

FISHERIES OF THE WEST COAST OF INDIA

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THE SARDINES

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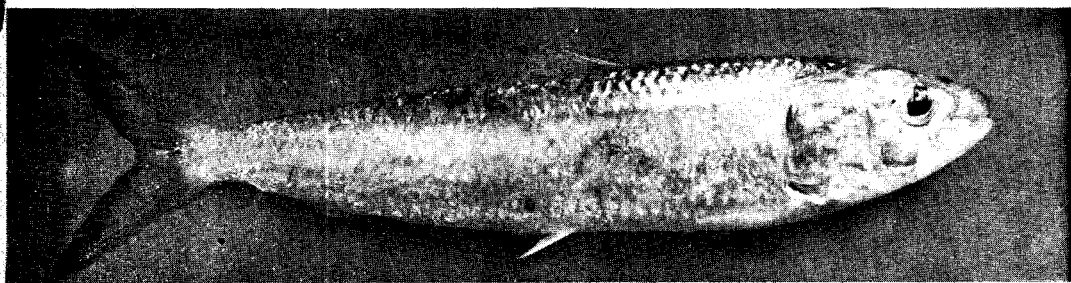
THE clupeoid group, which contributes about a third of the total marine fish production in our country is constituted mainly by such valuable fishes as sardines, anchovies, whitebaits, etc. Of these, the sardines are represented in our waters by 9 species of which some, like *Sardinella longiceps*, *S. fimbriata*, *S. gibbosa* and *S. albella*, occur in large shoals and form important fisheries along both the coasts of India.

Sardinella longiceps, popularly known as the oil-sardine, ranks as one of the best known among our commercially important fishes and is extensively used as food in the fresh and cured conditions. Its bye-products are valuable; oil is extensively used in the jute, leather, soap and other industries and by the fishermen as a specific against weathering and ship-worm attacks in boats; and guano is used as fertiliser for tobacco, coffee, tea and other cash crops.

The existence of this fishery has been known from time immemorial. As early as 1320, Odoric noted when he visited Ceylon, that 'there are fishes in those seas that come swimming towards the said country in such abundance, that for a great distance into the sea nothing can be seen but the backs of fishes which, casting themselves on the shore, do suffer men for the space of three daies to come and take as many of them as they please'. Nieuhoff and Dussumier also noted that the sardines were abundant in these waters and that they were utilised as manure for paddy and coconut plantations since they were found unfit for curing owing to the high oil-content of the fish. Day also emphasised that owing to the ignorance of the abundance and the uses of the oil-sardines, they were mostly captured to manure the land and for feeding the livestock, the quantity actually consumed being very little when compared with the abundance of the catches. He also observed that 'it is only of late years, since animal oil has become so dear, partially due to a deficiency of that of the whale, that attention has been directed to the immense shoals of sardines, which are found off Malabar and Ceylon'. The demand for fish oil from Europe and elsewhere gave an impetus to the sardine-oil industry and the industry and the trade which were nonexistent

before, rapidly developed during the early years. The average annual export value of sardine-oil from Malabar was well over £ 7,000 in the sixties of the 19th century. Day emphasised the adverse effects of this growing sardine-oil trade on the valuable fishery and observed that 'it must be left for future years to demonstrate whether the present increase of fish-oil trade is a healthy or unhealthy stimulus due to the present high prices; for if the latter, the fisheries are being overworked, and the future loss will be great'. He also suggested that a 'thorough examination into the fish captured as to whether the young are, or are not, used for salting or fish-oil, are objects which it would be very important to ascertain'. A decline in the sardine-oil production was noted during the later years which was partly caused by the erratic and undependable nature of the oil-sardine fishery.

Another phase in the exploitation of the oil-sardine fishery may be said to have commenced with the beginning of this century when Nicholson helped the revival of the sardine-oil industry by the introduction of an improved method for the extraction of the oil. The practice till then in vogue was very crude and primitive, the products were of a very inferior quality and the residue was generally thrown into the sea. A low grade fertiliser was also prepared during those days by allowing the fish to rot and dry on the beach. Large quantities of valuable oil, injurious to the crop, were wasted by this method and the product was also found deficient in the valuable nitrogen and phosphate contents. Nicholson estimated that 52,250 metric tons of oil-sardines were annually dried on the beach and 6,250 metric tons of oil worth 10 lakhs of rupees were totally lost during every season. With a view to stop this wasteful procedure, Nicholson, after some preliminary experiments, recommended the adoption of an improved method by which the sardines were boiled in open pans over a fire and the boiled sardines were then pressed in coir bags in indigenous screw presses to separate the oil. The residue in the bag was, later on broken up and dried in the sun to form the guano. He also advocated the installation of a number of such small factories throughout the coast. Nicholson's move to revive the sardine oil industry met with immediate success and the production of better quality oil, and guano of good manurial value, by the new method induced small capitalists to install several such factories all along the coast of Malabar and South Kanara. The number of oil and guano factories increased rapidly and the peak figure was reached in the 1922-23 season when 647 factories, or approximately 3 factories per mile of the coastline were in existence. The production of oil and guano also showed record figures of 12,500 and 33,500 metric tons respectively. In the subsequent years, however, the fall in the trade of oil and guano was caused mainly by the malpractices of the



The Oil-Sardine, *Sardinella longiceps* Cuv. & Val.



Operation of the Boat-Seine, 'Mathi Kolli Valai' used in Sardine Fishery



Auctioning of the Sardine Catch

traders who were induced to do them by the high prices prevailing then, and partly also by the extreme fluctuations encountered in the fishery. The complete failure of the fishery during the forties rendered all the oil and guano factories idle and the production of these bye-products of the fishery came to an end.

Oil-sardine occurs off the coasts of Arabia, Iran, Pakistan, India, Ceylon, and Java in the Bali straits. There is no information about its relative importance and place in the commercial fisheries of these countries. In Indian waters the range of distribution extends from Bombay State to Andhra State and large shoals have been encountered only along the Kerala and Mysore States. The fishery of the oil-sardine is restricted to a narrow 8-10 mile strip of the coastal waters and this is necessitated by the nature of the craft employed in the fishery, namely, the dugout rowing canoe. The gear on the other hand has attained very high efficiency during the course of several years and consists of nets which are ideally suited for the capture of this pelagic shoaling species. The common nets used in the fishery were the boat-seines, drift nets and cast nets. More efficient types of nets were later introduced to meet the growing demand of the numerous oil and guano factories. The high prices offered by them induced the fishermen to go regularly for night fishing also with these nets.

The fluctuations in the oil-sardine fishery, both seasonal and annual, have rendered it undependable for commercial exploitation with disastrous effects on the industries which it supported during the early years of plentitude. Day wrote 'abundant in some years, they occasionally forsake their haunts for several consecutive seasons, returning again in enormous quantities'. Even though early records of the landings of this fish are not available, the data relating to the export of sardine-oil from the port of Cochin, the chief exporting centre of the West Coast, show that the fishery was poor during the years 1860-63 and exceptionally good during the years 1858-59, 1859-60 and 1863-64. From the statistics of fresh and sun-dried sardines used in coffee plantations, collected by the agents of Messrs. Arbuthnot and Co., Ltd., it is evident that the fishery was good during the years 1893-94 to 1895-96. The figures relating to the oil-sardines cured in the fish curing yards of South Kanara and Malabar between the years 1896 and 1907 show that the fishery was more or less uniformly good throughout the period except during the years 1898 to 1900 which were poor years for the fishery. No information on the oil-sardine landings for the next two decades is available; however, the figures relating to the production of the bye-products, oil and guano, will serve to give an idea of the extreme fluctuation seen in the fishery.

The oil-sardine fishery was a failure from the years 1908-09 to 1911-12 and from 1914-15 to 1918-19. The fishery was exceptionally good during the 1922-23 and 1923-24 seasons when the total production of oil and guano along the coast reached the colossal figures of 20,000 and 57,000 metric tons respectively. The magnitude of the catches during these two seasons would become, apparent from the fact that about 2,85,000 metric tons of oil sardines had been utilised for the production of guano alone, excluding the quantities consumed in the fresh condition, used for curing or converted into beach manure. The figures serve to give an idea of the magnitude of the shoals of oil-sardines which frequented the inshore waters during those years of abundance.

The estimated landings of oil-sardine compiled by the different fish curing yards of South Kanara and Malabar and by the Central Marine Fisheries Research Station for the West Coast of India are given in Tables I and II.

TABLE I

Seasons	Landings in metric tons	Seasons	Landings in metric tons
1925-26	44,507.2	1938-39	3,413.2
1926-27	14,804.5	1939-40	7,090.2
1927-28	7,204.0	1940-41	25,268.8
1928-29	1,807.7	1941-42	4,450.2
1929-30	2,753.7	1942-43	919.5
1930-31	4,324.8	1943-44	442.5
1931-32	2,185.4	1944-45	656.7
1932-33	1,123.9	1945-46	17.7
1933-34	71,796.5	1946-47	8.8
1934-35	20,834.7	1947-48	1,191.1
1935-36	1,498.5	1948-49	290.7
1936-37	27,161.7	1949-50	3,390.0
1937-38	17,021.2		

TABLE II

Year	Landings in metric tons
1950	34,420
1951	17,240
1952	13,895
1953	51,831
1954	33,952
1955	30,447
1956	7,412
1957	1,91,469

The annual fluctuation characteristic of this fishery is seen clearly from Tables I and II. During the last 3 decades, the best catch was recorded last year when glut conditions reminiscent of the former years of abundance were seen and the fish contributed about 22% of the total marine fish production of the year. The total catch exceeded 25,000 metric tons during 1925-26, 1933-34, 1936-37 and 1940-41 seasons. Even though the annual catches of oil-sardine varied considerably during these years, the fishery reached disastrously low levels after the 1941-42 season, the lowest catch of 8.8 metric tons being reached in the 1946-47 season.

The unprecedented failure of the oil-sardine fishery extending over a number of years received the attention of the Government of Madras and restrictive legislation to prevent the capture of the juveniles and spawners was introduced in 1943. The main clauses were the prohibition of: (1) the use of the highly destructive boat-seine 'Mathikolli vala' during the sardine season from August to April, (2) the use of the gill-net 'Mathichala vala' during the spawning period in August and September and (3) the landing of sardines below 15 cm. exceeding a total weight of 1 maund from any single boat during the fishing season. The legislation was modified and extended for two more years from 1945 to prohibit the use of these two nets throughout the season and the landing of immature sardines. The legislation

lapsed in 1947 owing to various practical difficulties encountered in enforcing the regulations.

A pioneer attempt to determine the food, spawning habits and the factors which control the migration of the oil-sardine was made by Hornell who stressed the necessity for a sound knowledge of these aspects for the proper development of the oil-sardine fishery. He also emphasised the necessity for an intensive investigation of the problems connected with the seasonal migration, food and life-history of the oil-sardine and the mackerel, the two principal commercial fishes of the west coast. As a result of his representations, the Government of Madras established in 1921 the Fisheries Biological Station at West Hill for carrying out these investigations in a systematic manner. After an year's intensive study, Hornell and Nayudu published "Some aspects of the life-history of the oil-sardine together with notes on the plankton of the Malabar coast". Their important conclusions were as follows: The local races are absent among the oil-sardines of the Malabar and South Canara coasts. Oil-sardines attain sexual maturity and almost full adult size at the age of one year, when they measure on the average 15 cm. They leave the inshore waters just prior to spawning which takes place from June to August inclusive, once only in the year. After spawning, mortality is high, particularly among the females, and of those that survive to spawn a second time, very few are met with in the fishery. Growth during the second year is extremely slow, the oldest sardines examined being approximately $2\frac{1}{2}$ years old, and this appears to be the ordinary limit of life in this species.

After a lapse of 20 years the results were published of an investigation into the causes of the fluctuations of the annual fishery of the oil-sardine, the determination of its age and the discovery of its eggs and spawning ground. The important conclusions were as follows: *Sardinella longiceps* depends mainly on pelagic organisms for its food and is, therefore, a surface feeder, occasionally resorting to bottom feeding; the inedible *Noctiluca* when predominant in the plankton might cause disturbances in the food-chain of the oil-sardine leading to local scarcity of the fish; the free eggs of the oil-sardine were isolated from the marine plankton off Quilandy.

A detailed study of the otolith of the oil-sardine in recent years led to the detection of 2 and in exceptional cases 3 rings which indicated that the average span of life of the oil-sardine is about 3 to 4 years. Studies on the length-frequencies, size and age groups lent support to the above conclusions. It is believed that the availability of food and the surface temperature and salinity influence the movements of the oil-sardines and also the

spawning and survival of the young ones. The oil-sardine fishery, shows irregular fluctuations at intervals ranging between 2 and 6 years and small-sized immature sardines contribute largely to the success of the fishery in the years of abundance. An inverse relationship is found to exist between the oil-sardine and the mackerel fisheries.

The oil-sardine fishery always commences during the S.W. Monsoon with the appearance of the spawners along the coast. The post-monsoon months show the disappearance of the spawners and the entry of the juvenile oil-sardines which form the bulk of the commercial catches. The spent oil-sardines generally appear during the closing stages of the fishery. Oil-sardines reach the average size of 10, 15 and 19 cm. at the end of the 1st, 2nd and 3rd years respectively. One-year old sardines are indeterminates, two-year old sardines are immature with developing gonads and three-year old sardines are mature adults and active spawners. The sardines spawn only once in their lifetime. Intensive study of the food and feeding habits of the oil-sardine shows that *Fragilaria oceanica* is the favourite food of the oil-sardine, especially the juveniles, and that a significant correlation exists between the occurrence of the diatom and the oil-sardine. It is probable that one of the major factors governing the fluctuations encountered in the oil-sardine fishery is the availability of *Fragilaria oceanica* in the coastal fishing grounds.

From the general picture of the oil-sardine and its fishery presented in the foregoing pages, it is obvious that sufficient attention has not been paid to the study of the biology and fishery of this economically important and valuable marine fish of Indian waters. Even though investigations were commenced some three decades ago with these objects in view, precise information relating to many of the fundamental aspects of the biology of the fish, namely, the food and feeding habits, embryonic and larval development, spawning habits, age and rate of growth, became available in recent years only. There is practically no information about the nature and extent of the fishery beyond the 10-mile limit of the present fishing zone. The oil-sardine fishery commences in August and terminates in March. From where the oil-sardines come and where they go are still largely unsolved problems. Recruitment research to determine the rate of survival of the young sardines is being given attention since the success or failure of the fishery depends mainly on the juveniles recruited every year.