



Length-weight relationship of the white-spotted rabbitfish *Siganus canaliculatus* (Park, 1797) from Gulf of Mannar, south India

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Abstract

Length-weight relationship of the white-spotted rabbitfish *Siganus canaliculatus* (Park, 1797) were taken in fresh condition separately for male, female and indeterminants from the Gulf of Mannar region. Analysis of covariance revealed highly significant difference ($P < 0.05$) in the length and weight relationship between both the sexes and indeterminants. Hence, three different logarithmic equations were derived viz., i) Males: $\log W = -5.0218 + 3.0304 \log L$; ii) Females: $\log W = -5.8008 + 3.3990 \log L$ and iii) Indeterminants: $\log W = -4.1916 + 2.6410 \log L$. The value of regression coefficient 3.03 and 3.39 was obtained for males and females respectively and 2.64 for indeterminants that departed from the cubic value, 3 at 5% level.

Keywords: Length-weight relationship, *Siganus canaliculatus*, Gulf of Mannar.

Introduction

The representatives of the family Siganidae are popularly called rabbitfishes, foxface or spinefoot. There are 30 species recorded the world over, and are distributed in reefs among sea grasses, mangroves, and estuaries and also in shallow lagoons of tropical and subtropical coastal environments (Woodland 1999). *S. canaliculatus*, *S. javus*, *S. lineatus*, *S.*

stellatus and *S. vermiculatus* are the common species found in India. *S. canaliculatus* contribute 30% of total catch in some landing centres of the GOM region (Jaikumar, 2012). Two species of siganids, viz., *S. canaliculatus* (white-spotted spinefoot) and *S. javus* (streaked spinefoot) are found in the GOM region (Muralitharan, 1999). However, *S. canaliculatus* constitutes a consistent fishery as compared to *S. javus* and also dictates a high demand in the fish markets of this region. Siganids are economically important fishes (Woodland, 1990) and attracted the attention of mariculturists of the Indo-Pacific regions mainly because of their herbivorous food habits, rapid growth and commercial value (Lam, 1974; Randall *et al.*, 1990).

The length-weight relationship has number of important applications viz., in the fish stock assessment, in the estimation of biomass from the observed length, in estimation of the condition of the fish and also for comparisons of life histories of certain species between regions (Goncalves *et al.*, 1996, Froese and Pauly, 1998 and Odat, 2003). According to Le Cren (1951) the length-weight relationship (LWR) of fishes is calculated primarily to determine the mathematical relationship between the two variables, length and weight and to measure the variation from the expected weight for length of individual fish or groups of fish as an indication of fatness,

general well being or gonad development. LWR are usually calculated through linear regression on log-transformed data. The ordinary least squares or "Predictive" regression (Zar, 1984) is the most commonly applied method for estimation of LWR parameters. Weight of a fish is a function of length, since length is a linear measure and weight a measure of volume, it has been observed that LWR of fish could be expressed by the hypothetical cube law, $W = CL^3$, where 'W' represents weight 'L' the length and 'C' a constant.

Studies on the LWR of rabbitfishes in Indian waters are very limited. Prabhu (1954) was the first to estimate the length-weight relationship of rabbit fishes of the GOM region with special reference to *Teuthis marmorata*. Jayasankar (1990) estimated the length-weight relationships of *S. canaliculatus* of the same region. The LWR of *S. canaliculatus* and *S. javus* from Pulicat Lake was studied by Lazarus and Reddy (1987). As the information on LWR of *S. canaliculatus* is inadequate from Indian waters, the present study has been undertaken to elucidate the relationship in the GOM region.

Material and methods

The estimation of length - weight relationship was based on the samples collected fortnightly from Mandapam fish market (Gulf of Mannar) from November 2000 to October 2002. Total length (TL) was measured by a graduated measuring scale to the nearest millimeter. The total body weight of individual fish was recorded to the nearest 0.1 g using an electronic balance. Total length and corresponding weight of 543 fishes in the size range of 82 - 245 mm (TL) comprising, 43 indeterminants, 191 males and 309 females were recorded for the study.

The LWR was calculated employing Le Cren's (1951) hypothetical formula, $W = aL^b$ and its logarithmic form: $\log W = \log a + b \log L$ as followed by Ramasesaiah and Murty (1997). The constants "a" and "b" were estimated using the method of least square and the linear equation was fitted separately for males, females and indeterminants. Analysis of co-variance was employed to determine whether the "b" values differed among the categories at 5% level. The t- test (Snedecor and Cochran, 1967) was employed to test whether the regressing co-efficient (b) departed significantly from the expected cubic value.

Results and discussion

The estimated coefficients of the LWR and other details of statistical analysis are summarized in Tables 1 and 2. The observed values of length and weight of males, females and indeterminants of *S.canaliculatus* were plotted in figs. 1(a), 1(b) and 1(c) respectively and the calculated length-weight curve fitted to the sets of data showed a close relationship between the observed and calculated values. The logarithmic

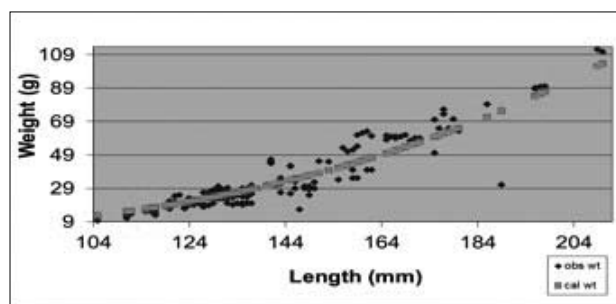


Fig. 1 (a). Scatter diagram of relationship between length and weight of males

Table 1. Regression data of length-weight relationship of males, females and indeterminants of *S. canaliculatus*

Sex	df	Sum of squares and products			b	Errors of Estimate	
		X ²	Y ²	XY		df	SS
Males	192	0.7813	9.3495	2.3677	3.0304	191	2.1743
Females	310	2.1248	26.1181	7.2226	3.3990	309	1.5681
Indeterminants	42	0.1616	1.3163	0.4268	2.6410	41	0.1891
	544	3.0677	36.7839	10.0171		541	3.9315

df – Degrees of freedom ; b – regression coefficient ; SS – Sum of squares

Table 2. Test of significance for males, females and indeterminants of *S. canaliculatus*

Source of variation	df	SS	MS	Observed F	F = 0.05
Deviation from individual regression within sexes	541	3.9315	.0072670		
Difference between regression	2	.01432	.0716	.003696	3.00
Deviation from total regression	543	4.0747			

df - Degree of freedom ; SS – Sum of squares

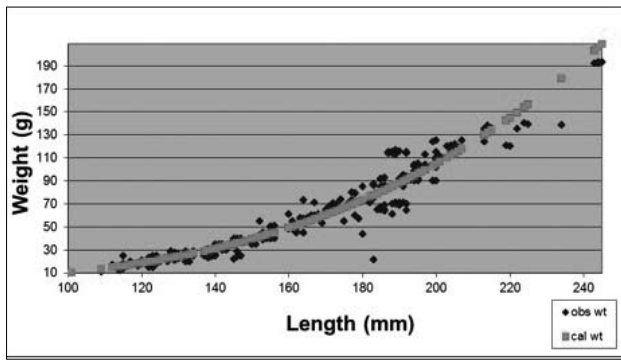


Fig. 1 (b). Scatter diagram of relationship between length and weight of females

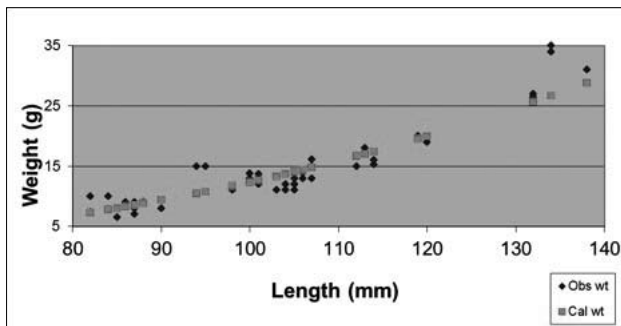


Fig.1(c). Scatter diagram of relationship between length and weight of indeterminants

equations derived for the three categories are given below:

Males : $\log W = -5.0218 + 3.0304 \log L$

Females: $\log W = -5.8008 + 3.3990 \log L$

Indeterminants : $\log W = -4.1916 + 2.6410 \log L$

and the parabolic equations derived are:

Males : $w = 0.006592 L^{3.0304}$

Females : $w = 0.003025 L^{3.3990}$

Indeterminant : $w = 0.015122 L^{2.6410}$

Analysis of covariance revealed highly significant difference ($P = 0.05$) in the length and weight relationship between both the sexes and indeterminants. Hence, the data of both the sexes and indeterminants were treated separately to obtain different equations. The t- test revealed that the value of regression coefficient 3.0304 and 3.3990 obtained for male (df 191) and female (df 309) respectively did not depart from the cubic value 3 at 5% level, whereas, the value of regression co-efficient for indeterminants 2.6410 departed from the cubic

value, 3 at 5% level.

For an ideal fish, which maintains dimensional equality, the isometric value of b would be 3. The slope (b) value less than 3 indicates that a fish becomes more slender as it increases in length. A slope value greater than 3 denotes stoutness or allometric growth (Pauly, 1984). According to Pauly and Gayanilo (1997), 'b' value may range from 2.5 to 3.5. The general expectation is that the weight of fishes would vary as the cube of length (Lagler, 1956) but the values of 'b' usually fluctuate between 2.5 and 4 (Carlander, 1969). Beverton and Holt (1957) recorded that the cubic relationship between length and weight existed and suggested that the value of 'b' is almost always near to 3. Ricker (1958) observed that a fair number of species seem to approach this ideal value 3.

Lazarus and Reddy (1987) found no significant difference between the length-weight relationships of *S. javus* and *S. canaliculatus* from Pulicat Lake and hence computed a common equation ($\log W = -6.3421 + 3.6741 \log L$) for their length-weight relationship. The equation derived by Bilecenoglu and Kaya (2002) for *S. rivulatus* was $W = 0.0064 L^{3.221}$ for females and $W = 0.0079 L^{3.135}$ for males. The length-weight relationship of *S. argenteus* ($b = 3.09$), *S. rivulatus* ($b = 3.11$) and *S. luridus* ($b = 2.94$) revealed almost cubic relationship, i.e., isometric growth in Gulf of Aquaba (Odat, 2003). The 'b' value estimated by Papaconstantinou *et al.* (1988) for *S. luridus* male and female were 2.762 and 3.04 respectively. The length-weight relationship for *S. fuscescens* off Bolinao was $W = 0.0028 L^{2.922}$ (De Norte and Pauly, 1990). Growth in *S. luridus* and *S. rivulatus* could be considered almost isometric in view of the very small divergence of $b = 3.04$ and $b = 2.82$ respectively from 3 (Abdallah, 2002). The isometric growth ($b = 2.93$) was found for *S. canaliculatus* in Phillipine waters (Abes, 1998) whereas, negative allometric growth was exhibited for the same species $b = 2.7$ in the Saudi Arabian Gulf waters near Dammam (Wassef and Abdul Hadry, 2001) and $b = 2.8$ in Western Indian Ocean waters.

In the present study, the exponential values obtained for males (3.0304) and females (3.3990) of *S. canaliculatus* indicated isometric growth pattern, whereas, for indeterminants (2.6410) negative allometric growth trend was observed. The 'b' value of 3.0304 for males and 3.3990 for females disagrees with the value of 2.8732 for males and 2.7486 for females as reported by Jayasankar (1990) for the same species in the same region (GOM). Moreover, by the same author the analysis of covariance (ANCOVA) test revealed no significant difference in the regression coefficient of the sexes and hence sexes were pooled and common equation was calculated as $\log W = -4.4389 + 2.8193 \log L$, which also disagrees with the analysis of variance (ANOVA) test of the present study to

treat the sexes separately. The LWR formulae for *T. marmorata* in the same region (GOM) was found to be $w = 0.01478 L^{2.9630}$ (Prabhu, 1954). It can be concluded that the weight of *S. canaliculatus* increases proportionately to the cube of the length as the exponent value was observed to be almost 3 (for males $b = 3.0304$, for females $b = 3.3990$ and for indeterminants $b = 2.6410$). The presently derived equation assumes importance in view of the fact that no attempt has so far been made to elucidate the relationship by sex-wise including indeterminants in *S. canaliculatus* from Indian waters more particularly with reference to GOM region.

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