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Short Communication: Length-weight relationship and relative condition factor (Kn) of *Selar crumenophthalmus* (Bloch, 1973) from Coastal Waters of Southeast Coast of India

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ABSTRACT

The big eye scad Selar crumenophthalmus is one of the commercial marine fish in India, and there was very limited information on biological aspects of this species. Therefore, the present work deals with length-weight relationship (LWRs) and relative condition factor of S. crumenophthalmus. Totally 416 individuals of Bigeye scad were resolved for LWRs relationship, with 164 males and 252 females. This study recorded the minimum length of 16.5 cm corresponding to the weight of 29.9 g, and the maximum length of 24.6 cm corresponding to the weight of 179.7 g. The logarithmic exponent 'b' values remained greater than 3 and stated as 3.1 for males, 3.2 for females with correlation coefficient of 0.9415 and 0.9494 respectively at 5% level. The calculated relative condition factor (Kn) fluctuated from 0.89 to 0.98 with mean value of 0.95 ± 0.001 for males and in the range from 0.91 to 1.0 with mean of 0.96 ± 0.0008 for females. Hence, it is concluded that values remain as evident that the bigeye scad was in healthy condition in the present study.

Introduction

The big eye scad *Selar crumenophthalmus* (Bloch, 1793) is a commercially important pelagic fish, distributed along the tropical and subtropical coastal waters (Kasim 2003; Roos *et al.,* 2007; Roux and Conand 2000). This species is commonly found in the seagrass beds and soft bottoms between 20 to 100 m depth (Rudi *et al.,* 2018). Length-weight relationship (LWRs) is a study find out the biology, population, and growth of the species (Le Cren, 1951; Muchlisin *et al*., 2010). It is helpful to study the transformation of growth-in-length to weight equations which is used in stock assessment models; biomass assessment using length observations; and in regional evaluations of life history of certain species (Moutopoulos and Stergiou, 2002; Muchlisin *et al*., 2017).

Individual variations of LWRs are commonly considered significant than the LWRs itself, which has been often studied in terms of 'condition' (Froese, 2006). The factor of condition (K) indicates the functional status of fish and in the dietary point of view; condition factor offers evidence once matching two populations existing in definite feeding intensity, climate etc., (Weatherly and Gills 1987; Batubara *et al*., 2019). Therefore, condition factor is essential to comprehending the life cycle of fish species and management of the species for retaining the ecosystem (Lizama *et al.,* 2002). The condition factor is also valuable to evaluate the fitness of fish from various habitations or to show the aptness of

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the ecosystem in which the fish are captured (Bannister, 1976; Muchlisin *et al.*, 2010; Bulanin *et al.*, 2017). It is often used as an index for biological studies of fishes, as it provides essential information associated to fish physiological state, based on the individual length, weight and condition (Lima-Junior *et al.*, 2002).

There is adequate scientific report on LWRs of Bigeye scad throughout the world (Ralston, 1998; Roos *et al.*, 2007; Echem and Miñoza, 2017; Uba, 2020). In India only one report is available on LWRs and condition factor of Bigeye scad from north-west Mumbai. Therefore, the present study was conducted along the Parangipettai coast, Southeast of India.

Materials and Methods

Specimens were collected from Annankoil landing centre from January 2018 to December 2018. During the study period there was 416 Bigeye scad fish were collected, then specimens were brought to the laboratory from the landing centre for further analysis. The total length of individual fish was gauged through a measuring board to the closest one meter (cm), and the body weight was assessed in grams accuracy of 0.5 g in an electronic weighing balance and the statistics have been analysed separately for males and females.

The length-weight relationship analysis was calculated through the formula as recommended by Le Cren (1951) and its logarithmic log W = log a + b log L;

$$W = a\,L^{b}$$

Whereas W = Total weight, L = Total length, a = constant, b = exponent.

The seasonal relative condition factor (Kn) of samples was assessed through the subsequent calculation given by Le Cren (1951).

$$Kn = W_o / W$$

Whereas Kn - Relative condition factor, W_o - Observed weight, W – Expected weight

The linear analysis was fit for males and females separately. The study of covariance (ANCOVA) was used to find out the significant differences between regression coefficients 'b' for the sexes at 5% level. Similarly, t-test was performed to examine in case the regression coefficient b disappeared substantially from the anticipated theoretical cubic value 3.

Results

Length-weight relationship

The present work analysed the length-weight relationship for 416 individuals of *S. crumenophthalmus* fish that included 164 male fishes and 252 female fishes. The minimum length values of 16.5 cm corresponding to the weight 29.9 g and the maximum length values of 24.6 cm with corresponding to the weight of 179.7 g were recorded. The range of total length and weight of males and females along the standard errors (SE) are depicted in Table 1. Regression analysis of males and females of *S. crumenophthalmus* is shown in Table 2. ANCOVA displaying difference between of LWRs of males and females is presented in Table 3.

The logarithmic statistics attained from linear regression were utilized to define the constant 'a' and proponent 'b' beliefs to confirm the cube law for males and females of *S. crumenophthalmus*. The proponent 'b' values were greater than 3 (b > 3) as 3.1 for males and 3.2 for females. For *S. crumenophthalmus*, the logarithmic calculations shown for males and females are given below:

The result showed positive allometric growth for males and females (Figure 1). The highest 'b' value of 3.2 was noted in females, which infers that female gained weight in relation to length than males. The slope was discovered to be considerable at 5% level ($p < 0.05$) of the species. The scattered lines among the liner fit are within 95% certainty limits for forecasting the weight of a given value of length. From these calculations, the exponential values of *S. crumenophthalmus* were almost the same. The coefficient of determination (R^2) found to be for males (0.9415) and females (0.9494) was estimated at the 5% level.

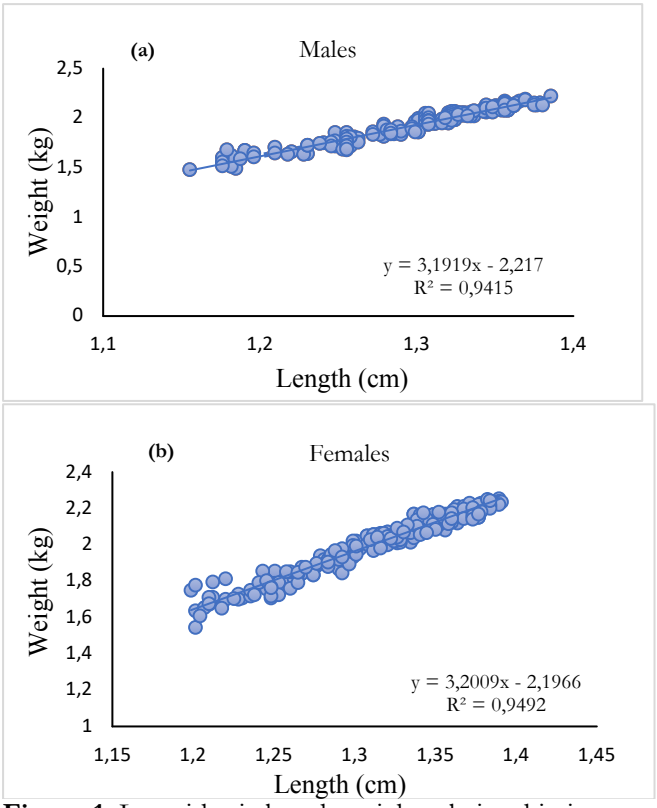

Figure 1. Logarithmic length-weight relationship in males (a) and females (b) of *S. crumenophthalmus*.

Table 1. Length-weight relationship in males and females of *S. crumenophthalmus*.

Sex	Sample number (n)	Total length (cm)			Weight (g)			Log LWR		
		Min.	Max.	Std. Error	Min.	Max.	Std. Error	a	b	R^2
Male	164	16.5	24.3	0.1708	29.9	166.9	2.549	-2.217	3.1	0.9415
Female	252	17.2	24.6	0.1387	34.9	179.7	2.244	-2.195	3.2	0.9494

Table 2. Regression analysis of length-weight relationship in male and female of *S. crumenophthalmus*.

Groups	Sum of squares and products					Errors of estimation	
	df	x2	y2	xy	b	Df = (n-1)	SS
Males	163	20807.58	1409454	307580	3.1919	162	3137228.86
Females	251	479.8499	3139673	600910.2	3.2064	250	749372940.1
Total	414	21287.43	(b)4549127	908490.2		412	752510169

Table 3. Analysis of covariance showing difference between regression of length-weight relationship in males and females of *S. crumenophthalmus*.

Sources of variation	df	SS	MS	F	*P-value*
Deviation from individual regression	412	752510169	1826481	732950	<0.56
Difference between regression	2	4.983917	2.491959		

Condition factor

The relative condition factor (Kn) calculated for males and females of *S. crumenophthalmus* are depicted in Table 4. The Kn value differed between 0.89 and 0.98 for males and from 0.91 to 1.0 for females with a mean value of 0.95 ± 0.001 and 0.96 ± 0.008 for males and females respectively. The t-test for male (0.95, $p<0.05$) and female (0.95, $p<0.05$) showed considerable variances in the test mean 1 (Table 4). The Kn value of males differed sesonally among post-moonsoon (1.4 ± 0.09) and monsoon (1.9 ± 0.01); between summer (1.6 ± 0.02) and pre-monsoon (1.6 ± 0.08). Correspondingly, the Kn values of females differed from post-moonsoon (1.6 ± 0.02) to monsoon (2.06 ± 0.01) and between summer (1.8 ± 0.02) and pre-monsoon (1.9 ± 0.01). The highest relative condition factor (Kn) value (1.9) occurred in monsoon season, whereas the lowest value (1.4) performed in post-monsoon season.

Discussion

The present study showed the exponent 'b' values for male and female have being 3.1 and 3.2. This falls in the range of 2.5 – 4.0 suggested by Hile (1936) and Martin (1949). The growth model of fish usually abide by the cube law, as the weight of the fish differs as the cube of its length and variation from this isometric growth in adults is unusual (Beverton and Holt 1957; Lagler, 1952). From the result, it is indicated that females gained more weight in a shorter period than males, which could be due to the variations in gonadal enlargement, plumpness and daily activity of fish (Le Cren, 1951; Muchlisin *et al.*, 2015). The modifications detected in the 'b' standards for males and females may be due to the variaintions in the contour and situation of the body or outline of the body or ecological conditions (Yosuva *et al.*, 2018; Muchlisin *et al.*, 2010). The exponent 'b' of LWRs was higher than 3 as observed in the present work in agreement with earlier works which have recorded the value range of 3.18 – 3.31 from Western Pacific Ocean, Northern Sulu Sea, Philippines and Western Mindanao, Philippines (Ralston, 1988; Uba, 2020; Echem and Miñoza, 2017). The present study established 'b' value of 3.19 for male and 3.20 for female, which revealed the isometric growth pattern. However, an earlier work at off north-west coast, Mumbai has recorded varied values of 3.34 for male and 3.39 for female (Panda *et al.*, 2016).

The determination coefficient (R^2) was noticed to be significant ($p < 0.05$) between sex as 0.9415 for males and 0.9494 for females. However, the regression value 0.93 for Bigeye scad was lower than that of earlier works which was reported higher values (R^2 = 0.98-0.99) in Mariana Archipelago (Ralston, 1998), Northen Sulu Sea, Philippines (Uba, 2020) and at Reunion Island, South-west Indian Ocean (Roos *et al.*, 2007). The present findings are similar to earlier report conducted in India where the

R^2 values of 0.98 for male and 0.97 for female and ANCOVA showed no significant differences ($P > 0.05$) among the sexes towards the slope of the LWRs (Panda *et al.,* 2016).

To understand the condition of fish, it remains necessary to diagnose the relative condition factor (Kn). Le Cren (1951) suggested that health of the fish is good when the Kn value shows 1 and the values shows less than 1 indicates unhealthy condition of fish. During the present study, the Kn values in females was higher in the monsoon season which indicates that the fishes were in health condition whereas lowered Kn values in post-monsoon may be due to the breeding of *S. crumenophthalmus* and achieve their length at 50% maturity (Roos *et al.,* 2007). The Kn value is considerably changed by the time of growth of the reproductive organs and the value is an indicator of gonadal maturity and spawning season or improved feeding circumstances (Anderson and Gutreuter 1983). Moreover, the monthly condition factor of fish is also influenced by the availability of food, dietary behaviours, and environmental condition at various seasons (Froese, 2006).

Conclusions

This work evidently implies a good healthy condition of both sexes of Bigeye scad caught along Parangipettai coastal waters. This study provides the standard information on the length-weight relationship and Kn factor for males and females of commercially important of *S. crumenophthalmus*. The data obtained from the work will utilized by the piscaries researchers, and conservation biologist for evaluating the stock, age, and growth of the fish species.

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