ON THE OCCURRENCE OF JUVENILE OIL SARDINE, *SARDINELLA LONGICEPS* VAL. IN THE INSHORE WATERS OF BOMBAY

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The occurrence of young oil sardine in large proportions in the inshore waters of Bombay is not very usual. The occurrence was noticed during January and February 1971. They were caught in 'dol' nets being operated from machanised boats just near and around the floating light house in Bombay. Size frequencies, scale studies and stomach contents were studied. A comparison of surface water temperature and salinity was made to see if they were responsible for the unusual large scale migration of these young oil sardines to the inshore waters of Bombay.

The unusual occurrence of young oil sardines in the inshore waters of Bombay coast in large quantities at the close of the winter season in January and February 1971 was observed. Though the general distribution of oil sardine include the Maharashtra coast also, the occurrence of the same was an unusual phenomenon in the inshore waters of Bombay.

In the course of routine fishery investigations during January 1971, the author noticed the occurrence of young oil sardines in large numbers in Sassoon Docks and in stray numbers in Versova fish landing centre in Bombay. The magnitude of this fishery was estimated to be to the tune of 364.11 metric tons as against 1276.72 metric tons of other fish landings and 92.12 metric tons against 322.89 metric tons of other fish landings during January and February respectively. The percentage of this fishery was worked out as 28.52 for the period. Thus an organised and regular oil sardine fishery had sprung up during the period. The fishing was done by the local small trawlers as well as by the mechanised boats operating 'dol' nets — a type of bag nets — in the inshore waters. On detailed enquires it was stated that these young oil sardines (ranging between 100 mm to 141 mm) were caught within a kilometer belt in the harbour and around the floating light house. Occurrence of very young ones measuring 35 mm onwards were observed in Mangalore zone in the months of July - September during the years 1960-'66 (Prabhu and Dhulkhed, 1967).

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Measurements of over 50 specimens were taken on each day of observation. The size frequencies of these juvenile oil sardines during January - February period (Fig. 1) showed that they belonged to the same year class as evidenced by the modal pattern of the size frequencies at 115 mm and 120 mm respectively in January and February. A small mode at 125 mm was also noticed. The minimum and maximum size measured during these periods

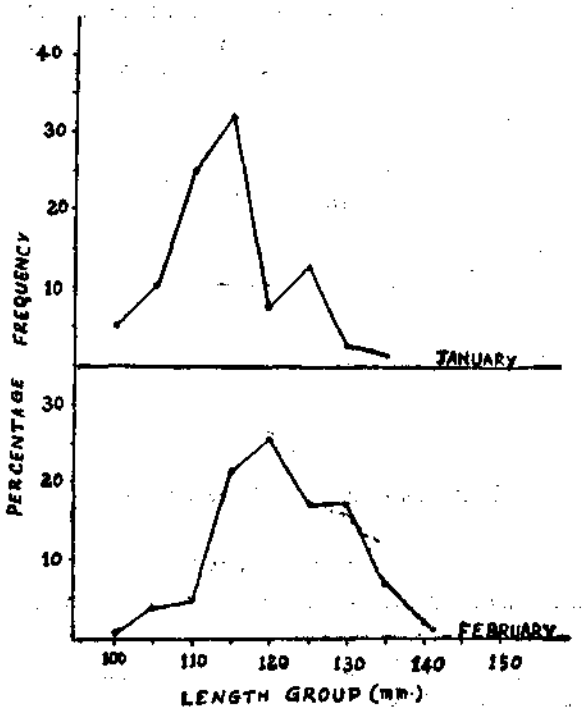

FIG. 1. The length frequency of juvenile oil sardine

were 100 mm and 140 mm, the majority of them being between 105 mm to 126 mm and 112 mm to 130 mm respectively in January and February. The absence of growth rings on the scales taken for examination from dorsal side just below the dorsal fin suggests that the fish may be from the O-year class.

Study of stomach contents showed a mixture of zoo plankton and phytoplankton. While the copepod *Microsetella* sp. was present in large numbers in the food, diatoms were represented on the basis of their abundance by *Chaetoceros* spp. *Pleurosigma* spp. and to a lesser extent by *Biddulphia* spp. *Peridinium* spp. were also present.

The real cause for sudden appearance of juvenile oil sardines in this coast was not known for certain. Probably it might be due to the unusual fall in the temperature during the winter months especially in December 1970

and January 1971. The values of average salinity and temperature were compared during the period of observations with those of the previous years. While the average salinity value remained constant at 35‰ during the said period from 1966-'67 to 1970-'71, the temperature fluctuated between 23.2°C to 26.1°C from 1966-'67 to 1969-'70 and fell to 19.4°C and 21.6°C in December 1970 and January 1971.

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SEX-RATIO IN OIL SARDINE

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The studies on the sex-ratios of oil sardine spread over eleven seasons indicated that the females have a higher rate of growth, hence their preponderance in the various length groups of the population. The stabilisation of the oil sardine fishery in the recent years appears to have a close relation with the dominance of females in the O-year class which supports the fishery.

During a study of the biology of oil sardine, *Sardinella longiceps* Valenciennes which extended over a period of eleven years the sex-ratios of fish caught in the Mangalore area by the non-selective gear, *viz.*, cast net, shore-seines (*kairampani* and *rampani*) and boat-seines, were determined. The cumulative annual distribution of males and females in the various length groups for 1960-61 through 1970-71 is given in Fig. 1. It is seen that the maximum total length attained by the males and females in general was more or less the same (212 mm); however, the data reveal that in most of the years the size attained by the females was larger than the males. The average length attained by the males and females for the eleven-year period works out to be 190.6 and 195.6 mm respectively. However, what is of interest is the significant variations in

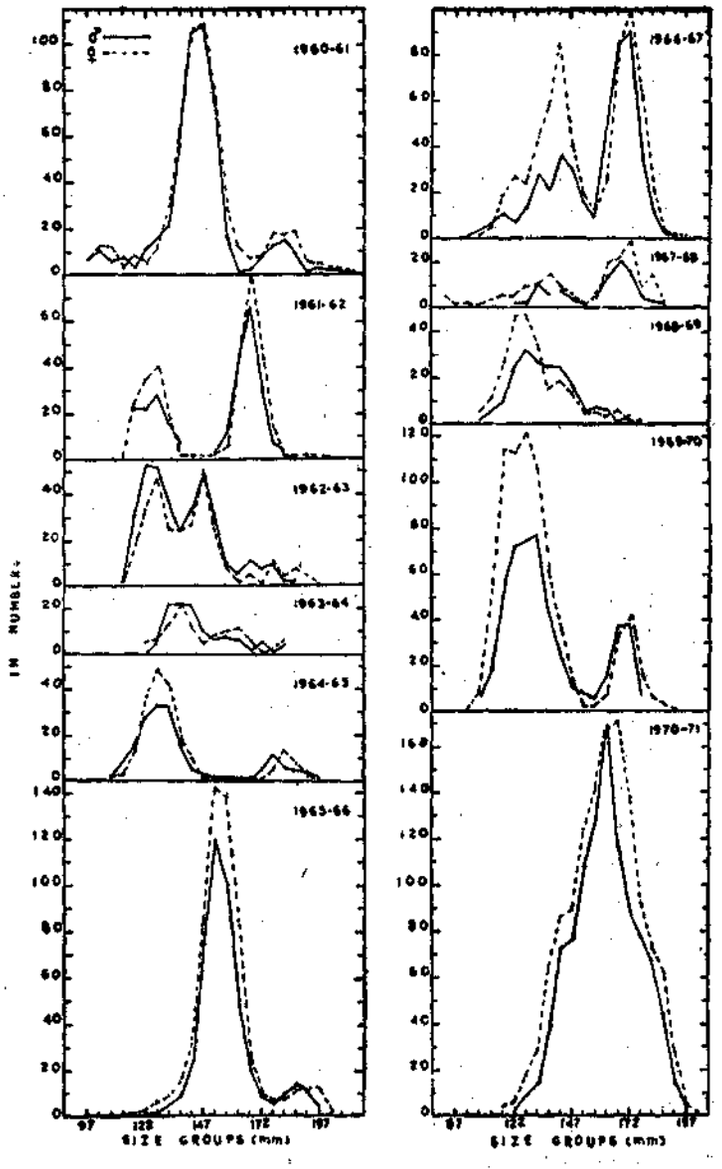

FIG. 1. Frequency distribution of males and females of oil sardine during 1960-61 to 1970-71.

the sex-ratios of various length groups. It is apparent that from 1960-61 to 1964-65 the proportion of males and females in most of the size groups was

of even order. In subsequent years, females outnumbered the males practically in most of the size groups.

The cumulative frequency of males and females for eleven years is given in Table 1. The preponderance of females is seen in almost all the length groups. This indicates the existence of differential rate of growth in oil sardine, the females growing faster than the males. The average length attained by the female, as mentioned earlier is more than the male and to this extent the preponderance of the former sex in the population is naturally to be expected.

TABLE 1. *Cumulative frequency distribution of sex-ratios of oil sardine for 1960-1971*

Size Groups (mm)	Male	Female	Ratio
90.00	6	12	1:2.00
100.00	26	46	1:1.77
110.00	190	317	1:1.67
120.00	498	693	1:1.39
130.00	558	717	1:1.28
140.00	738	841	1:1.14
150.00	678	768	1:1.13
160.00	722	821	1:1.14
170.00	481	623	1:1.30
180.00	206	283	1:1.37
190.00	43	79	1:1.84
200.00	2	8	1:4.00
210.00	1	2	1:2.00
Total	4,149	5,210	1:1.26

The oil sardine fishery, by and large, is supported by the 0-year group; the fish attaining maturity by the end of the first year (Bensam, 1968; Radhakrishnan, 1968). It may be stated that a length of 150-160 mm is reached during the first year since the size at first maturity is at about the same size range (Dhulkhed, 1964; Antony Raja, 1969). With this in view, the oil sardine were grouped under pre-and post-spawning categories to determine the pattern of distribution of sex-ratios (Table 2). The data revealed that the proportion of females was higher in the majority of the years in both the groups. This may be one of the reasons for the stabilisation of the oil sardine fishery since late-fifties.

TABLE 2. *Sex-ratio in pre-and post spawning groups of oil sardine during 1960-61 to 1970-71.*

Years	Pre-spawning (90.0 to 150.0 mm)			Post-spawning (160.0 to 210.0 mm)		
	Males	Females	Sex ratio	Males	Females	Sex ratio
1960-61	438	473	1:1.05	55	97	1:1.76
1961-62	110	131	1:1.05	155	186	1:1.20
1962-63	327	262	1:0.80	43	35	1:0.81
1963-64	101	77	1:0.76	21	29	1:1.38
1964-65	135	183	1:1.35	36	33	1:0.92
1965-66	333	434	1:1.30	124	172	1:1.39
1966-67	180	338	1:1.88	272	303	1:1.11
1967-68	39	79	1:2.03	61	101	1:1.66
1968-69	181	231	1:1.28	11	14	1:1.27
1969-70	399	635	1:1.59	100	107	1:1.07
1970-71	451	561	1:1.24	577	739	1:1.28
Total	2,694	3,394	1:1.26	1,455	1,816	1:1.25

There is some striking similarity between the stock of oil sardine and Peruvian anchoveta (Gulland, 1968). It appears that the fishery of oil sardine is based on the stock which has just completed one year of its life. The appearance of small fishes in fishery late in the season (January and February) suggests that they belong to the current year's brood (Dr. S. Z. Qasim, in personal communication). This also supports the view that the growth during the first year is very fast, and the fish reaches about 150-160 mm at the end of the first year. After attaining maturity the growth seems to slow down considerably. Qasim (1966) states that "the preponderance of one sex in the population is because of growth rate. Further growth probably leads to increasingly less effect from predation and this may influence the sex-ratios in favour of the sex growing faster". This seems to be applicable in the case of oil sardine as well as would be seen from the foregoing account.

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ON SOME GROWTH STAGES AND FOOD OF *AROTHRON STELLATUS* (BLOCH) (TETRAODONTIDAE:PISCES)

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The controversial characters in the colour pattern in the different growth stages of the species *Arothron stellatus* (Bloch) have been examined. The present study confirms that the continuous bands reported on the dorsal surface in fish of 26 mm length start breaking up at about 45 mm length and this is completed at even as early as 110 mm length, and that the continuous bands in the under surface of the medium sized fish disappear in the adult fish. Food of the species at the different growth stages has also been outlined.

The species *stellatus* was originally described by Bloch in 1801 under genus *Tetraodon* Linnaeus. But later it was assigned to *Arothron* Muller 1839. The present account attempts to provide a confirmation on the variations in the colour pattern of the species in the different growth stages (45 mm, 110 mm and 380 mm in total length) and provide information on the difference in the body proportions in these stages together with an account of the food of the species. The descriptions are based on specimens collected at Vizhinjam from shore seines and preserved in 5% formalin.

Colour — 45 mm size (Fig. 1. A and B): Body pale brown with dark brown bands on the upper side, radiating from a point mid-dorsally, midway between pectoral tip and dorsal fin origin; the bands, extending to all over