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Length: weight relationship and relative condition factor of Indian anchovy *Stolephorus indicus* (van Hasselt, 1823) from Thoothukudi coastal waters

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Abstract

Length – weight relationship and relative condition factor of Indian Anchovy *Stolephorus indicus* (van Hasselt, 1823) from Thoothukudi coastal waters was studied from September 2016 to July 2017. In present study the smallest size observed was 8.4 cm total length and 4.7 gm weight, the largest size was 15.3 cm TL and 28.13 gm weight. The value of growth constant $a = 0.0167$ and $b = 2.7273$. In the present study the b value was less than the ideal b (3) value which means the *Stolephorus indicus* shows the negative allometric growth pattern. The coefficient of determination of *Stolephorus indicus* was 0.9283, which indicates a significant relation between the length and weight of the species. The observation on condition factor and relative condition indicates that there no variation during the study period.

Keywords: Length-weight relationship, relative condition factor, *Stolephorus indicus*, Tamil Nadu

1. Introduction

Anchovies are typically marine coastal and schooling fishes, occurring in all seas from about 60° N to 50° S (Whitehead *et al.*)^[30]. Anchovies forming significant catch of the marine fish landed along the coastal states of India^[1]. Also known as whitebaits or the whitebait anchovy in the Southern states of India; common name applied to the fishes of the genera *Stolephorus* Lacepede 1803 and *Encrasicholina* Fowler, 1938^[1, 2, 3]. Anchovies belong to family Engraulidae under order Clupeiformes with 151 species and 17 genera (Eschmeyer *et al.*)^[4]. This group includes famous fisheries like Peruvian anchovy, Californian anchovy and Japanese anchovy. These fishes exhibit schooling behavior mostly in shallow coastal waters and estuaries. Most anchovies are marine rarely occurred in freshwater but around 17 species are freshwater, occasionally entering brackish water (Nelson)^[5]. 34 species of anchovies were reported from the Indian waters belong to five genera, viz., *Stolephorus*, *Coilia*, *Setipinna*, *Thryssa* and *Encrasicholina* (Gopi and Mishra)^[6]. Joshi *et al.*^[7] has reported 22 species of Engraulidae from Gulf of Mannar.

The length-weight relationship (LWR) is an important factor in the biological study of fish and their stock assessments^[8]. The study helps to determine the mathematical correlation between two variables and to calculate the variation from the expected weight for length of the individuals of the fish^[9]. In general, an increase in length of the fish implies that there is an increase in the body weight^[10]. In tropical & subtropical waters the growth fluctuation is more frequent in fishes due to variation in seasons, multiple spawning & food composition^[10].

Basically, 'condition factor' represents the quality of individuals, which is the result of the interactions between biotic and abiotic factors and their effect on the physiological condition of fish. Therefore, 'condition factor' represents the status of well-being of individuals in a fish population^[11]. The relative condition factor ('Kn') provides an important measure of different life cycle stages of fishes and valuable for the management of fishery resources in an ecosystem^[12].

Length - weight relationship of *Stolephorus commersonii* from Kerala coast was studied by Nair *et al.*^[11] and *S. commersonii*, *Encarsicholina devisi* and *Thryssa mystax* from southern coast of Karnataka observed by Abdurahiman *et al.*^[12]. Length - weight relationship of *E. devisi* and *S. waitei* along Indian coast was studied by Luther^[13], Luther *et al.*^[11] and Rohit and Gupta^[14]. However the length – weight relationship of *Stolephorus indicus* in Gulf of Mannar region is very limited.

The objective of the present study was to investigate the Length – weight relationship of *Stolephorus indicus* and their condition along the coast.

2. Materials and Methods

A total of 1014 fish specimens were collected from the landing centers along the Thoothukudi coastal waters from September 2016 to July 2017. The data on total length (length from the tip of snout to the tip of caudal fin) and weight of the fish was collected. The length was measured to nearest 0.1 cm and weight to nearest 0.1 gm. The Length – Weight relationships were estimated from the allometric formula proposed by Le Cren^[9],

$$W = aL^b$$

Where W = Weight in grams, L = total length in centimeters, 'a' is a scaling constant and 'b' the allometric growth parameter

Alogarithmic transformation was used to make the relationship linear:

$$\text{Log } W = \text{log } a + b * \text{Log } L$$

The condition index of Fulton (K) was estimated using the equation: $K = 100 * (W / L^3)$ Fulton's condition factor K, W = whole body wet weight in grams and L = length in cm; the factor 100 is used to bring K close to unity^[15].

The relative condition factor (Kn), introduced by Le cern^[9] was calculated using the formula: $Kn = W/We$ were W is the observed weight and We is the estimated weight. The significance of difference in the 'b' value from the expected value of 3 (isometric growth) was tested by following formula $t = (b-3) / sb$ were b = regression coefficient of log transferred data and sb = standard error of b^[11].

3. Results and Discussion

In the present study length and weight data for 1014 specimen of *Stolephorus indicus* were collected during period from September 2016 to July 2017. The smallest size recorded for the *S. indicus* was 8.4 cm total length and 4.7 gm weighing, while the largest size was 15.3 cm TL and 28.13 gm and average size of specie was 11.7 cm. The number of specimen in different length group is present in the Fig. 1.

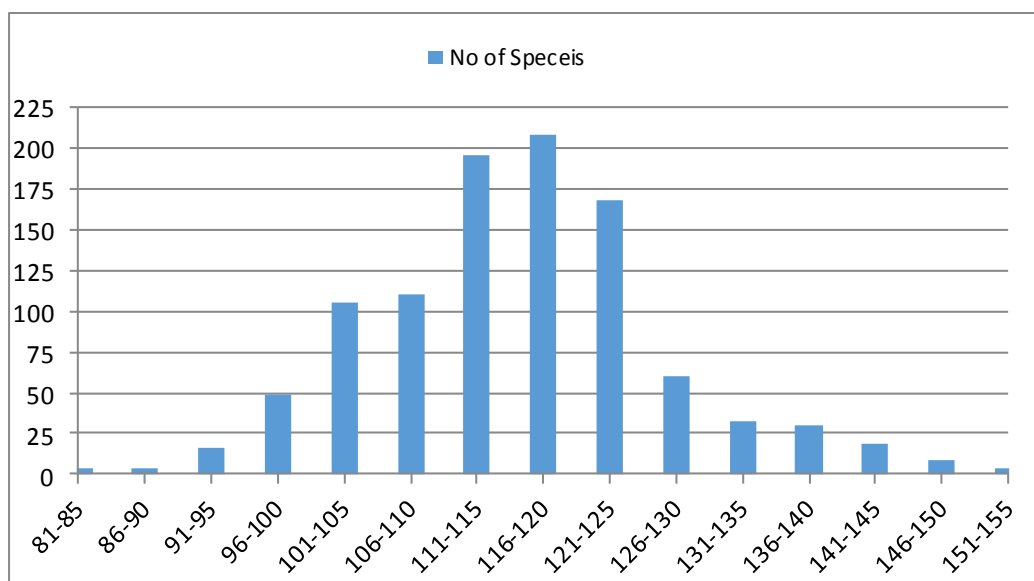


Fig 1: Number of *Stolephorus indicus* in different length group.

Maximum length of *S. indicus* was 7.5 cm observed along the Sindh coast of Pakistan reported by Musarratulain *et al.*^[16], which is less than the present study. Abdurahiman *et al.*^[12] reported the maximum length for male and female of *S. commersonnii* and *S. waitei* along the Karnataka coast. The observed maximum length for male and female of *S. waitei* was 9.7 and 10.0 cm and for *S. commersonnii* was 14.0 and 14.4 cm. Hoedt^[17] reported that a maximum length of Commerson's anchovy observed was 15.8 cm from Clevel and Bowling green Bays, North Queensland. Gopakumar and Pillai^[2] and Rohit and Gupta^[14] reported that the fishery of *S. waitei* supported by 35-133 mm length group and fishery of *E. devisi* supported by 20-105 mm length group. In the present study the maximum size observed for *S. indicus* was 15.3 cm. which is the largest size reported among all the reported species of *Stolephorus* group. The maximum size of *Thryssa malabarica* was 20.5 cm and for *T. dayi* was 25.5 cm reported by Roul *et al.*^[18], which indicates that the *T. malabarica* and *T. dayi* grow larger in size than the *S. indicus*.

3.1 Length-weight relationship

Length weight relationship of an ideal fish precisely follow the cube law and the value of exponent 'b' in the cube law

will become exactly 3 if the fish retains the same shape and specific gravity and grows isometrically during their lifetime^[11]. Allen^[23] reported that such an ideal fish with b value 3 is very difficult to observe in the natural environment. In other words, a majority of fishes for which length-weight relation were calculated in the past b value was less than or greater than 3, representing negative or positive allometric growth, respectively. The change in the b value mostly reflects the change in the body form when the weight of the fish affected by environmental factors likes temperature, food supply, and spawning condition.

The relationship between and the fish length and weight of the *Stolephorus indicus* was calculated. The parabolic and logarithmic equations were as follows

$$W = 0.0167 L^{2.7273}$$

$$\text{Log } W = -1.7773 + 2.7273 \text{ Log } L$$

The value of a = 0.0167 and b = 2.7273. In the present study the 'b' value was less than the ideal 'b' (3) value which means the *S. indicus* exhibits the negative allometric growth pattern. The curve for the length weight relationship is presented in the Fig. 2. The coefficient of determination of *S. indicus* was 0.9283, which indicates a significant relation between the length and weight of the species.

In present study, the estimated b value for *S. indicus* is 2.7273 which indicate that the species exhibits the negative allometric growth, where Musarratulain *et al.* [16] and Luther [18] observed that the *S. indicus* represents the positive allometric growth along the Indian and Sindh coast, Pakistan respectively. A positive allometric growth was also established for *S. commersonii* [12], *S. waitei* [1,14] and *Encrasicholina devisi* [1,12,14]. A positive allometric growth for *Stolephorus devisi* [24] and negative allometric growth patterns for *Stolephorus bataviensis* [25] reported along the Mangalore coast. Nair *et al.* [11] reported that *S. commersonii* along the Kerala coast followed the cube law and exhibits the isometric

growth. The estimation of length-weight relationship of different species of genus *Thryssa* like *Thryssa dayi*, *T. hamiltonii*, *T. malabarica* and *T. mystax* revealed that these species exhibited the positive allometric growth pattern [12, 18, 26, 27]. *Engraulis encrasicolus* from the Northern and central Adriatic Sea exhibits the positive allometric growth [28] and nearly isometric growth with b value in the range of 2.93 to 2.99 along the Turkish seas for *E. encrasicolus* [29]. Length weight relationship of *Coilia dussumieri* along the Indian coast stated that this species shows the negative allometric growth [10, 19, 20, 21, 22].

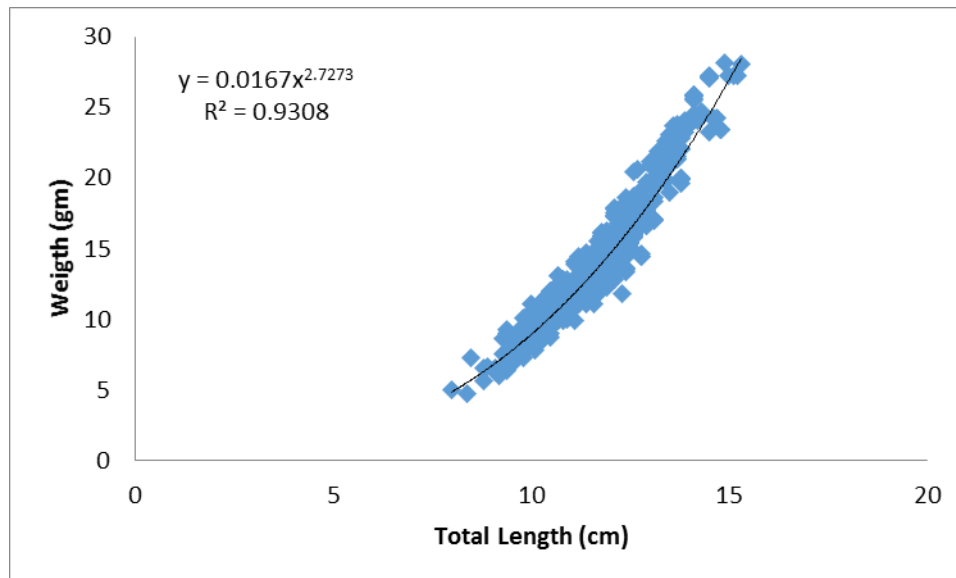


Fig 2: Length-weight relationship of *Stolephorus indicus*

The significance of variation of the estimates of regression coefficient value 'b' from 3 was tested using t-test. The estimated t value was 11.44, which is higher than the table of t at 1% and 5% level of significance. The variations were significant, and conforming the negative growth if the fish.

3.2 Condition factor (K) and Relative Condition Factor (Kn)

The monthly observation on value of condition factor and relative condition factor (Kn) indicates that there is no variation in the monthly Kn values. The value of Kn more than 1 indicate good health and less than a indicate poor condition of the fish [7]. In the present study, the lowest Kn value 0.9987 was estimated in January 2017 and the highest value 1.0083 was estimated in June 2017 with an average value was 1.0022 which indicates that the environmental condition along the Thoothukudi coast suitable for growth of *S. indicus*.

4. Conclusion

This study provides valuable information on length weight relationship and condition factor of *S. indicus* along the coast. The findings of this study could be effective information for fishery biologists and conservationists to initiate the stock assessments of these species along the coast. There are several other species of anchovies landed along the coast for that further investigation is required.

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