantially to expand our fishing effort, but such expansion should be based on a correct appreciation of the present volume of landings in terms of the effort expended to obtain them. A fairly satisfactory machinery for the collection of statistical and biological data on these lines has now been developed by the Central Marine Fisheries Research Station. In the table below is given the average production of sea fish in India for the past five years and the principal groups which comprise these catches.

PRODUCTION OF FISH IN INDIA

Average of figures for 1950-'54.

(a) Zonewise landings.

Zones	*Average Catch in tons*
1) West Bengal & Orissa	8,519
Andhra coast (south of Gopalpur to north of Visakhapatnam)	22,062
3) Andhra coast (Visakhapatnam to Masulipatnam) ..	28,669

4)	Andhra coast (south of Masulipatnam to north of Pulicut Lake)	..	2,028
5)	Coromandel coast (Pulicut Lake to Cuddalore)	..	18,688
6)	Coromandel coast (south of Cuddalore to Devipatnam)	..	14,057
7)	Palk Bay & Gulf of Mannar (south of Devipatnam to north of Cape Comorin)	..	8,330
8)	Travancore-Cochin and south Malabar (Cape Comorin to Ponnani river)	..	99,178
9)	Malabar and south Kanara (north of Ponnani river to Mangalore)	..	103,061
10)	Konkan cost (north of Mangalore to south of Ratnagiri)	..	57,415
11)	Bombay and Gujarat coast (Ratnagiri to Broach)	..	171,797
12)	Kathiawar coast	..	17,333
	Mechanised vessels	..	2,382
	All-India average	..	553,519

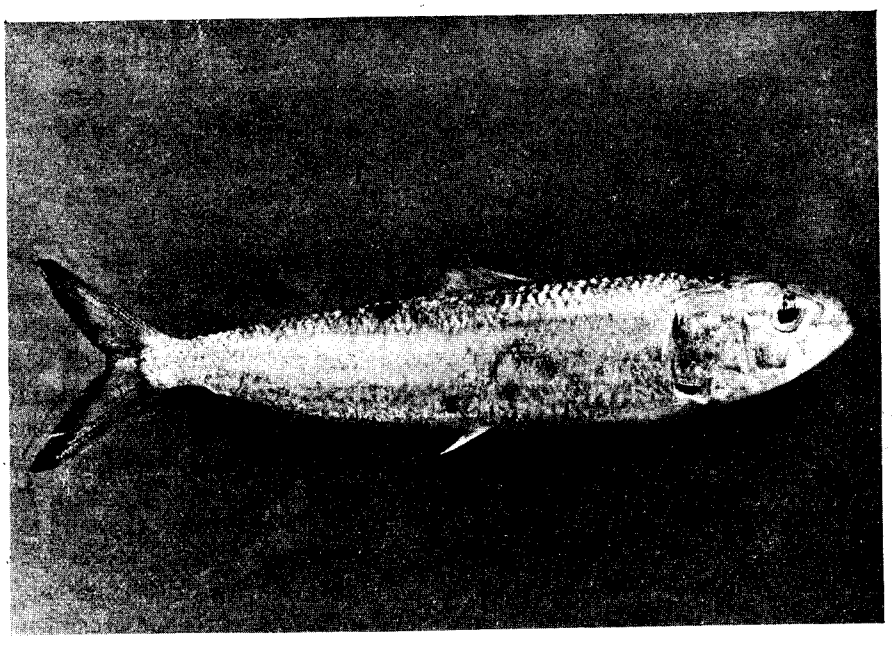
	Name of fish		*Average percentage*
1)	Mackerel	..	13.20
2)	Prawns & Crustaceans	..	16.84
3)	Sardines	..	13.04
4)	Whitebaits & Anchoviella	..	6.64
5	Other Clupeids	..	3.74
6)	Elasmobranchs	..	4.16
7)	Sciaenids	..	7.40
8)	Ribbon fish	..	5.57
9)	Bombay duck & Saurida	..	4.53
10)	Cat fishes	..	3.30
11)	Silver bellies & Lactarius	..	2.83
12)	Perches	..	1.84
13)	Carangids	..	1.75
14)	Soles	..	1.60
15)	Seer fishes	..	1.10
16)	Pomfrets	..	2.11
17)	Bregmaceros	..	1.15
18)	Chirocentrus	..	0.68
19)	Sphyraena (Barracuda)	..	0.21
20)	Flying fish	..	0.28

21)	Red mullets	..	0.19
22)	Polynemids	..	0.18
23)	Tunnies	..	0.34
24)	Mugils	..	0.01
25)	Miscellaneous	..	7.31

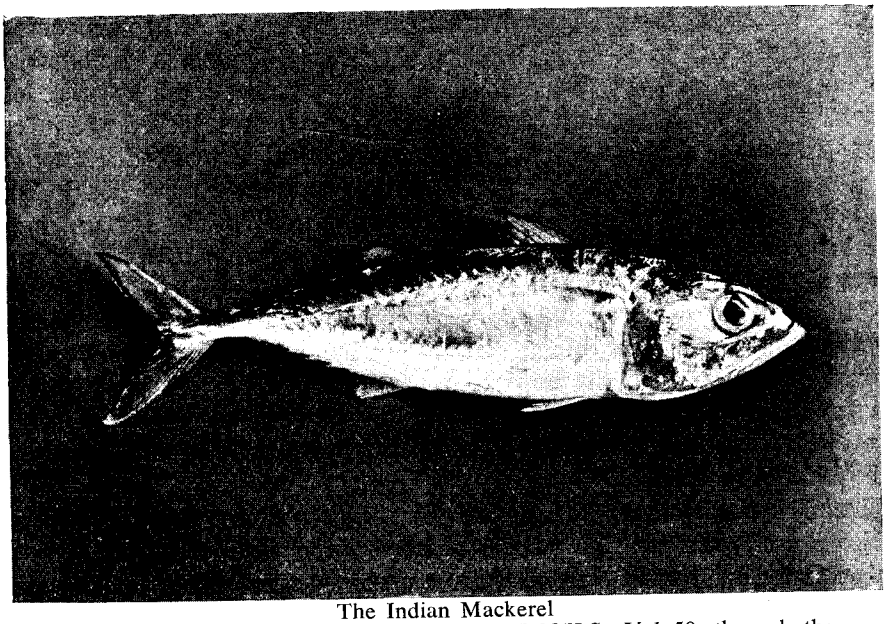
The second major aspect of fisheries research is to study the biology of the principal commercial species. Fisheries are natural resources which are renewable, but the rate of renewal, which is so important for developing management policies, can be understood only from careful long range studies. The abundance of fish comprising a particular fishery depends on a variety of conditions which include the length of life of the fish, the age at which the fish become mature, the duration of spawning, spawning areas, migratory habits and many other aspects including the amount of available food. This, by itself, is an extremely complex study and has to be undertaken with special reference to the major species. The most imporant sea fish of India is the Indian Mackerel which accounts for roughly a lakh of tons of sea fish per annum. Mackerel appear in shoals on the west coast of India, but its occurrence in commercial quantities is restricted to the September-February part of the year. The species contributing to the fishery is *Rastrelliger kanagurta* which has a very wide distribution in the Indo-Pacific. Either the same species or very closely related forms contribute to valuable fisheries in Malaya, Thailand, Viet-Nam, Cambodia, Indonesia and the Philippines. An important problem is raised whether these fisheries in the different countries are based on homogeneous stocks or on localized and independent populations. Another equally important problem is to explore new areas where mackerel occur in commercial quantites. In many countries it is known only from areas near the shores which they approach during certain seasons. If we know more about the habits of the mackerel, we should be able to catch them at all seasons and open up new fishing grounds.

The need for research on the biology of fish so far as it affects abundance is probably more apparent in the case of another sea fish, the Oil Sardine of Malabar. The fishery for the sardines has been highly fluctuating. It was very valuable during the years at the beginning of this century, but this fishery suffered substantial decline in recent years, although there was a spectacular revival during the 1953-'54 season.

Both the mackerel and the sardine are pelagic shoaling fish. They support a fishing industry of very high magnitude employing several thousands of people, but unexpected large scale fluctuations are a serious handicap in the full utilization of the fisheries. Is it possible to predict the magnitude of these fisheries by a closer study of the fish, their habits and the biological conditions under which



The Oil Sardine of Malabar



The Indian Mackerel
(Reproduced from Author's article in the J.B.N.H.S., Vol 50, through the courtesy of the Bombay Natural History Society.)

they grow and reproduce in the sea? This is a difficult problem, but is one which is constantly under review. It is hoped that careful and critical studies would help us understand the indications of successful or unsuccessful fishing seasons which may eventually lead to a system of fishery forecasting.

A sea fishery resource with great possibilities of commercial development in India is that of the prawns. Prawn landings are already of a very large magnitude on the west coast of India even though the present fishing is almost entirely based on the capture of juveniles in inshore waters. There is further the culture and capture of prawns in the inlets, creeks and paddy fields adjoining the shallow coastal belts in Travancore-Cochin. There is much that can be done to improve the methods of prawning in these areas. In some of the areas where conditions are optimal, it is possible to raise about a 1,000 lbs. of prawns per acre per annum in addition to a normal paddy crop from the same fields. Side by side with this line of work is the need to explore the offshore prawn fishing grounds.

These three examples have been cited to show some of the problems of research pertaining to sea fisheries. There are other fisheries composed of a large number of species. Mention could be made of the inshore fisheries for the Malabar Sole, the East Coast Sardine or 'Choodai', the Ribbon Fishes, the Silver Bellies, Shell Fish like Oysters and Clams, the Seer Fishes and Tunnies, the Bombay Duck and the Sharks and Rays. The last mentioned group has considerable importance because of the shark liver oil industry. Indications are that shark fishing possibilities are very considerable in India and may provide the basis for an expanded industry for oil, shark fillets and other by-products from these cartilaginous fishes.

Arising from the study of the habits of coastal fishes may be mentioned the possibility of developing saline coastal tracts into fish farms for cultivating sea fish. Certain species are particularly suitable for this purpose, as for example, *Chanos* or the Milk Fish abundantly occurring as fry in the shallow waters on the south-eastern coasts of India. Already an industry is being slowly developed to collect the small fry and fingerlings of this sea fish, transport them to the interior and stock them in brackish and freshwater ponds. *Chanos* culture is most advanced in Indonesia and the Philippines and there are many field practices which could possibly be adapted by us for application to local conditions. *Chanos* does not spawn in enclosed waters and one has to depend on natural sources of fry and if at any time it would be possible for *Chanos* to be bred in captivity, a very great stride in this industry would have been achieved. The shallow coastal areas where *Chanos* could be grown are also suitable for culturing prawns and clams. Development of suitable methods for the conversion of low-lying saline marshes into fish farms along with suitable management

techniques would make a very substantial contribution to increased fish production in the country. But all these require study and experimentation.

The deep-sea fishing operations which have recently been developed in India have opened up new fields of work, particularly the investigation of trawl fisheries. The vessels operating from Bombay have been landing large quantities of Ghol (*Sciaena* spp.), Dara (*Polydactylus indicus*), Rawas (*Eleutheronema tetradactylum*), Wam (Eels) and Karkara (Perches). From a careful examination of the catches of deep sea fishing vessels, it has been possible to demarcate fruitful grounds for trawling in the seas between Bombay and Kathiawar and these grounds are now being more and more exploited. The yield is good, partly because fishing is carried out on virgin grounds. Close watch will, however, have to be kept as to how the stocks are affected by increasing fishing, that is, whether the yield per haul and the size of fish in the hauls are decreasing. Wherever intensive fishing operations are taking place, it is essential to keep a close watch on the fishing grounds because unless they are conserved in a rational manner, the areas will get depleted. There is no danger of depletion now taking place, but the country should be prepared to apply immediate measures to check depletion the moment it is seen and for that purpose should have the basic data on a continuing basis.

In the above sections, much has been said about fish themselves, but it is increasingly becoming clear that fisheries cannot be separated from the external factors of the environment in which fish grow and spawn. That environment is the sea water whose chemical constituents, particularly the extent of nutrients available, determine the amount of organic plant and animal matter it can produce. It is after all the minute organisms that occur in the sea water which ultimately form the food of fish. The study of marine biological problems in relation to fisheries is therefore an essential one and the investigations in progress include a careful study of seasonal changes taking place in the properties of sea water, the amount of planktonic organisms present in the sea, the season-wise changes in the composition of plankton and the relation of plankton with the grazing organisms. Some general conclusions have been arrived at on the basis of studies carried out at some of the university centres in India like Waltair, Madras, Trivandrum and Bombay, and together with the results now being gathered on a continuing basis at the Central Marine Fisheries Research Stations at Madras, Mandapam, Kozhikode and Karwar, we have now a general idea of the productivity of inshore waters of India. The development in this line of work lies in the possible correlation of marine biological conditions with the fishing conditions and here substantial help could be given by oceanographical studies. Close examination and identification of the water masses are necessary, because it is now established that certain types of fisheries are associated with definite

types of water masses and areas of mixing of waters. It is needless to say that this is largely dependent on oceanic currents and the problem is an extremely complex one because after all conclusions have to be drawn from scattered observations on temperature, salinity, current measurements and similar indicative factors. These studies are only just beginning in India ; but sufficient interest has been aroused and when these investigations enlarge and become more closely tied in with fisheries programmes, the results would be of practical application to fishing.

Sea is a source of many other products which we hardly utilize at present. One such consists of sea weeds. Our weed resources are probably not comparable with the extensive beds found in some of the colder countries, but none the less they are valuable. Recent work at the Central Marine Fisheries Research Station has shown that there are weeds of great value available to us and methods have been recently developed to prepare sea weed products like agar, sea weed manure, etc. on a cottage industry basis without the employment of heavy or expensive machinery.

Although sea fish production in India is considerable, a good fraction of it is not utilized to the best advantage. This is partly because of inadequate means of transportation and the absence of industrial processes for preserving fish. A time honoured method is the curing of fish with salt followed by sun-drying which our people have practised for centuries. This method, if carried out properly, is still one of the best, but much remains to be done to improve the standards of curing by ensuring that good and sufficient salt is used and that drying and storage are done under hygienic conditions. There are many variants in curing practices followed in different parts of the country. These have not been adequately compared, tested and further improved upon and for this purpose critical studies on fish curing practices have recently been started. Pioneering work in this direction has been by the Madras State Fisheries Department. Thanks to the efforts of fishery organizations in many maritime State Governments, the standard of curing has somewhat improved in most parts of India, but even at present the cured product is such as would not stand comparison with the cured fish prepared in many other countries and which could be handled and marketed by any retailer. Owing to the high average temperatures prevalent in our country fish tend to spoil soon after capture. Chemical and bacteriological studies on spoilage will probably help a great deal to devise means whereby such spoilage could be retarded.

In the above account, some of the major lines of research on sea fisheries at present handled at the Central Marine Fisheries Research Station have been indicated. In addition to work that is going on at this Institute, research on certain aspects of sea fisheries are being pursued by the State Fisheries Depart-

ments of Madras, Travancore-Cochin, Bombay and Saurashtra. Among these, biological work at present seems to be confined to Madras, but with the central research organisation developing, the tendency in recent years has been for the State Governments to concentrate more and more on developmental problems relating to fisheries, leaving the major research problems of a long-term nature to be tackled by the Central Stations. The Universities are continuing to play an important part in the training of research personnel and also in investigations on the fundamental aspects of marine sciences. Interesting and useful work on these lines is being pursued at the Universities of Madras, Travancore, Andhra and Bombay.

The work of the Central Marine Fisheries Research Station is expected to be substantially expanded under the Second Five Year Plan in such a way that the Institute will be in a position to handle more effectively the question of sea fisheries statistics on an all-India basis, while investigations on the sardines, mackerel, prawns and trawl fisheries and the marine factors will be further intensified. All these aspects of work will be integrated with a programme of exploratory fishing to be carried out in off-shore waters in both the Arabian Sea and the Bay of Bengal. It is hoped that with the development of these projects, a standing organization to place the sea fishing industry on a scientific basis would have taken shape paving the way for increased sea-fish production, assuring that such production would be maintained at optimal level for all time and that large quantities of fish in good condition would be available to the people at a low cost.