# THE FOOD OF SMALL-SIZED OIL SARDINE OF THE MANGALORE AREA

M.H. DHULKHED

*Central Marine Fisheries Research Institute; Sub-station, Mangalore*

ABSTRACT

The food of oil sardine ranging 40-79 mm in length consisted of diatoms, dinoflagellates and copepods. There seems to be no consistency in regard to various food items in different size groups. Studies have also shown the absence of selective feeding in small oil sardine.

## INTRODUCTION

Studies made so far on the food of the oil sardine, *Sardinella longiceps* Val., have been confined mainly to the larger size-groups (Hornell and Nayudu, 1924; John and Menon, 1942; Chidambaram, 1950; Nair, 1953; Dhulkhed, 1962; Bensam, 1964 and Kagwade, 1964). A reference to the food of the juveniles has, however, been made by Bensam (1964) based on the samples collected from Cannanore. Investigations carried out at Mangalore over a period of five years have revealed some interesting information.

## MATERIAL AND METHODS

In the Mangalore area the small-sized oil sardine are caught by *kooribale* (small-meshed cast net), *kairampani* (shore-seine) and *kollibale* (boat-seine) which are operated in the inshore waters at depths ranging from half to six metres (Prabhu and Dhulkhed, 1967). The fishery for small-sized oil sardine (indeterminates) lasted for a day or two in August or September and as such only a limited number of samples were available during each season. In 1961, 1966, 1969 and 1970 small-sized oil sardine occurred in September whereas in 1965 they were available in August. On the days when small oil sardine were caught, specimens of commercial size were not available for a comparative study of food.

Oil sardine ranging 40 - 79 mm in length were taken for the analysis. To determine whether there was any difference in the food preferences in different size-groups, the fish were grouped into 10 mm size-classes. The gut contents of ten specimens from each group were examined on each sampling day. In almost all the fish the food was present in the cardiac part of the stomach only. As this region contained small quantities of food, the volume of the gut content could not be determined by

the displacement method, nor was it possible to estimate the weight of food accurately. The stomach content of each fish was made up to a known volume (5 ml) and from this 1 ml was taken and spread over a counting chamber. The number method (Hynes, 1950) was followed for the estimation of various items. The percentage of each item of the diet was calculated and is given in Table 1.

## Results

It can be seen from Table 1 that diatoms (*Coscinodiscus* spp., *Fragilaria oceanica*, *Pleurosigma* spp. etc.) dinoflagellates (*Dinophysis* spp., *Pyrophacus*, *Prorocentrum*, *Ornithocercus* sp. etc.) and zooplankters (copepods and young bivalves), constituted the chief items of food. Tintinnids occurred rarely. In a few oil sardine, foraminiferan shells and sand particles were also observed.

Differences in the composition of food of young sardine from year to year can also be observed from Table 1. In 1961, an increase in the percentages of diatoms with the increase in size of the fish was quite evident. In that year dinoflagellates constituted more than 50.0% of the gut contents in the two size-groups 50-59 mm and 60 - 69 mm, as against 25.0% in the larger group (70-79 mm). No zooplankters were observed in the size-group 40 - 49 mm, whereas in the size - groups 50 - 59 mm, 60-69 mm and 70-79 mm the ir percentages were 20.0, 5.3 and 15.0 respectively.

In 1965 and 1966 the diatoms formed the major part of the diet, constituting more than 85.0% in all the groups excepting the 70-79 mm group of 1965. In 1965, dinoflagellates were practically absent in the stomach. However, in 1966 they constituted about 12.5% and 5.7% in the size-groups 45-49 mmand 70-79 mm respectively, but their percentages in the other groups were less than 5.0. In 1965 zooplankters contributed to the food in lesser numbers in the first three groups whereas in the size-group 70-79 mm copepods alone accounted for about 54.1% of stomach contents. It is evident from these data that in 1969 the percentages of diatoms increased in the food coupled with an increase in the size of oil sardine. In the case of dinoflagellates, on the contrary, it decreased. Excepting 2.1% of copepods in 60-69 mm size-group animal organisms were absent in other groups. In 1970 copepods alone formed about 74.1% of the sardine diet in 60-69 mm size-group. However, in the next group, i.e. 70-79 mm, the food consisted more of diatoms (25.7%) and dinoflagellates (54.3%) than copepods (13.3%) as observed in the preceding group.

It can also be seen from Table 1 that in the years 1961, 1966, 1969 and 1970 more dinoflagellates were observed in stomach content with an increase in the length of oil sardine.

## Discussion

The present investigations show that the food of young oil sardine consists of diatoms, dinoflagellates and copepods. These also form important items of diet of adult (Dhulkhed, 1962.) Qualitatively there does not seem to be much difference

TABLE 1. *Percentage of stomach contents of small oil sardine*

| Size - groups | 40—49 mm | | | 50—59 mm | | | | 60—69 mm | | | | | 70—79 mm | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1965 | 1966 | 1969 | 1961 | 1965 | 1966 | 1969 | 1961 | 1965 | 1966 | 1969 | 1970 | 1961 | 1965 | 1966 | 1969 | 1970 |
| Name of species | | | | | | | | | | | | | | | | | |
| *Coscinodiscus* | 88.8 | 78.2 | | 14.3 | 76.1 | 79.5 | 18.8 | 42.1 | 67.9 | 76.5 | 18.9 | 10.0 | 60.0 | 27.1 | 80.0 | 34.6 | 21.9 |
| *Fragilaria oceanica* | 9.0 | 3.0 | | 5.7 | 15.2 | 7.2 | | | 17.8 | 4.9 | | | | 16.7 | 5.7 | | 2.9 |
| *Pleurosigma* | | 6.3 | | | 2.2 | 4.8 | | | 3.6 | 6.2 | | | | | 6.7 | | 0.9 |
| *Biddulphia* | | | | | | 1.2 | | | | | | | | | 0.9 | | |
| *Diplones* | | | | | | | | | | 2.5 | | | | | | | |
| *Triceratium* | | | | | | 1.2 | | | 3.6 | 2.5 | | | | 2.1 | 0.9 | | |
| *Rhizosolenia* | | | | | | | | | | 2.5 | | | | | | | |
| Total | 97.8 | 87.5 | | 20.0 | 93.5 | 93.9 | 18.8 | 42.1 | 92.9 | 95.1 | 18.9 | 10.0 | 60.0 | 45.9 | 94.2 | 34.6 | 25.7 |
| *Dinophysis* | 1.1 | | | 51.4 | | 1.2 | 29.0 | 36.8 | | 3.7 | 16.2 | 7.5 | 20.0 | | 3.9 | | 27.6 |
| *Prorocentrum* | | | | 8.6 | | | | 15.8 | | | | 4.2 | | | | 3.8 | 1.9 |
| *Pyrophacus* | | 9.4 | | | | 3.6 | 43.5 | | | | 24.3 | 4.2 | 5.0 | | | | 24.8 |
| *Peridinium* | | | | | | | | | | | 2.7 | | | | 0.9 | 23.1 | |
| *Ceratium* | | | | | | | | | | 1.2 | | | | | 0.9 | 3.8 | |
| *Ornithocercus* | | 3.1 | | | | | | | | | | | | | | | |
| Total | 1.1 | 12.5 | | 60.0 | | 4.8 | 72.5 | 52.6 | | 4.9 | 43.2 | 15.9 | 25.0 | | 5.7 | 30.7 | 54.3 |
| Copepods | 1.1 | | | 14.3 | 6.5 | 1.2 | | | 7.1 | | 2.7 | 71.6 | 15.0 | 54.1 | | | 13.3 |
| Bivalves (young) | | | | 5.7 | | | | 5.3 | | | | | | | | | |
| Cirripedes (young) | | | | | | | | | | | | 2.5 | | | | | |
| Total | 1.1 | | | 20.0 | 6.5 | 1.2 | | 5.3 | 7.1 | | 2.7 | 74.1 | 15.0 | 54.1 | | | 13.3 |
| Tintinnids | | | | | | | | | | | | | | | | | 6.7 |
| Foraminiferans | | | 100.0 | | | | 8.7 | | | | 35.1 | | | | | 34.6 | |
| Other items | Green detritus | | Sand grains | Sand grains | | | | Sand grains | | Sand grains | | Sand grains | | | | | |

between the food of adults and the juveniles. Scofield (1934), while investigating the food of Pacific sardine (*Sardinops caerulea*) observed a predominance of copepods in fish ranging from 44 to 99 mm and of diatoms in fish measuring more than 100 mm. He attributed this difference in feeding to the development of gill-rakers. In the young ones the gill-rakers do not seem to be well developed and hence this results in a poor abundance of diatoms in the food. Bensam (1964) observed similar structural differences in the gill-rakers of juvenile and adult oil sardine, *Sardinella longiceps* Val., and stated that the juveniles feed more on crustaceans than on phytoplankton. Sekharan (in press) has also stated that in *Sardinella albella* and *S. gibbosa* of Mandapam, the ratio of copepods to diatoms in stomach content decreased with an increase in the size of the fish. The present study does not seem to indicate any consistency in regard to abundance of different items, the dominant group being different in different years. It may, however, be seen that the highest percentage (in numbers) of diatoms was 90 although it could be as low as 10, while the percentage of zooplankton items varied between 1 to 54. Cushing (1955) has indicated that one copepod is equivalent to about 2900 diatoms. Therefore the copepods seem to be more important as food than diatoms for the small oil sardine.

In certain years, the copepods were lacking in the stomachs of some size-groups. It would appear from this that small-sized oil sardine do not resort to selective feeding, but feed passively by filtering seawater through their gill rakers. Furthermore, August and September are the main months of phytoplankton bloom (Subrahmanyan, 1959 and Ramamurthy, 1963) in the inshore area and hence a predominance of diatoms is to be expected in the diet. More detailed studies on the mechanism of feeding in the oil sardine are needed.

## Acknowledgement

The author is thankful to Dr. R.V. Nair for suggesting the problem. Sincere thanks are also due to Prof. K.V. Sekharan and Dr. S. Ramamurthy for their valuable suggestions for improving the paper.

## References

Bensam, P. 1964. Differences in the food and feeding adaptations between juveniles and adult of the Indian oil sardine *Sardinella longiceps* Valenciennes *Indian J. Fish.*, **11** A: 377-390.

Chidambaram, K. 1950. Studies on length frequency of oil sardine *Sardinella longiceps* Cuv. and Val., and on certain factors influencing in the Calicut coast of Madras Presidency. *Proc. Indian Acad. Sci.*, **31** B: 252-286.

Cushing, D.H. 1955. Production and pelagic fishery. *Fish. Invest., London* Ser. 2, **27** (7) 104 pp.

Dhulkhed, M.H. 1962. Observations on the food and feeding habits of the Indian oil sardine, *Sardinella longiceps* Val. *Indian J. Fish.*, **9** A: 37-47.

Hornell and M.R. Nayudu. 1924. A contribution to the life history of the Indian oil sardine with notes on the plankton of the Malabar coast. *Madras Fish. Bull.*, **17**: 129-197.

HYNES, H.B.N. 1950. The food of the freshwater sticklebacks (*Gasterosteus aculeatus* and *Pygosteus pungitius*) with a review of methods used in studies of the food of fishes. *J. Anim. Ecol.*, **19**: 35-58.

JOHN, C.C. AND M.A.S. MENON. 1942. Food and feeding habits of oil sardine and mackerel. *Curr. Sci.*, **11**: 243-244.

KAGWADE, P.V. 1964. Food and feeding habits of the Indian oil sardine, *Sardinella longiceps* Valenciennes. *Indian J. Fish.*, **11A**: 345-370.

NAIR, R.V. 1953. Studies on the revival of the Indian oil sardine fishery. *Proc. Indo-Pacif. Fish. Counc.*, 1952, Sec. II, 115-129.

PRABHU, M.S. AND M.H. DHULKHED. 1967. On the occurrence of small-sized oil sardine *Sardinella longiceps* Val. *Curr. Sci.*, **36**: 410-411.

RAMAMURTHY, S. 1963. Studies on the hydrological factors in the North Kanara coastal waters. *Indian J. Fish.*, **10**: 75-95.

SCOFIELD, E.C. 1934. Early life history of the California sardine (*Sardina caerulea*) with reference to distribution of eggs and larvae. *Calif. Fish. Game, Fish.* Bull., **41**: 48 pp.

SEKHARAN, K.V. On the food of sardines, *Sardinella albella* (Val.) and *S. gibbosa* (Bleek.) of the Mandapam area. *Indian J. Fish.*, (in press).

SUBRAHMANYAN, R. 1959. Studies on the phytoplankton of the west coast of India. Part I. Quantitative and qualitative fluctuation of the total phytoplankton crop, the zooplankton crop and their interrelationship, with remarks on the magnitude of the standing crop and production of matter and their relationship to fish landings. *Proc. Indian Acad. Sci.*, **50** B: 113-187.