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Maturation and spawning in the fringe scale sardine, *Sardinella fimbriata* (Cuvier and Valenciennes, 1847) from Karwar waters, Uttar Kannada District, Karnataka

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Abstract

It is significant to study the reproductive biology of fish because it is useful in the prediction of spawning grounds, spawning seasons and for exploitation of fishable stocks. The investigation and the work regarding the knowledge about reproduction of *Sardinella fimbriata* is of commercial importance. It has been observed that at Karwar coast, the size of *Sardinella fimbriata* during first recruitment was found to be 6 to 7 cm, while 7 to 13.5 cm sized *Sardinella fimbriata* were dominated in the bulk landings. Spawning season was determined on the basis of occurrence of individuals in various stages of maturity during the period December- 2011 to December- 2012. During the present study, seven stages of maturity were observed in *Sardinella fimbriata*, (According to the ICES standards). Little attention is paid on the reproductive biology of the fishes. Keeping above points in view, the study of the reproductive biology of fringe scale sardine, *Sardinella fimbriata* (Cuv. & Val.) from Karwar waters was undertaken.

Keywords: Fringe scale sardine, Maturation, *Sardinella fimbriata*, Spawning, Stages of maturity.

1. Introduction

Karwar is one of the major fish landing centers from Uttar Kannada district of Karnataka. Though extensive studies on oil sardines have been carried out from time to time, very few researchers have paid attention on lesser sardines and their fishery. India occupied second position by contributing 5.49% to the world fish production; fish production showed rise from 4.16 million tonnes (1991- 92) to 8.67 million tonnes (2011- 12); (DAHA & F, 2012- 13)^[1]. In India clupeid fish contributes about 1/3rd of the total marine fish production mainly represented by the Sardines, Anchovies and White baits. Sardines and lesser sardines form a major fishery resource among the marine pelagic fin fishes of the Indian Seas, of which *Sardinella fimbriata* and *S. gibbosa* dominate in the commercial catches landed in and around Karwar, which meets the need of food of coastal people and also used as manure. Considerable information is available on the morphological and reproductive aspects of sardines and lesser sardines; amongst notable ones are by Dharmamba (1959)^[2]; Dutt (1959)^[3]; Sam Bennet (1965 & 1967)^[4 & 5]; Nair (1973)^[6] & Lazarus (1984a)^[7]; Prabhu (1956)^[8]; Annigeri (1989)^[9] & Qasim (1973)^[10] have given sufficient information on reproductive biology of economically important fishes from the Indian Ocean. The present study has been done to add recent information in order to redress the balance.

2. Materials and Methods

Karwar is located at 14° 48' N and 74° 07' E and has the Kali estuarine complex, which is subjected to greater fluctuations due to South-West monsoon which also causes upwelling. Thus there is an enormous availability of food and it also provides breeding ground for the commercially exploited fish. At fortnightly intervals, by random sampling method; fresh samples of *S. fimbriata* were collected from Karwar and Karwar fish market, fish landing centres Baithkol and Majali during the period from December- 2011 to December- 2012 (Plate-1). The collected fish were brought to the laboratory and thoroughly cleaned, blotted with blotting paper and studied for the biological details. During present study a total of 1575 fish were examined. Amongst 1415 (698- Males and 717- Females) fish were used for the

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determination of sex and 160 fish were in-determinate. Each fish was weighed nearest to 0.1 gram and length was also measured to the nearest mm. All were sorted in to different size groups then were cut open and the sex was determined by examining the gonads and the maturity stages were recorded according to seven point scale Nikolasky (1963) [11] & Antony Raja (1966) [12]. Samples of ovaries and testes from various stages of maturity were preserved in 5% formaldehyde for further reproductive studies and histological preparations.

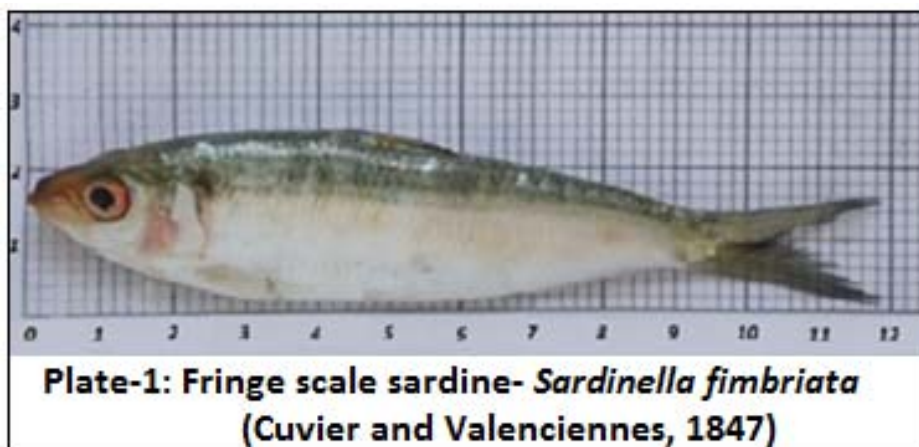
3. Results and Discussion

The development of fisheries mainly depends upon the knowledge of the biology of the local fishes in India. Distinguishing between various stages of maturity is necessary

for understanding the maturation process in the gonads of fish. Stages of maturity of gonads were studied on morphological basis as well as microscopically. Macroscopic observations like appearance of gonads (colour, shape and size in relation to body cavity), change in diameter of un-spawned ova, amount of yolk deposition was taken in to consideration, while for the fresh fish samples only morphological observations were made. Standards laid down by ICES were followed, ICES has noted seven stages of maturity, I and II as immature; III and IV as maturing; V as mature; VI as ripe and VII spent, Qasim (1973) [10].

3.1 Classification of maturity stages in the testes and ovaries of *Sardinella fimbriata*

Stage	Maturity Stages	Testes (Fig. 1)	Ovaries (Fig. 2)
I	Immature (Never spawned) (Fig. 1 & 2 - I)	Smaller in size, whitish in colour, translucent and asymmetrical with long and thin vas deference.	Small, thread-like, translucent and have two small asymmetrical clear lobes with long and thin oviduct. Ova were not visible to the naked eye. Ova diameter ranged between 0.053 to 0.131 mm.
II	Immature (Developing/ Maturing (Virgin)/ Recovered spent or Rematuring stage (Fig. 1 & 2 - II)	White in colour, flattened, translucent/ opaque, extends about ½ length of the body cavity with little reduced vas deference.	Yellowish in colour, occupies about ½ length of the body cavity. Ova diameter ranged between 0.133 to 0.159 mm.
III	Developing (Fig. 1 & 2 - III)	Thickened and white in colour, translucent, extended less than two third length of the body cavity with wide and reduced vas deference.	Turgid, opaque and yellowish in colour with granular appearance. Ovaries occupied about two third length of the body cavity. Oviduct was reduced. Ova diameter ranged between 0.161 to 0.176 mm.
IV	Maturing (Fig. 1 & 2 - IV)	Massive in size, creamy whitish in colour. Acquired more than two third length of the body cavity with very much reduced vas deference.	Ovaries were reddish yellow in colour. Blood vessels prominent, Ova were semitransparent and spherical. Ova diameter ranged between 0.180 to 0.201 mm.
V	Mature (Fig. 1 & 2 - V) and (Plate-2 &3)	Prominent in size, acquired more than ¾ lengths of the body cavity and milt starts oozing out if pressure is applied on the abdomen.	Ovaries large, orange colored and fully developed. Extended almost in the entire body cavity. Ovaries were filled with numerous, yellowish ova. In mature condition the eggs were large and visible with naked eye. Size of ova varied between 0.204 to 0.295 mm
VI	Ripe (Fig. 1 & 2 - VI)	Testes were very thick, flattened, turgid and creamish white in colour. More Prominent in size (extensive), acquired full length of the body cavity and shows milting. Milt oozes out from the cut ends of the testes in the copious amount	Fully filled with yolk, free and opaque large eggs, those were almost ready for liberation. Size of ova varied between 0.322 to 0.512 mm (Plate-4)
VII	Spent (Fig. 1 & 2 - VII)	Appeared shrunken and transparent.	Partially and fully spent ovaries were found. At this stage few residual eggs were seen. The fully spent ovaries were flabby, contracted and empty.



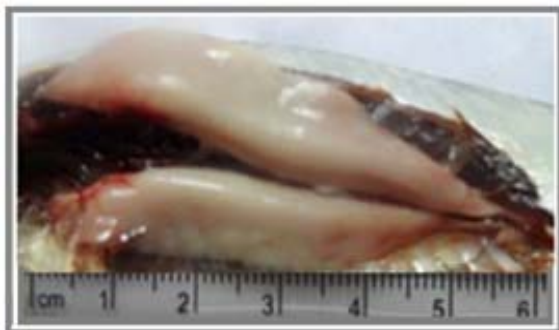
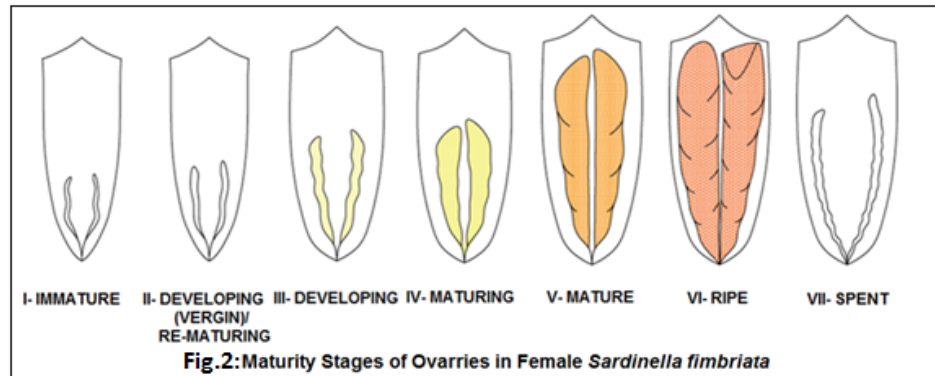
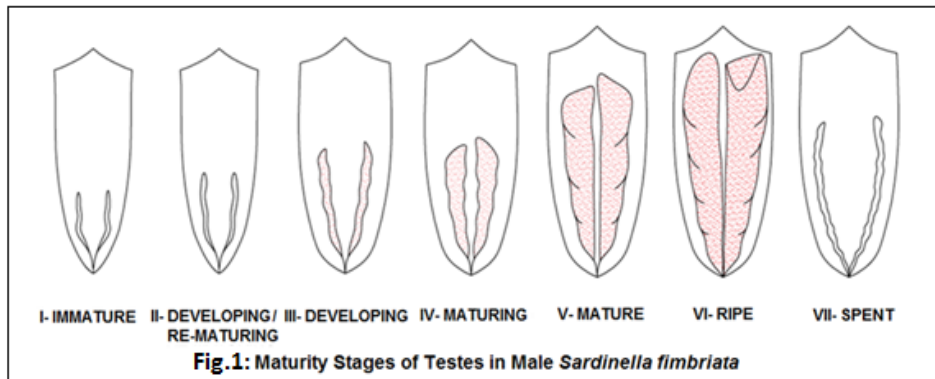


Plate-2: Mature testis of *S. fimbriata*



Plate-3: Mature ovary of *S. fimbriata*

ones in a year for short duration especially from January to April; similar observations were made in *S. fimbriata* by Radhakrishnan (1964) [13]. During present study it was observed that the percentage of mature males and females was highest from October to April. Males matured well in advance than females. Females attain sexual maturity comparatively at the larger size than males. Similar observations were made by Lazarus (1984a) [8] at Vizhinjam for *S. sirm*; Sekharan (1968) [14] for *S. gibbosa*; Dutt (1963) [15] for *S. fimbriata*. Knowledge about spawning habits and maturation cycle is necessary to know the periodic replenishment of fishable stock. Thus this attempt has been made so as to add more information to the existing data.

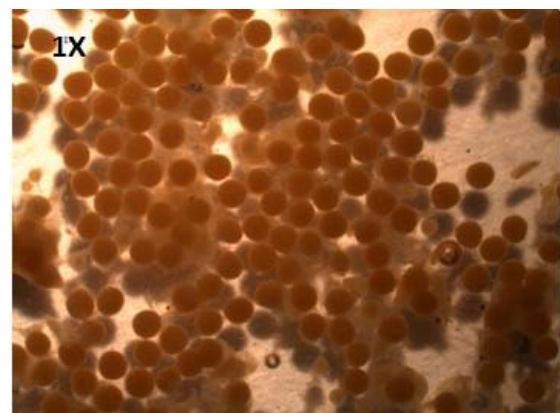


Plate-4: Eggs of *Sardinella Fimbriata* (1X)

3.2 Spawning

Spawning season gives an idea about peak of maturity in fishes. Spawning season can be predicted on the basis of occurrence and dominance of advanced stages as well as mature fishes in the commercial catches with respect to particular time. Different stages of sexual maturity were seen in the fish above 10 cm. At Karwar coast *S. fimbriata* spawns

4. Conclusion

During the study period, results obtained for the maturity stages of the gonads of *Sardinella fimbriata* showed that the overall growth and development of fish at Karwar coast was well.

5. Acknowledgements

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