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Length-weight Relationship and Condition Factor of *Liza subviridis* (Valenciennes, 1836) of Parangipettai Waters, Southeast Coast of India

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Abstract: Determination of Length-weight Relationship (LWR) of any commercially important fish is crucial to validate the wild stock level, to predict their wellbeing in the natural habitat and for various sustainable fishery management practices. *Liza subviridis* (Valenciennes) is noted to be highly abundant along the coast of Parangipettai, South east coast of India. Hence, the present study was aimed to establish Length-weight relationship and condition factor of Greenback mullet, *Liza subviridis* (Valenciennes) occurring in Vellar estuary, Parangipettai (lat. 11°30' N, long. 79°46' E) using least square method. To determine the actual relationship between length and weight of *L. subviridis* exponent coefficient or equilibrium constant (b) and relative condition factor (Kn) analysis were adopted. The females were found to be heavier than males at similar length. The equilibrium constant 'b' was found to be 2.7106 in males and 2.8927 in females. The corresponding parabolic representation for male was $W = 0.0462L^{2.7106}$ and for female $W = 0.0382L^{2.8927}$. The equilibrium constant did not obey the cube law as it deviated significantly from 3 in the case of males. The relative condition factor around 1 and little over it revealed the well-being of *L. subviridis* in Parangipettai waters.

Key words: Length weight relationship, relative condition factor, mugilidae, vellar estuary, *Liza subviridis*

INTRODUCTION

The Length-weight Relationship (LWR) provides a humongous contribution in fisheries as it reveals the mathematical relationship between the variables length and weight of fishes (Arshad *et al*., 2012; Thulasitha and Sivashanthini, 2012). It is an important parameter and is helpful in understanding the growth dynamics of fish populations (Morato *et al*., 2001). Studies on length-weight relationship are also helpful to the researchers and policy makers in the preparation of effective management plans of fishery resources (Karna *et al*., 2012). It is also helpful in knowing the rate of feeding, metamorphosis, fatness, onset of maturity, gonadal development and spawning of the fish population (Le Cren, 1951; Pauly, 1993), in comparing the life history of fishes of different localities (Petrakis and Stergiou, 1995), to establish yield equations to estimate the stock size (Abdurahiman *et al*., 2004) as well as to determine (or) predict the condition or general wellbeing of the selected animal via interpreting the condition (K) or relative condition factor (Kn) (Bolger and Connolly, 1989; Kulbicki *et al*., 1993; Venkataramanujam and Ramanathan, 1994; King, 1996; Fagade, 1979; Oni *et al*., 1983). It was also noted that the actual relationship between length and weight of any selected fish directly depends on their inherited body size and shape (Schneider *et al*., 2000). In particular, a detailed analysis on length weight relationship is crucial to estimate the number of fish landed in comparison to the population in natural habitat at particular time (Cicek *et al*., 2008; Khan *et al*., 2011).

An observation by Thomson (1984) observed the schooling of *Liza subviridis* along the shallow coastal waters which eventually enters lagoons, estuaries, backwaters and fresh waters to feed. Parangipettai has all the above diverse ecosystems and abound with mullets (Reddy, 1977) particularly *Liza subviridis.* As Length weight relationship provides many useful information about this organism and its healthy condition (Cone, 1989), the present study was undertaken on this species.

MATERIALS AND METHODS

Specimens of *Liza subviridis* were collected from Vellar estuary using gill and cast nets besides from the fish landing center at Annankoil in Parangipettai (lat.

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11°30' N, long. 79°46' E) for a period of one year (May 2011 and April 2012). A total of 1344 specimens (579 males and 765 females) ranging in size from 8.5 to 24.6 cm in the case of males and 8.5 to 24.5 cm in females were used for the present study. The Total Length (TL) of each fish was measured to the nearest mm from the anterior most edge of the snout to the posterior most edge of caudal fin with a measuring board. Weight (W) was measured to the nearest 0.1 g by an electronic balance (Shimadzu Electronic digital weighing balance) after draining the water from the buccal cavity and wiping the moisture content on the body of fish following King (1996). Fishes with damaged caudal fin were not considered for the study.

The length-weight relationship was calculated separately for each sex based on the methodology of Le Cren (1951). The hypothetical and parabolic equation used by him was W = aLb. Its logarithmic transformation is log e W = log e a+b log e L i.e., Y = a+bx according to Ramaseshaiah and Murthy (1997), where 'W' represents weight in g and 'a' and 'b' the constants, which were estimated by the method of least squares.

The linear equation was fitted separately for males and females of *Liza subviridis*. Analysis of Covariance (ANCOVA) was employed to test the significance of difference between regression coefficients (b) at 5% level (Snedecor, 1956; James, 1967; Snedecor and Cochran, 1967). The t-test (Snedecor and Cochran, 1967) was employed to test whether the regression coefficient (b) departed significantly from the expected hypothetical cubic value (3).

Relative condition factor: The seasonal mean relative condition factor (Kn) of samples was estimated by using the equation:

$$Kn = \frac{W_0}{W}$$

where, Kn is the fFulton's condition factor, W_0 is the observed weight and W is the expected weight of each size group calculated from the length-weight relationship.

RESULTS

The estimated of the length-weight relationship coefficients of *Liza subviridis* are noted to be 2.7106 for male and 2.8927 for female fishes (Table 1). The observed regression coefficient (R^2) values in LWR logarithmic plot was observed to be 0.9741 for male (Fig. 1) and 0.9913 for female (Fig. 2) which showed the reliability of plotted curves. Similarly the parabolic relationship between length and weight of male (Fig. 3) and female (Fig. 4) *L. subviridis* indicated a linear relationship between the two variables. The logarithmic equations derived for males and females of the *Liza subviridis* are given below:

- For males: log W = -3.167+2.7106 log L
- For females: log W = -3.349+2.8927 log L

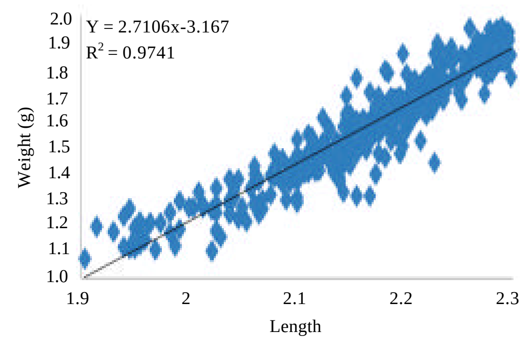

Fig. 1: Logarithmic relationship between length and weight in males of *Liza subviridis*

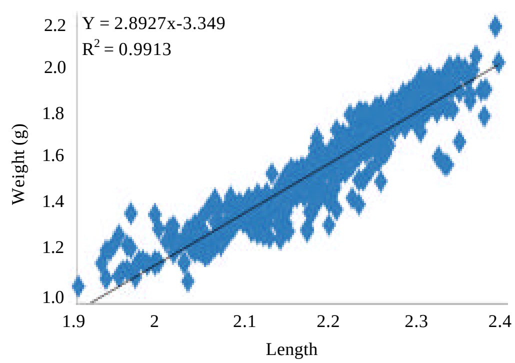

Fig. 2: Logarithmic relationship between length and weight in females of *Liza subviridis*

Table 1: Regression analysis of data for length-weight relationship in males and females of *Liza subviridis*

		Sum of squares and products				Errors of estimation	
Category	df	x^2	y^2	xy	b	Df = (n-1)	SS
Male	579	1215.231388	543.5286	723.1082	2.7106	578	113.252
Female	765	1626.150128	722.5033	964.5513	2.8927	764	150.379
Total	1344	2841.381517	1266.032	1687.66		1342	263.631

b: Regression coefficient

and the parabolic relations derived are:

- For males: $W = 0.0462 L^{2.7106}$
- For females: $W = 0.0382L^{2.8927}$

Analysis of covariance (Table 2) done to test the difference in regression coefficients between males and females revealed significant differences ($F = 6436.85$, $p< 0.01$). The t-test revealed that the regression coefficient of male (2.7106) departed significantly from the cube value (3) at 5% level (2.2897 $p<0.05$). However, it was not so in the case of females (1.018 $p>0.05$).

Relative condition factor: In the present study, the seasonal condition factor (Kn) of male *L. subviridis* varied between 0.9781 and 1.0634. For females, the Kn were in the range of 0.9834 to 1.0855. In both the sexes, the condition factor was found to be minimum during summer (0.9908 in males and 0.9987 in females) and maximum during post monsoon (1.0634 in males and 1.0855 in females) (Fig. 5).

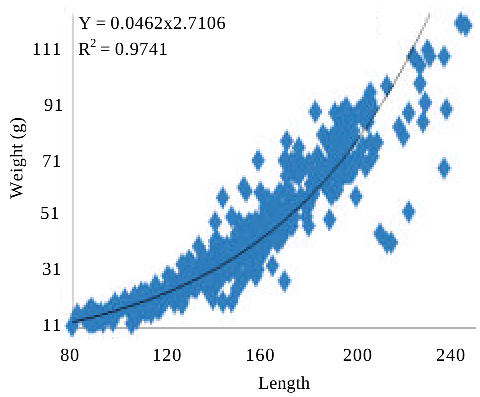

Fig. 3: Parabolic relationship between length and weight of males of *Liza subviridis*

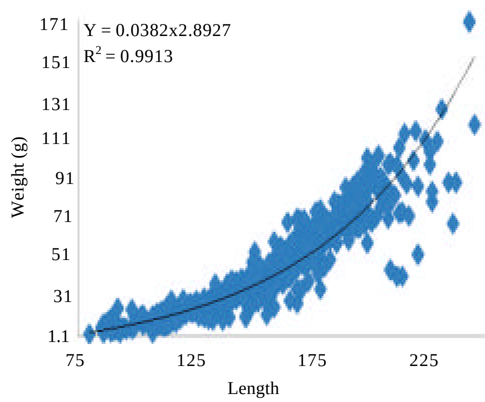

Fig. 4: Parabolic relationship between length and weight of females of *Liza subviridis*

DISCUSSION

Fish generally do not keep the shape of the body contours throughout their life span and the relationship may deviate from the cube law proposed for an ideal fish. Authors like Qasim (1973), Sinha (1973), Kaur (1981) and Dasgupta (1982) and Bal and Rao (1984) equivocally emphasized that this variation might be credited to geographical variations, physiological parameters, sex, gonadal development (stage of maturity), food habits and nutritive conditions of the habitat.

As opined by Tesch (1968), the regression coefficients of less than 3 obtained in the present study for *L. subviridis* reflected ('b' values of males 2.7106 and females 2.8927) the negative allometric pattern of growth in this species. The b values of males (2.7106) differed significantly from the hypothetical value of 3. However the regression coefficient of females (2.8927) did not differ significantly. The b value of the present study agrees well with the value obtained by Shadi *et al.* (2011) in Iranian waters for the same species (2.819 for both the sexes combined). The analysis of covariance also showed significant differences between the regression equations of males and females. Similarly, the critical analysis by Allen (1938) and Carlander (1969) pointed out that the exponent coefficient (b) value in the length-weight relationship of any fish can be varied between 2.5-3.5 but usually 3.

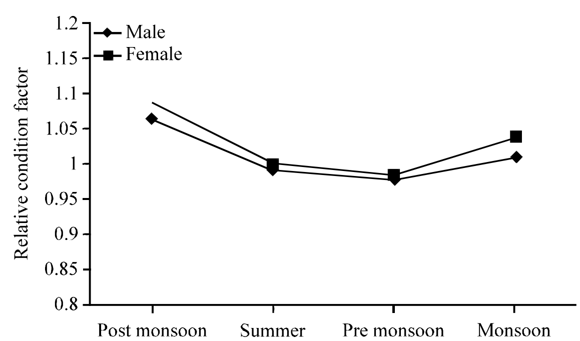

Fig. 5: Season-wise relative condition factor (Kn) for *Liza subviridis*

Table 2: Analysis of covariance showing difference between regression of length-weight relationship in males and females of *Liza subviridis*

Sources of variation	df	Sum of squares	Mean squares	F-value	p-value
Deviation from individual regression	1341	263.631	0.196592841	6436.85	<0.01
Difference between regression	1	1265.44	1265.44		

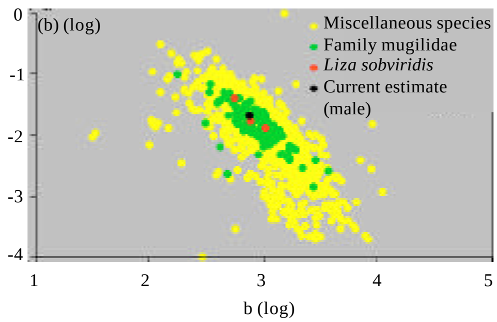

Fig. 6: Graph depicting logarithmic "a" versus "b" observed for male *Liza subviridis* with previous reported values available in FishBase 2012

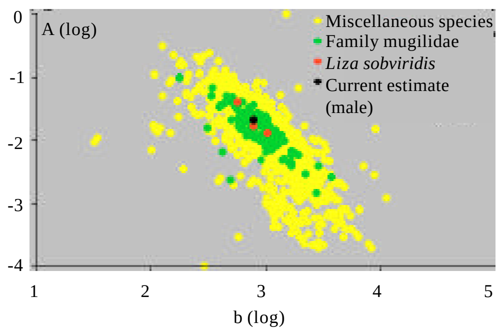

Fig. 7: Graph depicting logarithmic "a" versus "b" observed for female *Liza subviridis* with previous reported values available in FishBase 2012

According to Le Cren, 1951 and George *et al.* (1985) "the relative condition factor Kn is an indicator of general well-being of the fish. Kn greater than one (1) is indicative of the general well being of fish, whereas its value less than one (1) indicates that fish is not in a good condition". Kn values of the present study fluctuated between 0.9908 and 1.0855 for both the sexes. The condition factor is basically influenced by a number of factors internal and external factors such as the onset of maturity (Hoda, 1987), spawning (De Silva and Silva, 1979; Al-Daham and Wahab, 1991), sex of the fish and maturity stage (Gowda *et al.*, 1987; Doddamani *et al.*, 2001) and pollution (Bakhoum, 1994 and Devi *et al.*, 2008). In the present study, the values were more or less 1(0.9908) and during monsoon and post monsoon for both the sexes = 1. Therefore, it can be concluded that the health of *L. subviridis* in Parangipettai waters is in good condition.

The 'a' and 'b' values obtained for *L. subviridis* were superimposed in log 'a' versus 'b' graph which includes 1700 other miscellaneous species from FishBase 2012 for comparison. Both Male (Fig. 6) and Female (Fig. 7) were clustered well within the genera and the values of the present study (2.8) fall well within the range as reported earlier for *L. subviridis* (Al-Daham and Wahab, 1991). Hence, the results of the present study on commercially important *L. subviridis* are useful contributions for fisheries stock assessment modeling in Parangipettai waters and also form the benchmark data for comparative studies in the future.

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