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Estimation of Fecundity in Fringe Scale Sardine *Sardinella fimbriata* (Cuvier and Valenciennes, 1847) from Karwar Waters

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Abstract: *Fecundity study is necessary to know the reproductive potential of fish. Randomly collected fresh fish specimens of fringe scale sardine, Sardinella fimbriata were collected fortnightly from the fish landing centers- Karwar, Baithkol, Majali and also from the Karwar fish market and were studied for morphological and biological details in the laboratory during the period December- 2011 to December- 2012. For determining the number of ova in each ovary, 100 mg weighed portion from the anterior; middle and posterior regions of each right and left lobes of the ovaries were taken and the number of eggs was counted from the mature and ripe ovaries only. Data was pooled together and estimated fecundity was calculated and regression equations were obtained. The number of eggs which were found in S. fimbriata was ranged from 14513 to 25490 and estimated fecundity varied from 14508 to 25485. On an average the estimated fecundity was 19671 whereas the observed fecundity was 19675. Study on the reproductive aspects such as fecundity and ova diameter studies can help in the fisheries forecast for its successful management.*

Keywords: *Fecundity, fringe scale sardines, reproductive potential, Sardinella fimbriata.*

I. Introduction

Fisheries development is dependent upon the recruitment pattern and reproductive biology of the fish. As the fish is cheaper source of animal protein and in future can meet the need of fast growing population. Marine fishery plays an important role in social and economic development of India besides provides employment opportunities and contributes to the valuable foreign exchange. Karwar is one of the major fish landing centers located in the Uttar Kannada district, covers 144 km of coastal stretch, from Majali in the North to Bhatkal in the South. Kali estuarine complex provides feeding and breeding grounds for commercially important fish species. Fecundity study will help to predict seasonal crop and reproductive capacity of *Sardinella fimbriata.* From India, Muthu *et. al.* (1969) [1], studied on the spawning of *S. gibbosa*; Raja and Hiyama (1969b) [2], on *Sardinella sirm*; Sekharan *et. al.* (1969) [3], studied the spawning concentrations of *S. gibbosa*. An attempt has been made to study the fecundity of *Sardinella fimbriata*; these findings will help to predict the fish catch from Karwar waters.

II. Material And Methods

2.1 Study area

Karwar is located at 14^{o} 48’ N and 74^{o} 07’ E in Uttar Kannada district. For fecundity study three sampling stations were selected, Karwar and Karwar fish market, Baithkol (located at 14^{o} 80’ N and 74^{o} 11’ E) and Majali (located at 14^{o} 90’ N and 74^{o} 10’ E).

2.2 Description of the species

According to Berg’s (1940) [4]- Fringe scale sardine, *S. fimbriata* belongs to Phylum- Chordata, Subphylum- Vertebrata, Superclass- Osteichthyes, Class- Actinopterigii (Cuvier, 1829), Subclass- Neopterygii, Order- Clupeiformes, Family- Clupeidae, Genus- *Sardinella*, Species- *fimbriata* (Cuvier and Valenciennes, 1847)
ITIS Report: Taxonomic Serial Number of Species is- 16176,

2.3 Specimen collection and sampling procedure

The fresh specimens of fringe scale sardine, *S. fimbriata* were collected fortnightly from selected sampling stations. Total 1575 specimens were studied for morphological and biological details in the laboratory during the period December- 2011 to December- 2012.

Fecundity was studied by examining the ovaries of twenty-five females. Each ovary was taken out and excess of moisture was blotted out by using blotting paper. Weight of each ovary was taken nearest to the mg. For the estimation of fecundity, mature and ripe ovaries of *S. fimbriata* were used. For determining the number of ova in each ovary, 100 mg weighed portion from the anterior; middle and posterior regions of each right and left lobes of the ovaries were taken, on the pre-weighed Aluminium foil by using digital electronic balance. These samples were preserved in modified Glison's fluid in screw-capped glass sampling vials and were shaken periodically for the liberation of ova from the septum of ovigerous lamellae. Each sample was teased in the water for two minutes so as to spread the eggs uniformly, then microscopic examination and counting was done. The numbers of mature ova were counted with ripe ones to avoid underestimation of fecundity.

Fecundity or Season's crop was calculated by using formula-

$$F = \frac{No\ of\ ova\ in\ the\ sample\ \times Total\ weight\ of\ the\ ovary(g)\ \times 100}{Weight\ of\ the\ fish(g)} \quad (1)$$

The relationship between fecundity- *F* and total length- *TL*; body weight- *BW*; ovary length- *OL* and ovary weight- *OW* were expressed by least square method:

$$log\ F = log\ a + b\ log\ x \quad (2)$$

Where:

$'F'$ Is fecundity, $'a'$ is constant,

$'x'$ Is variable (Total length; body weight; ovary length and ovary weight) and

$'b'$ Is correlation coefficient (The exponent).

To achieve the success for increasing potential of the Sea and to support socio-economic status of fishermen and ultimately economy of the nation, fecundity study of fringe scale sardine, *Sardinella fimbriata* is necessary for prediction of yield.

III. Results And Discussion

3.1 Fecundity studies in the *S. fimbriata*

Knowledge of reproductive potential is an essential pre-requisite for the proper management and conservation of the fishery resources. During present study ovaries of twenty five female fish from advanced stages (Stages- V and VI) were taken during peak spawning months January and April. The number of ova produced was studied and relationships between fecundity and four variables viz. standard length; body weight; ovary length and ovary weight was established.

The number of eggs which were found in *S. fimbriata* was ranged from 14513 to 25490. Estimated fecundity varied from 14508 to 25485. On an average the estimated fecundity was 19671 whereas the observed fecundity was found out to be 19675. During the present study no significant variation has been found in the estimated and calculated fecundity of *S. fimbriata*. Appa Rao (1981) [5] and Ghosh *et. al.* (2013) [6] in *Sardinella gibbosa* and *S. fimbriata* have made similar findings.

The data was pooled together and scatter diagrams were plotted; (Figs.1, 2, 3 & 4). Lines of regression were fitted by least square method. The relationship between fecundity and standard length; ovary length; body weight and ovary weight of *S. fimbriata* were established.

3.1.1 Relationship between fecundity and standard length of the *S. fimbriata*

The scatter diagram of observed and estimated fecundity for standard length has been depicted and the regression equations were obtained (Fig.1). Regression equations obtained from the scatter graph for the standard length; observed and estimated fecundity are as follows:

Y = 0.631 X + 2.984 (R^2 = 0.984) and

Y = 0.631 X + 2.983 (R^2 = 0.984) respectively.

Where:

Y = log F (Fecundity in thousands) and X = log L (Standard length in mm)

From above equations, it is the fact that for standard length; observed and estimated fecundity were the linear functions of each other, latter on showed increase at the rate of 2.984 and 2.983 times to the standard length respectively. Further the results of this study support the Simpson's view that the fecundity of a fish increases at the rate of about third power of its standard length.

There was no significant difference between correlation coefficient (R^2) for the observed and estimated fecundity. For both the same values of R^2 were obtained (R^2 = 0.984). The value of R^2 is closer to one, thus there is highly positive relationship between the standard length and fecundity in case of *S. fimbriata*.

3.1.2 Relationship between fecundity and body weight of the *S. fimbriata*

The scatter diagram of observed and estimated fecundity for body weight has been depicted and the regression equations were obtained (Fig.2). Regression equations obtained from the scatter graph for the body weight; observed and estimated fecundity were similar, as given below:

Y = 0.217 X + 4.001 (R^2 = 0.970)

Where:

Y = log F (Fecundity in thousands) and X = log L (Body weight in gm)

From the above equation, it is clear that for body weight; observed and estimated fecundity were the linear functions of each other, latter on showed increase at the rate of 4.001 times to the body weight respectively. Further the results of this study support the Simpson's view that the fecundity of a fish increases at the rate of about third power of its body weight.

There was no significant difference between correlation coefficient (R^2) for the observed and estimated fecundity. For both the same values of R^2 were obtained (R^2 = 0.970). The value of R^2 is closer to one, thus there is highly positive relationship between the body weight and fecundity in case of *S. fimbriata*.

3.1.3 Relationship between fecundity and ovary length of the *S. fimbriata*

The scatter diagram of observed and estimated fecundity for ovary length has been depicted and the regression equations were obtained (Fig.3). Regression equations obtained from the scatter graph for the ovary length; observed and estimated fecundity were similar, as given below:

Y = 0.039 X + 2.737 (R^2 = 0.97)

Where:

Y = log F (Fecundity in thousands) and X = log L (Ovary length in mm)

From above equation, it is the fact that for ovary length; observed and estimated fecundity were the linear functions of each other, latter on showed increase at the rate of 2.737 times to the ovary length. Further the results of this study support the Simpson's view that the fecundity of a fish increases at the rate of about third power of its ovary length.

There was no significant difference between correlation coefficient (R^2) for the observed and estimated fecundity. Same values of R^2 were obtained for observed and estimated fecundity (R^2 = 0.97). The value of R^2 is closer to one, thus there is highly positive relationship between the standard length and fecundity in case of *Sardinella fimbriata*.

3.1.4 Relationship between fecundity and ovary weight of the *S. fimbriata*

The scatter diagram of observed and estimated fecundity for ovary weight has been depicted and the regression equations were obtained (Fig. 4). Regression equations obtained from the scatter graph for the ovary weight; observed and estimated fecundity were similar, as given below:

Y = 0.692 X + 4.010 (R^2 = 0.895)

Where:

Y = log F (Fecundity in thousands) and X = log L (Ovary weight in gm)

From the above equation, it is clear that for ovary weight; observed and estimated fecundity were the linear functions of each other, latter on showed increase at the rate of 4.010 times to the ovary weight respectively. Further the results of this study support the Simpson's view that the fecundity of a fish increases at the rate of about third power of the ovary weight.

There was no significant difference between correlation coefficient (R^2) for the observed and estimated fecundity. For both little variation in the values of R^2 was obtained (R^2 = 0.896 & 0.895 respectively). The values of R^2 are closer to one, thus there is highly positive relationship between the ovary weight and fecundity in case of *S. fimbriata.*

Literature available on the fish fecundity shows that there have been some variations in its definition based on stage of ova counted. Franz (1910) [7] and Clark (1934) [8] stated that fecundity increases at the square of fish length. Simpson (1951) [9]studied fecundity by taking into consideration the index of diversity; according to him this factor affects the population size and also stated that in Plaice the fecundity showed increases per cube of the length of fish. Lehman (1953) [10] in the American shad, *Alosa sapidissima* found that the relation between fecundity and length is linear. He found that fecundity increases with the increase in length, weight and age of the fish thus those are directly proportional to each other.

According to Bagenal (1957) [11] and Scott (1962) [12] environmental conditions and adequate food supply are the factors which affect the fecundity in fish. Qasim and Qayyam (1963) [13] have given detailed pathways in order to understand fecundity, further useful for the fishery biological work. According to him in some fresh water fishes there was straight line relationship between gonad weight and fecundity. Antony Raja (1972b) [14] studied the fluctuations in the fecundity of oil sardine and stated that its relationship with length of fish is curvilinear and with weight rectilinear. According to Qasim (1973) [15] as the ova are withdrawn from the ovaries in batches, thus there is difficulty in accurate determination of fecundity of species. James *et. al.* (1980) [16], said that fecundity varies with size and age of the species.

IV. Figures

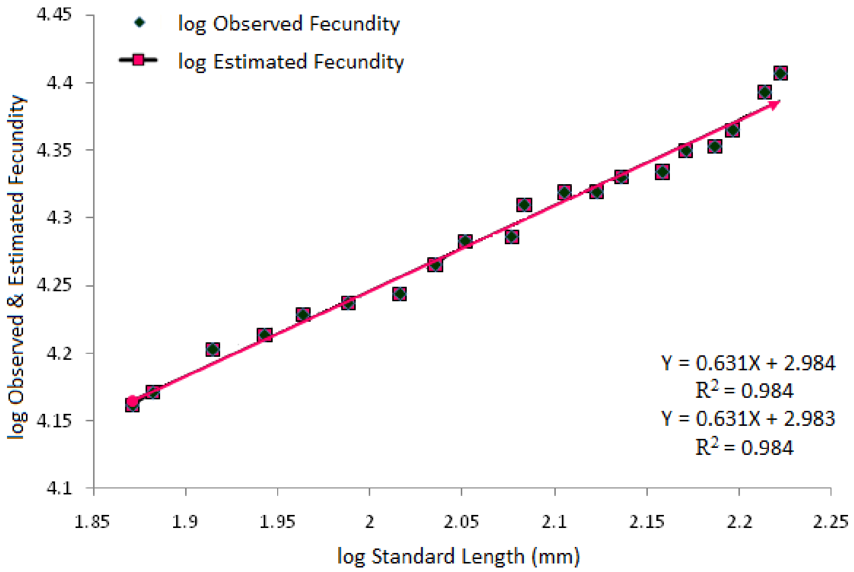

Fig. 1: Relationship between fecundity and standard length of the *Sardinella fimbriata*

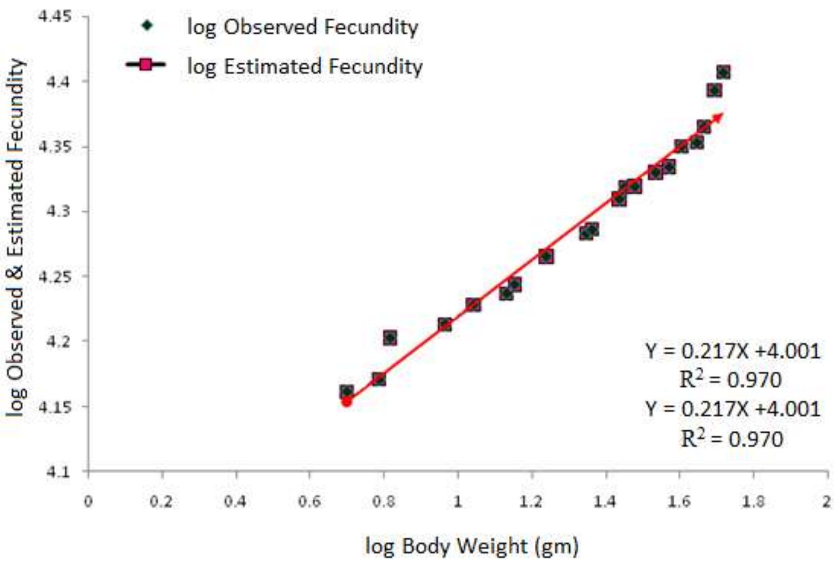

Fig. 2: Relationship between fecundity and body weight of the *Sardinella fimbriata*

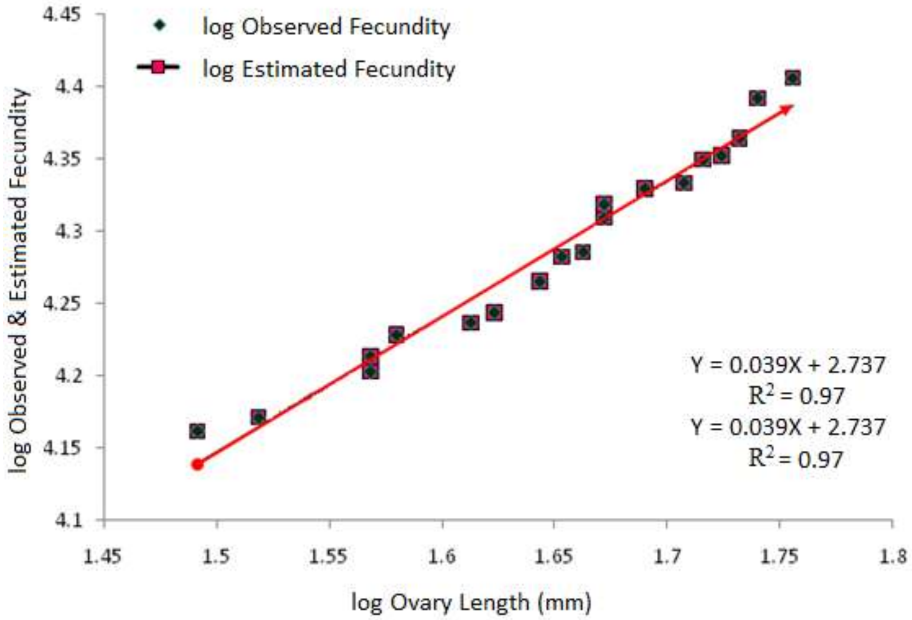

Fig. 3: Relationship between fecundity and ovary length of the *Sardinella fimbriata*

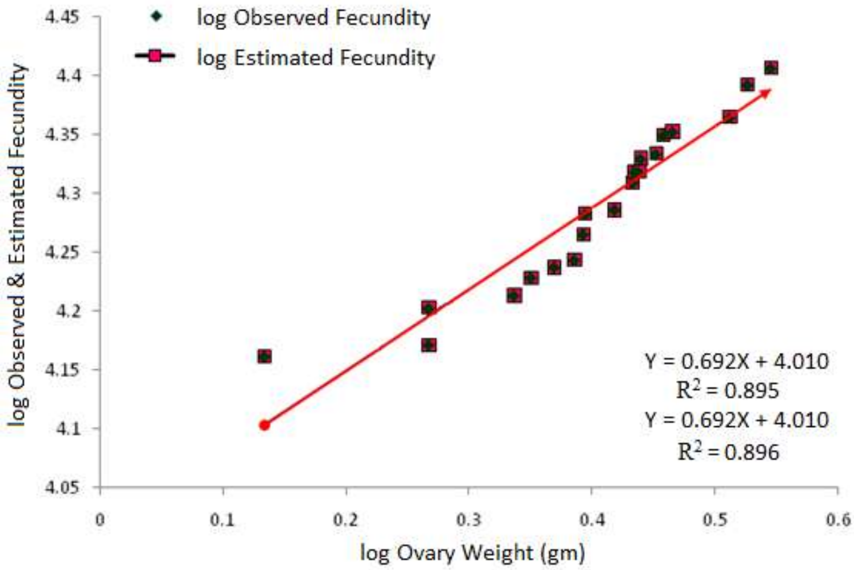

Fig. 4: Relationship between fecundity and ovary weight of the *Sardinella fimbriata*

V. Conclusion

From the regression equations obtained for four different parameters, an average difference between the observed and estimated fecundity against standard length; body weight; ovary length and ovary weight was found to be negligible. A result obtained indicates that the estimated fecundity can be calculated accurately by taking any two variables. So the conclusion is that the standard length; body weight; ovary length and ovary weight are better suited for the estimation of fecundity in the fringe scale sardine- *S. fimbriata.*

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