NOTES ON SOME ASPECTS ON THE BIOLOGY OF THE FRINGE SCALE SARDINE, *SARDINELLA FIMBRIATA* (CUVIER & VALENCIENNES)

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Introduction

The important clupeoids of Kanara coast are *Sardinella longiceps, Sardinella fimbriata, Opisthopterus tardoore, Kowala kowal* and anchovies. A detailed study on some aspects on the biology of *Sardinella fimbriata* at Karwar was taken up from September 1958. Nair (1959) has shown that the west coast production of this species is on an average one and a half times more than the east coast and that the peak period of the fishery along the east coast is during December-January, whereas along the west coast two peak periods are seen *i.e.*, March-April and November-December. From the catch statistics collected at Karwar during the last few years, it is noted that this fishery commences sometime in September and lasts up to May-June of the following year, the primary and secondary peaks being September-November and December-March.

Length Frequency Studies

The account given is based on the results of investigation carried out at Karwar from 1958 to 1962. For purpose of length frequency studies, the total length, distance from the tip of the upper jaw to the upper caudal tip, has been taken into account. Samples were taken from the shore seines, cast nets and drag nets. Since there was no difference between the size groups prevailing in different gears, the data were pooled together irrespective of the nets employed.

1958/1959 *Season*: A good *S. fimbriata* season was observed at Karwar and lasted from September 1958 to June 1959. Heavy landings during this season were also reported from other centres of North Kanara area. 15 samples totalling 1,621 fishes ranging from 81 to 156 mm. were measured for the season under review (Fig. 1). For September, October and November 1958, the mode 'a' is seen to be in the 90-99 mm. size group. For January 1959, the curve is still unimodal and that on assumption that the population has been the same throughout, the forward movement of the mode is noticed and the mode 'a' is traced at 110-119 mm. group. The largest size represented during the month is in the 130-139 mm. group. The mode remains stationary for February, March and April, but at the right end the range has increased revealing the growth trend. For the months of May and June, the 130-139 mm. group predominated, the curve tending to remain unimodal. The mode 'a' showed its first appearance

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in September 1958 at 90-99 mm. group and when it passed through the May-June period following the seasons of abundance in the fishery, the dominant size has moved to the 130-139 mm. group indicating a probable growth of 40 mm. in 10 months time.

1959/1960 *Season*: September marks the commencement of this season and the fishery came to a close by August, 1960. 51 samples comprising 5,163 fishes with the size range 61 to 175 mm. were available for studies (Fig. 1). For September and October the 90-99 mm. group dominated the fishery. (Mode 'b'). In October, it is seen that there is an increase in the proportion of the size groups above 90-99 mm., the maximum size recorded for the month falls within the 140-149 mm. size group. For November, the forward movement of the mode 'b' by 10 mm. is seen and the mode has shifted to 100-109 mm. group. For December to March a further increase in growth is noticed as the mode is traced at 120-129 mm. group which remained stationary during these months. In March 1960 the curve is unimodal, but the 120-129 mm. group forming 47.08% dominated the catch, whereas the other mode at 90-99 mm. contributed only to about 20% of the total catch. April 1960 was the only month when large sized individuals were recorded in the catches. The size range varied from 105 to 165 mm. and the mode 'b' has moved to 140-149 mm. group. In May 1960, the mode 'b' contributed only about 18%. The mode remains at the same point where it was during the previous month. The result of the recruitment of a new generation into the population is noticed in May 1960 and the mode 'c' showed its appearance at 70-79 mm. group. For August, the 140-149 mm. group dominated. The progressive shifting of the mode from 90 mm. in September 1959 to 140 mm. in August 1960 may be regarded as showing the growth of the species, indicating a growth of about 50 mm. in 12 months.

1960/1961 *Season*: The season was of a short duration lasting for about four months *i.e.*, September 1960 to December 1960. 1,410 individuals ranging from 81 to 135 mm. from 14 samples were measured during the season (Fig. 1). The dominant group for September, October, November and December were 100-109, 110-119, 100-109 and 110-119 mm. respectively. From the total seasonal figures, it is seen that the 100 mm. size group predominated mostly in the commercial catches.

1961/1962 *Season*: This season was a complete failure as landings of *S. fimbriata* were not reported at Karwar and the neighbouring centres.

Sekharan (1959) while analysing the data on age and rate of growth of *S. albella* and *S. gibbosa* indicated that the growth rate of these species varied from season to season and remarked that "this in all probability is mainly due to changes in environmental conditions and density of population". The

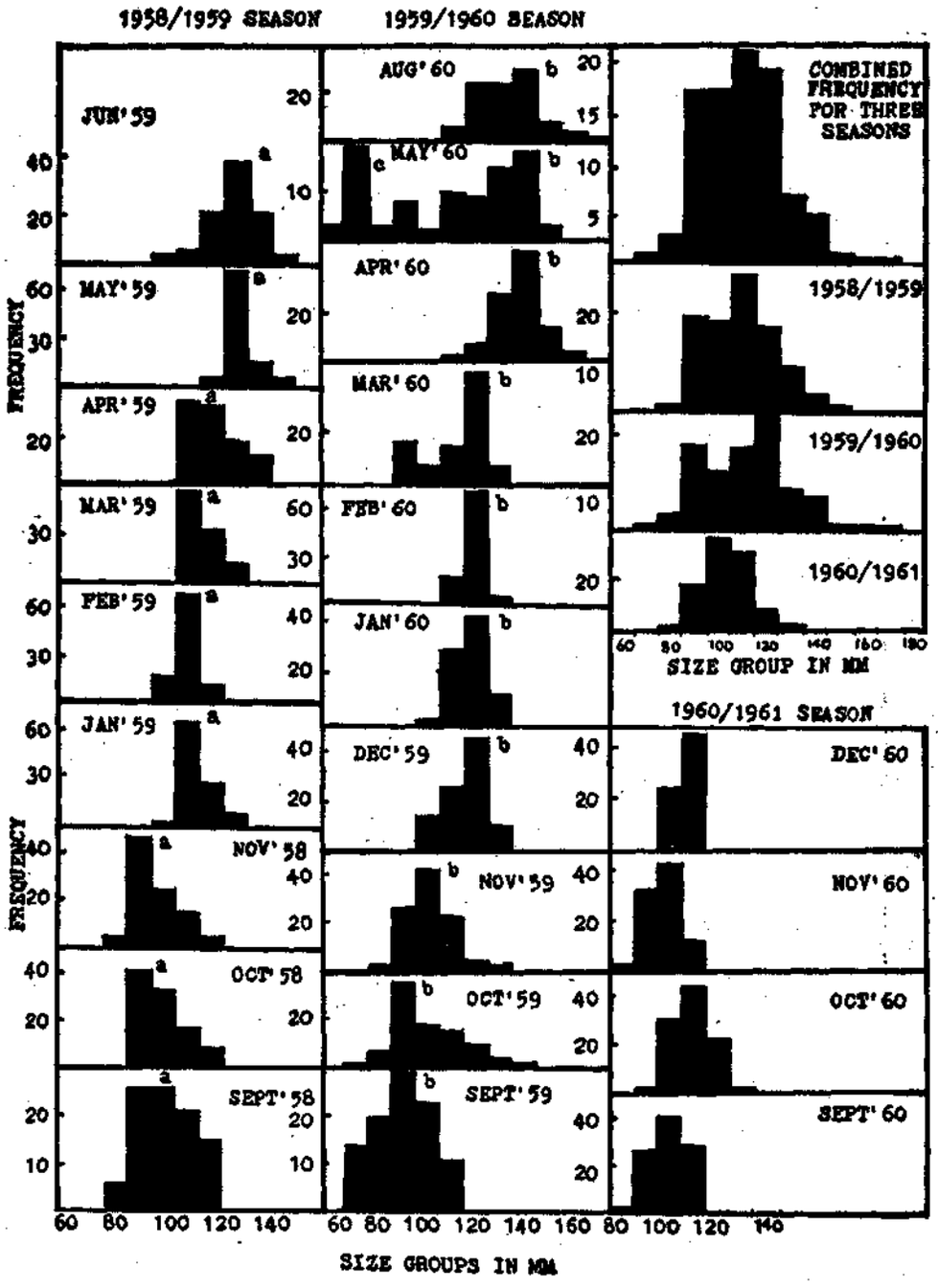

FIG. 1 Length frequency distribution of *Sardinell fimbriata* at Karwar.

monthly increment in length of *S. fimbriata* during the seasons 1958-1959 and 1959/1960 at Karwar appeared to be more or less the same. Since the duration of the fishery was very short and the occurrence was intermittent, it was not possible to determine the rate of growth of the species during 1960/1961 and 1961/1962.

Based on the catch statistics, the season for *S. fimbriata* could be divided into three separate periods. (1) September-November (Peak period); (2) December-March (Secondary peak period); and (3) April to August (Slack season). In order to get a comparative picture during the different periods mentioned above, it was considered worthwhile to pool together the length frequency data for the three seasons together, under the three seperate heads (Fig. 2). It is interesting to note that the 100-109 mm. group dominated for September-November period and 120-129 mm. group for December-March. For April to August the bulk of the catch was composed of individuals in the 130 to 149 mm. range, besides another mode at 70-79 mm. group.

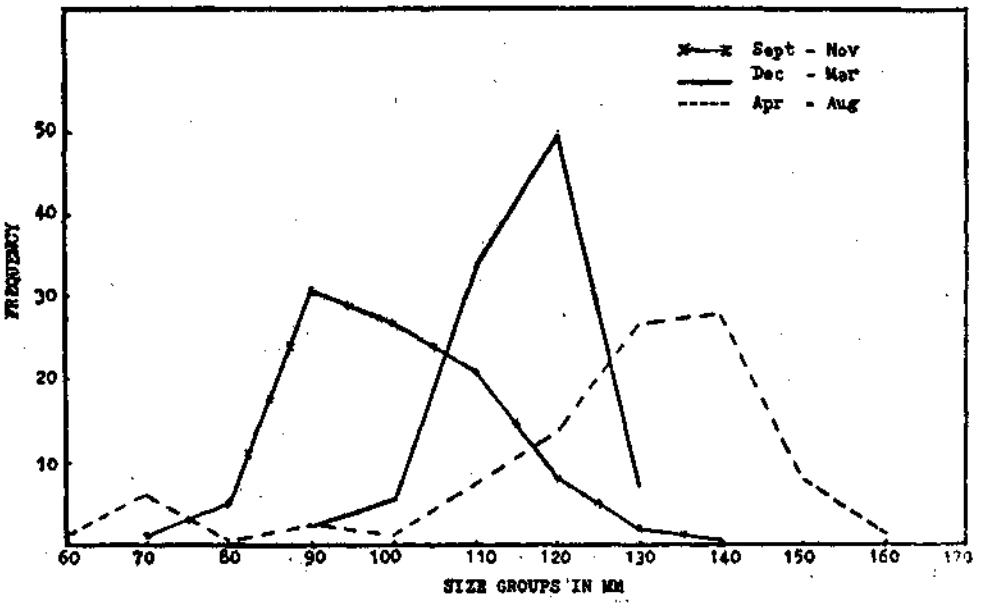

FIG. 2 Periodwise length frequency studies of *Sardinella fimbriata* during the three seasons, 1958/59, 1959/60, 1960/61 at Karwar.

The annual length frequency distribution of *S. fimbriata* during the different years (Fig. 1) showed that during 1960/1961 the 100-119 mm. group dominated with 72.9%. A bimodal curve is noticed at 90-99 mm. (18.28%) and 110-129 mm. (24.9%) during 1959 (1959/1960) 1960. The dominant group for 1958/1959 was 110-119 mm. group contributing 28.6% besides a minor mode at 90.99 mm. with 19.98%. Combining the figures for all the three seasons, we could

see that the 110-119 mm. predominated with 22.43% and 90-99 mm. group with 18.81%. Thus we could conclude from the length frequency analysis that the fishery as a whole was mainly dominated by I+year group and that fishes measuring above 140 mm. contribute very little to the fishery.

Maturation and Spawning

Qasim and Qayyum (1961) on studies on spawning frequencies and breeding seasons of some fresh water fishes with special reference to those occurring in the plains of Northern India, has taken into consideration only 3-4 average sized individuals of each species for the oocyte study and from these fishes a typical condition was laid down on the basis of its predominance to illustrate the distribution of oocytes. The same method was followed in the present analysis also. The ova diameter frequencies of 3,000 ova collected from six specimens have been illustrated in Fig. 3. Besides the immature group of ova, there is a distinct mode at 0.238 — 0.255 mm. which are the group of eggs already withdrawn from the general egg stock for maturation. The ova forming this mode are small and semiopaque. The peak of the large sized opaque ova are seen at 0.425—0.442 mm. The minimum and maximum length/ breadth of the ovary of the mature specimens were 38 to 52 mm. and 05 to 13 mm. respectively. Since the ova diameter measurements have shown only a well defined group (18-19u to 26-27u) which is separated from the general egg stock, it is reasonable to assume that an individual of this species probably spawn only once and the spawning season as a whole may be restricted to a short one. This is further supported by the monthly length frequency distribution of fish (Fig. 1) presented in the earlier section.

The different maturity stages observed at Karwar during various months are given below. From September to December the specimens examined were in maturity stages I, II and III. Stages of maturity up to III-IV-V and occassionally spent ones (Stage VII) could be recognised from January to April. Individuals in maturity stages I and II predominated again during May to September and I to III-IV in November. Spawning specimens in Stage VI of maturity were not collected during the period of study. There appears to be a tendency for this sardine to migrate away from the inshore area for the purpose of spawning. Dutt (1959 & 1961) while analysing the biological data on *S. gibbosa* and *S. fimbriata* from Waltair coast indicated that "out of the two species no maturing and mature adults of *S. fimbriata* have been observed at any time during the period of occurrence on the Waltair coast but empty adults have been observed towards the fag end of the season". It is seen that at Karwar, individuals in maturity stages III-IV-V and VII are recorded in the commercial catches only during January to April and that the entry of young individuals during April to September. Based on this it can be said

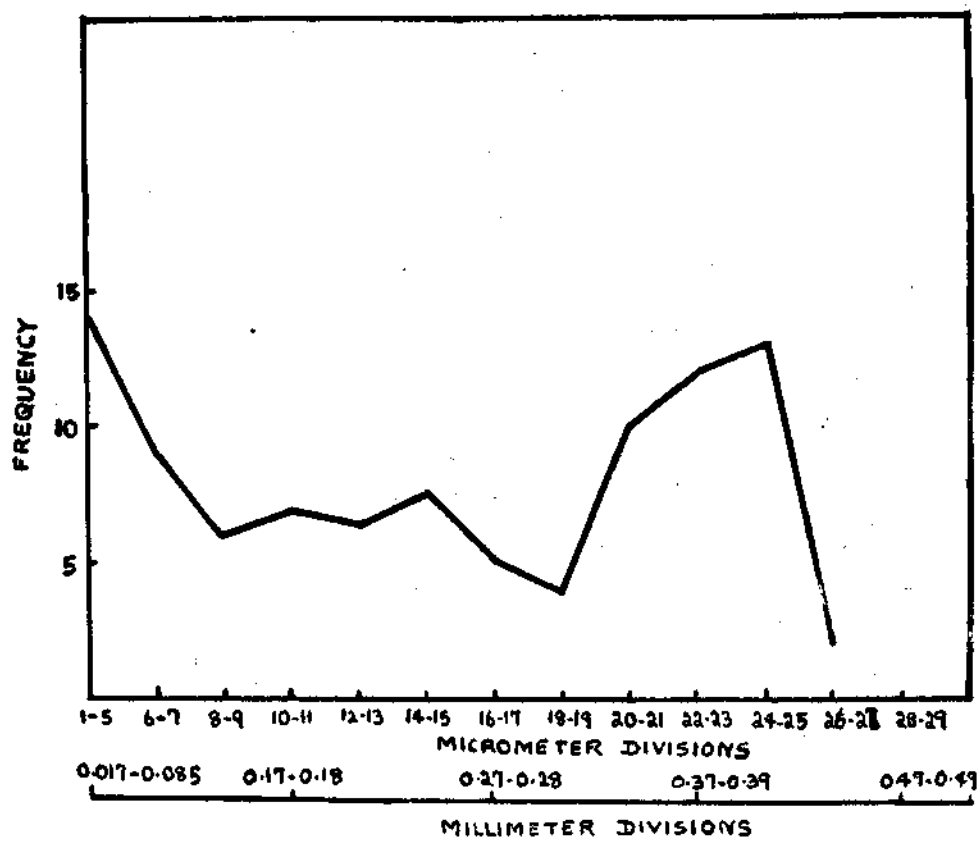

FIG. 3 Diameters of 3000 ova from 6 mature ovaries of *S. fimbriata* at Karwar.

that the spawning of this species at Karwar area presumably commences sometime during the early part of the year. Chidambaram and Venkataraman (1946) are of opinion that along the Malabar coast the spawning season extends from April to June. Chacko (1956) found that in Tuticorin Bay, it extends from October to November. Bapat (1955) has shown that the spawning season of this species in the Gulf of Mannar is short and confined to the colder months of the year (December-March).

The smallest individuals with ovaries in the spent condition were in 140-159 mm size group and probably the fishes mature for the first time when they attain the above mentioned size which agrees with the findings of Chidambaram and Venkataraman (1946). Chacko (1956) states that this sardine attains maturity when it measures 12 cm whereas Dutt (1959) has shown that "they reach maturity in March when they are about 10 cm in length". The early life history of *S. fimbriata* has been worked out by Delsman (1926) and Bapat (1955).

Food Analysis

The food of this species has been worked out earlier by a few authors, Chidambaram and Venkataraman (1946), Chacko (1956) Venkataraman (1960) and Basheeruddin and Nayar (1961). Based on the present analysis at Karwar it is noted that during September to November (peak period of the fishery) the food consists mainly of constituents like *Acartia, Evadne, Penilia,* Copepod eggs, *Coscinodiscus, Euterpina* and *Cypris* larvae. For December to March the abundance of zooplanktonic food in the guts was noticed, the most important component being *Acartia,* bivalve larvae, *Lucifer, Temora,* Copepod eggs and diatoms like *Coscinodiscus* and *Schmackeria.* From April to August the phytoplankton predominated in the stomachs, the commonest species being *Coscinodiscus, Navicula, Nitzchia, Thallasiothrix* and zooplankonic forms like *Lucifer* and *Oithona.* It can be concluded that this species feed both zoo and phytoplankton. Fish larvae were also recorded in the stomach of this species in September, so also fish scales in April to May.

Summary

The paper deals with a general account of the *S. fimbriata* fishery in the Karwar area with particular reference to length frequency distribution, maturation and spawning and food of the species. The fishery commences at Karwar sometime in September and lasts up to May-June of the following year with primary and secondary peaks in September-November and December-March. The age and size groups of fish occurring in the commercial landings are discussed. The rate of growth noticed for 1958/1959 and 1959/1960 respectively were 40 mm. in 10 months and 50 mm. in 12 months. It is seen that the fishery as a whole was mainly dominated by I+year group. Based on gonadial studies, it is concluded that the spawning of the species commences sometime during the early part of the year. Ova diameter studies has revealed that the spawning season appears to be a short one. The different stages of maturity observed at Karwar for the various months are shown. Food analysis revealed that *S. fimbriata* feeds both on zoo and phytoplankton. The different food constituents seen during different periods are also given.

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