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Study on the Fecundity and Gonado somatic index of *Rastrelliger kanagurta* (Cuvier, 1817) of southern coast of Maharashtra, India

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Abstract: Investigation of fecundity and gonado somatic index (GSI) of *Rastrelliger kanagurta* were carried out from March 2011 to February 2012. Fecundity was determined at different length, weight and ovary ranges of different individual fishes. Study revealed that at 5% significant level significant average absolute fecundity was found to be 1,08,266 and relative fecundity ranged from 407 to 1499. The number of ova generally increased with increase in length and weight. However, variations in fecundity with respect to length and weight were also noticed. The gonado-somatic index (GSI) was calculated for each individual fish (592 numbers) and was averaged for each month. The average GSI values were plotted against each month to analysed monthly variations. GSI showed wide variations between sex and it was highest for both males and females during the month of April and September, showing occurrence of more ripe individuals. Analysis of regression showed that there were significant relationship between the fecundity with the fish length, body weight and ovary weight.

Keywords: Fecundity, Gonado Somatic Index (GSI), Indian Mackerel, *Rastrelliger*

INTRODUCTION

A clear knowledge of the fecundity plays a significant role to evaluate the commercial potentialities of fish stock and also to assess the abundance and reproductive potential of the spawning stock. The Indian mackerel, *Rastrelliger kanagurta* belonging to family Scombridae is one of the most important pelagic, shoaling marine fish in India. Its fishery is second in importance to that of oil sardine in the multispecies structure of Indian marine fishery (Yohannan and Sivadas, 2003). Indian mackerel being a much esteemed table-fish which is greatly in demand, its fishery is an important source of livelihood to those engaged in fishing and dependent industries. Indian mackerel is also called as "Rake gilled mackerel" and locally known as *Bangda* in Maharashtra (Doiphode,1974.).

The annual production of the Indian mackerel is also characterized by wide fluctuation as evident from the catch records of the past 50 years. Generally, the coastal upwelling ecosystem are colonized by planktivorous small pelagic fishes such as Sardine, Indian mackerel and these fish population are characterized by significant inter-annual fluctuation in their abundance (Krishnakumar *et al.*, 2008). From the point of fisheries management, it is observed that there is localized variation in fishing intensity along the Indian coast and therefore the stocks have to be effectively decline. Therefore to overcome of such problem adopts management strategies on local/ regional scales a holistic knowledgebase on biology, life history and behaviour of species in the region is crucial (Adams, 1980; Begg *et al.,* 1999; Prathibha *et al*., 2004).

As the reproductive potential of individual fishes within the spawning stock affects recruitments, most fish biomass assessment programmes require inputs on reproductive parameters such as the age/length at maturity, proportion of mature fishes in the population, fecundity, GSI and spawning frequency (Nikolskii, 1969). These parameters are widely applied to formulated capture fisheries management strategies such as enforcement of minimum catch at size restriction, close fishing seasons during peak breeding period etc. Thus, the present study would definitely throw some light on these aspects. In view of the above, the present study focuses on some sound knowledge about fecundity and gonado-somatic index of Indian mackerel *R. kanagurta*. Therefore, it is hopeful that the present updated work will contribute some knowledge to the biologist in future for more intensive research and

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management of this fish.

MATERIALS AND METHODS

Coastal water of Maharashtra along the west coast of India was selected as study area. The study is based on the total of 611 individuals of Indian mackerel, *R. kanagurta* ranging in the size range from 6.4 to 29.9 cm, total length comprising of 215 males, 277 females and 119 indeterminants. The mackerel samples were collected on a weekly basis from the fish landings by purse seine, trawl, gill net and rampani nets, during the fishing season March 2011 to February 2012. The specimens of the different size groups were randomly collected. The length, weight, gonad condition and stage of maturity of individual fish in each sample were noted. The ovaries were removed and preserved in Gilson fluid for further studies.

For determination of fecundity, fresh ovaries were used. The excess moisture was removed by using blotting paper and the ovaries were weighed to the nearest milligram. A sub sample of 1 mg ripe ovary was weighed with an electronic balance of 0.1 mg accuracy. The sub-sample was then taken from three parts of ovary i.e. anterior, middle and posterior, in a watch glass and the numbers of ova were counted physically and the average was computed. The fecundity was determined by the formula given by Sinha (1995).

$$\text{Fecundity} = \frac{\text{Total weight of ovary}}{\text{Sub} - \text{sample weight}} \text{ X Average number of ova in the sample} \quad \ldots\text{Eq. 1}$$

Relation between fecundity and other parameters such as total length, total weight and ovary weight were obtained by fitting data as a scatter plot and fitting linear regressions. For calculating the gonado somatic index, the weight of the each individual of both sexes was noted and the gonads were removed carefully and weight on an electronic balance. The formula used for estimation of GSI (Bal and Rao, 1984) is as follows:

$$GSI = \frac{\text{Total weight of gonad}}{\text{Total weight of fish}} \text{ X } 100 \quad \ldots..\text{Eq.2}$$

RESULTS AND DISCUSSION

Fecundity: Fecundity is the number of mature ova laid by a female in one spawning season. Only the ripen ova were considered for the estimation of fecundity. In *R. kanagurta*, a clear demarcation of mature and immature ova was noticed from stage VI onwards. Hence, for fecundity studies, fishes of stage VI (a) and VI (b) were taken into consideration. The absolute fecundity in *R. kanagurta* ranged from 55,264 (22.7 cm, 120 gm) to 3,14,568 eggs (29.9 cm, 304 gm) with an average of 1,08,266 and relative fecundity ranged from 407 to 1499. The minimum weight of the mature *R. kanagurta* was 80 g and the maximum weight was 304 g, with total length varying between 20 cm to 29.9 cm. The number of ova generally increased with increase in length and weight. However, variations in fecundity with respect to length and weight were also noticed. Absolute fecundity estimates of mackerel in earlier studies range from 94,000 eggs (Devanesan and John, 1940); 20,911 to 111,000 eggs (Rao, 1967) and about 38,000 eggs (Antony Raja and Bande, 1972). Several workers felt that fecundity of mackerel is much higher than these reports (Sekharan, 1958; Yohannan and Abdurahiman, 1998). Yet, this study does not indicate much variation in absolute fecundity from those reported by earlier workers. However, the relative fecundity of mackerel estimated in this study is much higher than the range of 701 - 866 eggs reported by Rao (1967) in mackerel off Mangalore coast. Pillai *et al.* (2009) reported that the fecundity of *R. kanagurta* ranged from 39,600 eggs to 73,781.Abdussamad *et al.* (2010) calculated the *R. kanagurta* along tuticorin coast as 68,500 eggs. Tge recent study by Hulkoti *et al.* (2013) obtained fecundity between 86,744 and 94,376 eggs with a mean of 91,258±SD. Arrafi *et al.* (2016) observed that the fecundity of *R. kanagurta* varied from 28,542 to 123,760 with an average of 56,635 eggs.

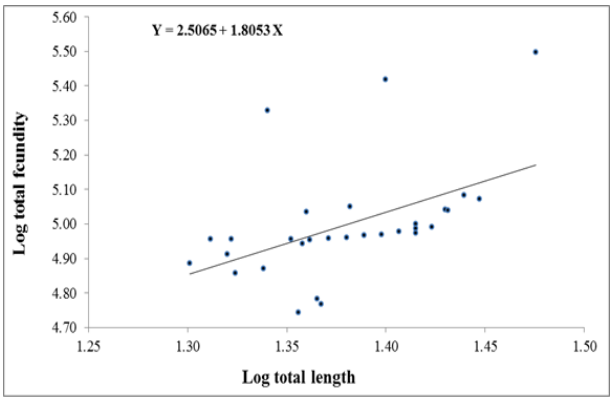

Fig. 1. *Logarithmic length and fecundity relationship of R. kanagurta.*

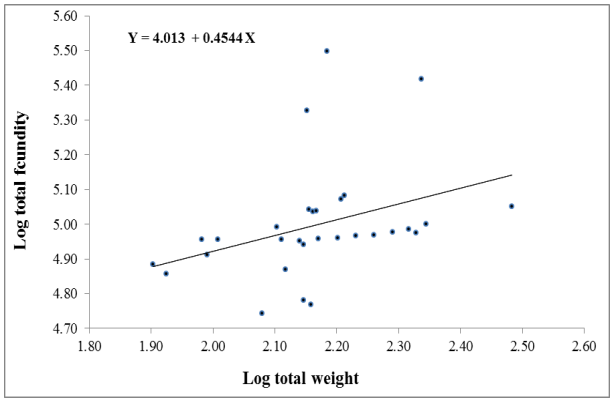

Fig. 2. *Logarithmic weight and fecundity relationship of R. kanagurta.*

Relation between fecundity and length of fish: When the logarithmic values of fecundity (Y) were plotted against logarithmic values of length (X), it

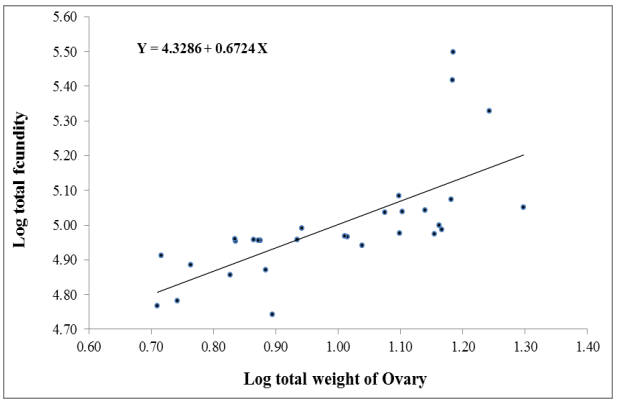

Fig. 3. *Logarithmic ovary weight and fecundity relationship of R. kanagurta.*

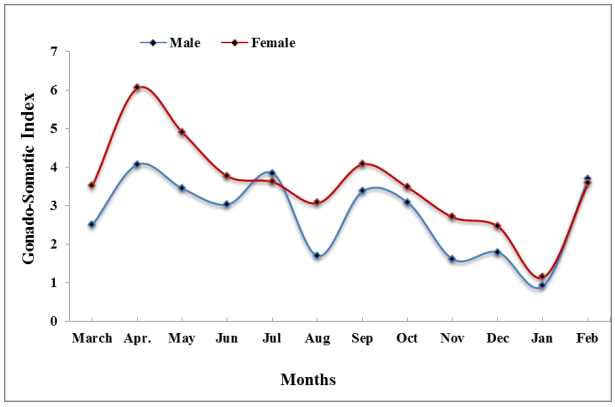

Fig. 4. *Monthly variations in the GSI values of males and females of R. kanagurta.*

showed a linear relationship between the two variables (Fig. 1). The relationship between length and fecundity was Y = 2.5065 + 1.8053 X

Where, Y = Log fecundity and X = Log total length of fish.

The correlation co-efficient "r" calculated from the logarithmic values of these two variables was at 0.8839.

Relation between fecundity and weight of fish: The relationship between the weight (W) and the fecundity (F) of *R. kanagurta* was linear (Fig. 2). The linear form of regression between fecundity and weight of fish was calculated as

Y = 4.013 + 0.4544 X

The correlation co-efficient "r" between fecundity and weight of fish was 0.3532.

Relation between fecundity and ovary weight: The logarithmic values of the fecundity (Y) when plotted against logarithmic gonad weight (X) of the fish Fig.3 indicate a linear regression equation of the form Y= A+BX. The calculated regression equation was Y = 4.3286 + 0.6724 X

The correlation co-efficient "r" between fecundity and weight of ovary was 0.6906.

Logarithmic relations between fecundity and length of fish, fecundity and weight of fish and fecundity and gonad weight were found to be linear indicating that the fecundity generally increased with increasing length, weight and gonad weigh. These observations are in agreement with the observations of Yohannan and Abdurahiman (1998). In the present investigation r value indicated strongest relationship with total length followed by ovary weight. (Pillai *et al*., 2009). The length-fecundity relationship showed coefficient of determination (R2 = 0.564). Arrafi *et al.* (2016) also showed that there were a significant relationship with body weight and ovary weight of the fish *R. kanagurta*. High coefficient of determination as R 2 =0.659 and 0.887 respectively compared to the body length were observed.

Gonado somatic index (GSI): In this study, both male and female were taken into consideration separately. The gonado-somatic index (GSI) was calculated for each individual fish and was averaged for each month. The average GSI values were plotted against each month to analysed monthly variations (Fig.4). GSI showed wide variations between sex and it was highest for both males and females during the month of April and September, showing occurrence of more ripe individuals. In the present investigation, the gonadosomatic index (GSI) of mackerel increased more prominently in females than males. It indicates female mature earlier than male. The GSI values ranged between 0.9220 to 4.0717 in male fish. The lowest GSI value was recorded in January, while the highest was in April. In case of female, the GSI values fluctuated between 1.1473 to 6.0607. The lowest value of GSI was in the month of January and it gradually increased from February to April. The data on the gonado-somatic index also reveal that spawning peak was in month of April. Hulkoti (2005) was estimated the GSI values ranged between 0.6192 to 0.9941 in male and 1.9473 to 5.8573 in female whereas Arrafi *et al.* (2016) reported monthly mean GSI values ranged from 0.32 to 3.37. The GSI values were high during June to November with peaks in July and August indicating the spawning period of this fish along Mangalore coast. The monthly GSI values in *R. kanagurta* of Karnataka coast followed the similar trend in males and females when compared to present investigation, higher values of GSI coincided with spawning (Gondhalli, 2010). The maximum of GSI was estimated at 6.1842 for females in May and 5.0628 for males in May for *R. kanagurta*. Arrafi *et al.,* (2016) reported the GSI of *R. kanagurta* and showed two peaks, one during January - March and other during August - October. The GSI values ranged from 0.33 to 4.04.

Conclusion

The conclusion in the present study is pertinent for the implementation of length-based fishery management measures. Presently more emphasis is placed on conservation of juveniles and a minimum legal size (MLS)

of around 20 cm to ensure that mackerel , *R. kanagurta* can spawn at least once in life. It is also suggested that ovarian weight and total length are most important in determining fecundity of Indian mackerel. The logarithmic relations between fecundity and length of fish, fecundity and weight of fish and fecundity and gonad weight were found to be linear indicating that the fecundity generally increased with increasing length, weight and gonad weight.

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