# ON SOME ASPECTS OF FISHERY AND BIOLOGY OF SARDINES . OF WALTAIR AREA

T. APPA RAO
*Waltair Research Centre of CM.F.R. Institute, Waltair.*

ABSTRACT

Along the Waltair Coast the fishing season for *Sardinella fimbriata* starts in October-November and terminates in May-June, whereas for *Sardinella gibbosa* the fishing season is shorter, March to Juiie-July. The average annual landings of both the species together are 73 t. *S. fimbriata* measuring less than 120 mm domi- ' nates the esriier part of the season and larger specimens measuring more than 120 mm dominate the later part. The reverse is the case for 5. *gibbosa.* Both the sardines feed on planktonic copepods, diatoms and larvae of other organisms. Length-weight relationship, sex ratio and fecundity hajve been studied.

## INTRODUCTION

Among the clupeoids, the lesser sardines, viz, *Sardinella fimbriata* and *Sardinella gibbosa* occupy an important position in the inshore fisheries at Waltair as they contribute 20-35% of the total clupeoid catches. The present account deals with the fishery, length-weight relationship, sex ratio and fecundity of *S. fimbriata* and 5. *gibbosa* during the period 1968-76.

## MATERIAL AND METHODS

The total sardine landings at Lawson's Bay, Waltair, were estimated regularly from the catches of shoreseines, gill nets and boatseines. From the data on the number of units of each gear, catch and effort, the total catches per day was estimated. Samples of *S. fimbriata* and *S. gibbosa* were collected from all the types of gear. The points method of Hynes (1950) was followed for quantitative analysis of feed, length-weight relationship was determined by using the equation $W = aL^n$ (Leoren 1951).

## FISHERY

The gear-wise catch, catch per unit for the sardines and the percentage composition in the total catch during 1968 to December 1975 are given in Table 1. In the shoreseines, sardines accounted for about 6% of the total fish catch. During the period 1968 to 1972, there was a decreasing trend in the catches but during 1973-76 the trend was variable. In the boatseines the sardines contributed to less

TABLE 1. *Catch per unit* (c/u) *values of sardines from different units during the period* 1968-76. *Percentage values are given in parenthesis.*

| | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 Average | |
|---|---|---|---|---|---|---|---|---|---|---|
| Shoreseine | | | | | | | | | | |
| C (kg) | 4027 | 3896 | 2229 | 1408 | 10«5 | 3627 | 1343 | 5185 | 3004 | 2150 |
| | (18.7) | (1.4) | (1.2) | (1.0) | (2.1) | (H.3) | (1.4) | (M.5) | (2.4) | (6.0) |
| C/U (kg) | 4.29 | 4.19 | 8.00 | 2.9 | 2.0 | 3.6 | 1.0 | 5.7 | 1.99 | 3.30 |
| Boaitseine | | | | | | | | | | |
| C (kg) | 257 | 918 | 168 | 2421 | 12 | _____ | 798 | _____ | 375 | 412 |
| | (1.19) | (0.3) | (0.1) | (1.7) | (0.1) | | (0.8) | _____ | (1.3) | (0.31) |
| C/U (kg) | 0.05 | 0.26 | 0,15 | 2.12 | 0.02 | | 0.47 | | 0.76 | 0.66 |
| Gil! net | | | | | | | | | | |
| C (kg) | 17207 | 255913 | 482734 | 136092 | 4981* | 28036 | 91759 | 30471 | 50414 | 70203 |
| | (80.0) | (89.2) | (98.7) | (97.3) | (97.6) | (87.6) | (97.*) | (85.5) | (81.1) | (84.9) |
| C/U (kg) | 12.04 | 32.7 | 25.2 | 20.1 | 16.7 | 20.3 | 9.9 | 11.7 | 14.14 | 23.87 |
| AM units | •21591 | 260727 | 184131 | 139921 | 5091'5 | 31663 | 93900 | 35656 | 53793 | 72802 |
| | (2.4) | (24.7) | (28.2) | (22.4) | (9.0) | (5.9) | (15,3) | (7.4) | (11.48) | |

Catch data incomplete for the yee'r.

than 1% of the catches and in gill nets to about 85%; January-April was the peak season. In bottom-set gillnets only in 1972 and 1973, total catch of 109 kg and 322 kg respectively, were obtained. Considering the catch per unit, gill-nets were found to be the most efficient gear (average 23.87 kg) followed by shore seines (average 6.0 kg). In boat seine, catch per unit was less tihan 1.0 except in 1971 (2.12).

## LENGTH-FREQUENCY DISTRIBUTION

From the studies on length-frequency distribution of *S. fimbriata* and *S. gibbosa* from selective nets (gill nets) and non-selective nets (shoreseines and booatseines) during the period 1971-76 it was inferred that the juveniles of *S. fimbriata* (50-100 mm) contributed to the fishery in the earlier part of the season and later they were replaced by adults (120-160 mm). The reverse was true for *S. gibbosa* since maturing and mature fish (150-200 mm) first made their appearance in the fishery and later the juveniles ( < 100 mm) contributed to the fishery. Sekharan et al (1969) also reported the spawning concentrations of 5. *gibbosa* (size range: 120-184 mm) im Waltair region during March-April.

## FOOD

For this study the fishes were grouped broadly into 50 mm size intervals, i.e., fishes measuring less than 50 mm as juveniles, between 50-100 mm as immature and more than 100 mm as adults.

*Food of* S. fimbriata:

The percentage frequency of different components of stomachs in different size groups of *S. fimbriata* is given in Table 2.

TABLE *2. Percentage composition of dominant food components in different size groups in* Sardinella fimbriata.

| | % of empty stomachs | Diatoms | Copepods | Bivalve and gastroped larve | Other items |
|---|---|---|---|---|---|
| Size group: 50-100 mm | | | | | |
| Nov 71 | 60.0 | 100.0 | — | — | — |
| Dec 71 | 23.3 | 55.9 | 25.6 | 13.5 | 5.0 |
| Jan 72 | 31.6 | 11.4 | 85.0 | — | 3.6 |
| Feb 72 | 10.5 | 0.2 | 54.8 | 30.0 | 15.0 |
| Nov 72 | — | 0.6 | 88.0 | 6.0 | 5.4 |
| Dec 72 | 50.7 | 6.8 | 77.2 | 5.1 | 10.9 |
| Dec 73 | 15.3 | 5.4 | 75.2 | 3.5 | 15.9 |
| Jan 74 | 6.0 | 0.7 | 99.3 | — | — |
| Dec 74 | — | 42.8 | 44.7 | 5.9 | 6.6 |
| 101-150 mm | | | | | |
| Nov 71 | 14.3 | 12.5 | — | | 87.5 |
| Mar 72 | — | — | 49.4 | 1.9 | 48.7 |
| Jun 72 | 17.8 | — | 96.7 | 3.3 | |
| Dec 73 | 2.0 | 5.3 | 88.3 | — | 6.4 |
| Jan 74 | 20.0 | 30.0 | 60.0 | 10.0 | |
| Mar 74 | — | | 71.2 | 11.3 | 17.5 |
| 160-200 mm | | | | | |
| Jun 72 | 2.2 | — | 94.4 | 4.4 | 0.8 |
| Jul 72 | 64.2 | — | 85.9 | 14.1 | — |
| Mar 74 | 1.9 | — | 16.3 | 3.6 | S0.1 |
| Apr 74 | — | — | 0.5 | 1.0 | 98.5 |
| May 74 | 80.0 | — | — | — | 100.0 |

Fish measuring less than 50 mm fed mainly on diatoms such as *Coscinodiscus* sp. Fish of 51-100 mm group also fed on diatoms particularly during the period November-December. During the other months they fed on copepods, larvae of bivalves and gastropods. *S. fimbriata* measuring between 101-150 mm preferred copepodes as food; the other items were larval forms of bivalves and gastropods, mysids, megalopa and alima larvae. Similar components could also be seen in the stomachs of fishes of 151-200 mm size group. The monthly percentage frequency of different food components during the period 1971-76 is given in Table 3.

*Phytoplankton:* The diatom, *Cosctnodiscus* sp. contributed more than 55.8% of the stomach contents in December, 71, June, July and November of 72 and February, 76. During the other months, the contribution of this item was between 1.7-43.2%.

TABLE 3. *Percentage frequency of dominant food components during different months in* Sardinella fimbriata.

| | Diatoms | Copepods | Bivalves | Other items |
|---|---|---|---|---|
| Nov 71 | 43.2 | — | — | 56.8 |
| Dec 71 | 55.8 | 25.7 | 13.5 | 5.0 |
| Jan 72 | 11.2 | 85.0 | — | 3.8 |
| Feb 72 | 7.9 | 50.0 | 27.6 | 14.5 |
| Mar 72 | — | 49.2 | 1.6 | 49.2 |
| Jun 72 | 99.4 | — | — | 0.6 |
| Jul 72 | 69.2 | '— | 30.8 | — |
| Nov 72 | 86.3 | — | 6.7 | 7.0 |
| Dec 72 | 6.8 | 74.8 | 1.8 | 16.6 |
| Dec 73 | 4.8 | 81.8 | 1.0 | 12.4 |
| Jan 74 | 1.7 | 98.3 | — | — |
| Mar 74 | — | 61.3 | 12.9 | 25.2 |
| Apr 74 | — | 11.5 | 6.0 | 82.5 |
| May 74 | — | — | 20.0 | 80.0 |
| Dec 74 | 42.7 | 44.7 | 5.9 | 6.7 |
| Nov 75 | 38.4 | 51.6 | 10.0 | — |
| Dec 75 | 14.0 | 82.5 | 1.6 | 1.9 |
| Jan 76 | — | 100.0 | — | — |
| Feb 76 | 82.3 | — | 6.2 | 11.5 |

*Tjooplankton:* Zooplankton occupied a dominant place in the food. Copepods were very common, forming more than 50% almost in all the samples. *Eucalanus, Calanus Paracalanus, Macrosetella, Acartia, Microsetella, Temora, Oithona, Centropages, Oncaea, Pseudodiaptomus* and *Corycaeus* were the important copepod genera encountered. Larval forms of bivalves and gastropods were commonly found in the majority of stomachs. Other items like mysids, megalopa, alima larvae, amphipods and prawn larvae contributed to lesser extent.

*Food of* S. gibbosa:

The percentage frequency of different food components in different size groups of *S. gibbosa* is given in Table 4.

Specimens of 50-100 mm size group mainly fed on copepods and other items such as alima larvae, larval forms of bivalves and gastropods. Fishes of 101-150 mm size had copepods, amphipods and diatoms as the main components of their food. Alima larvae and larvae of bivalves and gastropods which are included under other items were secondary in importantance. In fishes of 151-200 mm size, besides copepods, bivalve and gastropod larvae, prawn larvae were encountered in the food.

TABLE 4. *Percentage composition of dominant food components in different size groups in* Sardinella gibbosa.

| Size group(mm) | | % of empty stomachs | Diatoms | Copepods | gastropod larvae | Other items |
|---|---|---|---|---|---|---|
| 50-100 | Apr 72 | — | | 96.7 | — | 3.3 |
| | Nov 73 | 13.0 | 2.1 | 58.7 | 4.6 | 34.6 |
| 101-150 | Apr 72 | — | | 94.3 | 2.4 | 3.3 |
| | Jun 72 | 20.0 | 18.6 | — | — | 81.4 |
| | Jan 73 | — | | 5.0 | 30.0 | 65.0 |
| | Oct 73 | 5.2 | 62.5 | 37.5 | — | '— |
| 160-200 | Feb 72 | 50.0 | | 25.0 | — | 75.0 |
| | Apr 72 | 83.3 | | — | 100.0 | — |
| | Jan 73 | 96.8 | | | 100.0 | |
| | Mar 73 | 100.0 | | | | |

The monthly percentage frequency of different food components of stomachs of *S. gibbosa* is given in Table 5.

TABLE 5. *Percentage frequency of dominant food components during different months in* Sardinella gibbosa.

| | Diatoms | Copepods | Bivalves | Other items |
|---|---|---|---|---|
| Feb 72 | | 25.0 | - | 75.0 |
| Apr 72 | — | 93.1 | 2.5 | 4.4 |
| Jun 72 | 18.6 | 81.4 | — | — |
| Jan 73 | — | 5.6 | 22.2 | 72.2 |
| Oct 73 | 62.5 | 37.5 | — | — |
| Nov 73 | 2.1 | 58.7 | 4.6 | 34.6 |
| Dec 75 | 100.0 | — | — | — |
| Mar 76 | — | 50.0 | — | 50.0 |
| May 76 | — | 36.9 | — | 63.1 |

*Phytoplankton:* As in *S. fimbriata,* diatoms such as *Coscinodiscus* sp were the main items.

*Zoolplankton:* Copepods particularly species of *Paracalanus Microsetella, Eucalanus, Oncae, Acartia* and *Undinula* were important. Larvae of bivalves, mysids, megalopa larvae and alima larvae contributed to the food to some extent.

## LENGTH-WEIGHT RELATIONSHIP

Length-weight relationship was determined based on specimens of *S. fimbriata* of total length range of 30-200 mm and specimens of *S. gibbosa* ranging in total length from 50-200 mm (Figs. 1 & 2). Transformed logarithmic values of length and weight of the various equations were calculated by the method of least squares; analysis of co-variance was employed for significance test. A significant difference in the length-weight relationship between males and females, adults and immature individuals did not exist. A single equation was justified.

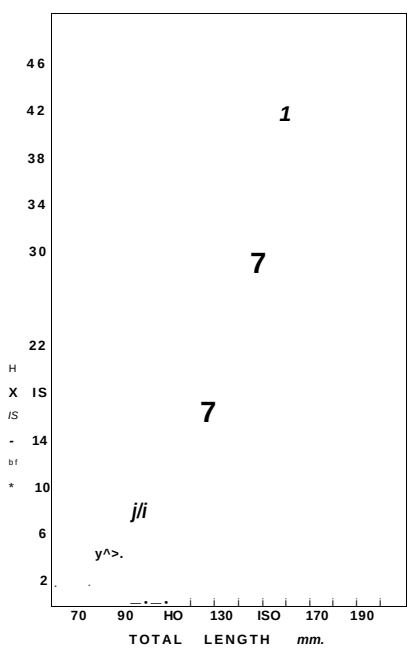


FIG. 1. Calculated length-weight curve fitted' to the average observed length values for *Sardinella fimbriata* (Val).

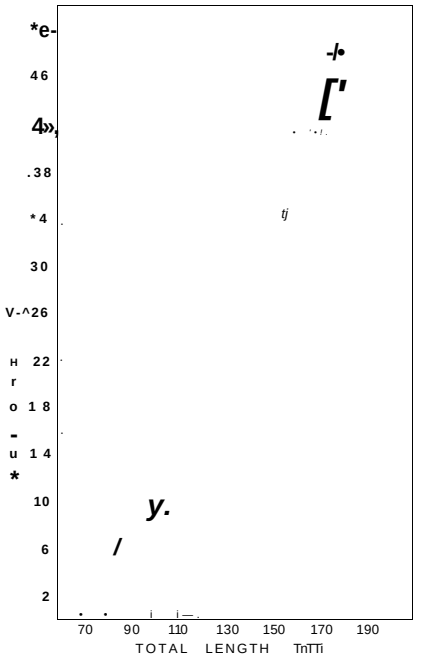


FIG. 2. Calculated length curve fitted to the average observed .length-weight values for *Sardinella gibbosa* (©ltor).

*S. fimbriata*

W - 0.002571 L3.4632 or log W - "2.59 + 3.4632 LogL

*S. gibbosa*

W = 0.009818 L2.9480 or Log W = "2.008 + 2.9480 Log L

## SEX RATIO AND FECUNDITY

In *S. fimbriata* almost all specimens examined were indeterminate except in February, March and June of 1972; even in these months indeterminates

exceeded 94%. For *S. gibbosa* the percentage of females were found to be equal in February, 1972. In June 1972, the percentage of females was more than that of the males and the ratio was 4 : 1. In January-February 1973, the percentage of males was more than females. Nair (1960) stated that in *S. fimbriata* sexes were equal in April, but in June female to male ratio was 3 : 2 . From these data it could be concluded that the ratio of females and males in *S. fimbriata* and *S. gibbosa* was not constant. In *S. fimbriata* the fecundity varied from 17974 to 34545 and in *S. gibbosa* between 12786 and 41326.

## CONCLUSIONS

The important feature of 5. *fimbriata* fishery was that it was mostly sustained by length range of 50-120 mm, larger specimens being rare. This would indicate that spawning grounds might perhaps be away from the inshore fishing grounds. Certain size groups of *S. fimbriata* suddenly disappeared from the fishing grounds during some months and certain other size groups showed up in the catches indicating that different broods entered the population. This might be due to multiple recruitment throughout the season.

The important feature of *S. gibbosa* fishery was the dominance of adult fish in the population consisting of fish with mature and ripe gonads.

The length-frequency analysis of 5. *fimbriata* showed that the fish less than 10O mm entered the fishery during the beginning of the fishing season i.e. November-February and larger fish measuring more than 120 mm dominated the catches during March-June. *S. gibbosa* fishery usually starts sometimes during the period February-March consisting of mature individuals measuring more than 120 mm in length and sometimes during October-December comprising immature fish measuring less than 100 mm in length.

Analysis of stomach contents of *S. fimbriata* revealed that it fed both on phyto- and zooplankton indicating plankton-feeding habit. Furher, it was found that fish measuring less than 50 mm fed mainly on diatoms whereas fishes of 51-100 mm size fed on both diatoms and copepods. But larger fish measuring more than 100 mm fed mainly on copepods. *S. gibbosa* was found to be a zooplankton feeder.

At Waltair, *S. fimbriata* showed a predominance of females over males as the female to male ratio was found to be 2 : 1 and fecundity varied from 17974 to 34545. From Vizhinjam, Bennet (1967) also reported predominance of females over males in *S. fimbriata* and. fecundity varied from 5500 to 41700 in fishes measuring 138 to 184 mm. But in *S. gibbosa* the percentage of males was more than the females and the fecundity varied from 12786 to 56378.

## ACKNOWLEDGEMENTS

The author acknowledges the constant encouragement offered by Dr. E. G. Silas, the helpful suggestions of Drs. K.' Radhakrishna, B. Krishnamoorthi, G. Luther and P. Vedavysa Rao, and the help of Shri B. Narayana Rao in drawing the figures.

## REFERENCES

BENNET, P. S. 1967. Some observations on the Fishery and biology of *Sardinella fimbiiata* (Val) at Vizhinjam. *Indian J. Fish,* 14(1 &2): 145-158.

HYNES, IH. B. N. 1950. The food of the fresh water stickle back, *Gasterosteus acukatus* and *Pygosteus pungitius* with a review of the methods used in studies on the food of the fishes. /. *Anim. Ecol.* 18(1): 35-3«.

LECREN, C. D. 1951. The length weight relationship and seasonal cycle in gonad weight and condition in the Porch *(Peroa fluviatils). J. Anim. Ecol,* 20: 201-219.

NAIR, R. V. J'960. Synopsis on the biology and fishery of Indian Sardines. *Proc. World Sci. Meet Biol, Sardines and related species* FAO, Rome. 2: 329-414.

SEKHARAN, K. V., M. S. MUTHU, G. SUDHAKARA RAO AND B. NARAYANA RAO. 1969. Spawning concentrations of the Sardine, *Sardinella gibbosa* (Meeker), off the North Andhra coast in March-April 1969. *Indian J. Fish.* 16: 156-160.