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# Length-weight relationship in three species of silverbellies from Chennai coast

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## ABSTRACT

Length-weight relationship in three species of silverbellies - *Photopectoralis bindus, Secutor insidiator* and *Gazza minuta* was studied based on the data obtained from 742, 862 and 1900 samples of each species respectively, collected during the period January 2004 -February 2006. Analysis of covariance revealed no significant difference between males, females and indeterminates in all the three species. The coefficients 'a' and 'b' of the LW equation were derived as 0.000011989 and 3.0515 for *P. bindus*, 0.00002369 and 2.905 for *S. insidiator* and 0.00002088 and 2.9228 for *G. minuta*. Statistical test for isometric growth ($H_0$:b=3) carried out using student's 't'-test on the regression coefficient 'b' revealed that the values of b estimated for the three species do not deviate significantly from the isometric value of '3' at 5% level.

Keywords: *Gazza minuta,* Length-weight relationship, *Photopectoralis bindus, Secutor insidiator*, Silverbellies

## Introduction

"Growth" is usually defined by a measure of increase in body dimensions, particularly length and weight, which gives the best estimates of the organism's growth status at a particular point of time (von Bertalanffy, 1938). The length-weight relationship in fishes is defined by the hypothetical cube law $W=C L^3$, where 'W' is the weight of the fish, 'L' is the length of the fish and 'C' is a constant. If the density and form of the fish remains constant irrespective of its growth, this formula can be considered to hold good . However, since in actual fact this is not the case, the value of the exponent in the formula may differ from 3 (Martin, 1949). The relationship then is better expressed as $W=a L^b$, (Le Cren, 1951), where 'a' is a constant equivalent to 'C' in the isometric cube equation, and 'b' is another constant that needs to be calculated empirically (Martin, 1949). The growth is termed isometric when b = 3 and this is always the case in an ideal fish, which maintains its shape without any change (Allen, 1938). Beverton and Holt (1957) stated that significant variations from isometric growth are rare in fishes. However, the value of 'b' in fishes usually tends to vary between 2.5 and 4 (Hile, 1936; Martin 1949) and may also lie outside this range in some fishes at some stages of development.

Silverbellies (Family: Leiognathidae, Order: Perciformes) constitute important component of the marine fisheries of several countries exploiting the coastal fishing grounds in the Indo-Pacific and the Western Central Atlantic Oceans. They are small to medium-sized fishes assuming maximum lengths ranging from 100 to 170 mm. Silverbellies are important constituents of demersal finfish landings along the Indian coastline, particularly by trawl nets (Murty *et al.*, 2003). In the present study, the length-weight relationships in three major species of silverbellies - *Photopectoralis bindus, Secutor insidiator* and *Gazza minuta* are described.

## Materials and methods

Samples were collected fortnightly from the trawl landing centre at Kasimedu and the gillnet landing centre at Kovalam during the period January 2004-February 2006. Details of the number of fishes used for the study, along with the length and weight ranges, are given in Table 1. The 'Total length' (TL) of the fish, taken to be the distance between the tip of the snout and the tip of the upper caudal lobe, was measured using a graduated measuring scale and expressed to the nearest mm. The 'whole body weight' (W) of the fish was recorded to the nearest 0.01 g using an electronic balance.

The length-weight relationship was derived using the exponential hypothetical formula $W = a L^b$ given by Le Cren (1951). This relationship was linearised by logarithmic transformation to get the equation:-

$$\log W = \log a + b \log L,$$

The constants 'a' and 'b' were derived by the method of linear least squares. The equations derived separately for males, females and indeterminates were compared for

Table 1. Number and size range of samples used for the study

| | Number | Length range (mm) | Weight range (g) |
|---|---|---|---|
| *P. bindus* | | | |
| Male | 356 | 40 – 130 | 0.843 – 36.749 |
| Female | 312 | 40 – 133 | 0.853 – 40.611 |
| Indeterminate | 74 | 13 – 45 | 0.024 – 0.801 |
| Total | 742 | 13 – 133 | 0.024 – 40.611 |
| *S. insidiator* | | | |
| Male | 318 | 39- 118 | 0.808 – 22.064 |
| Female | 471 | 39 - 118 | 0.813 – 24.215 |
| Indeterminate | 73 | 12 - 42 | 0.031 – 1.439 |
| Total | 862 | 12 – 118 | 0.031 – 24.215 |
| *G. minuta* | | | |
| Male | 1004 | 40 - 159 | 1.0113 – 55.7 |
| Female | 763 | 39- 159 | 0.9265 - 58 |
| Indeterminate | 133 | 10 - 39 | 0.01 – 1.2 |
| Total | 1900 | 10 - 159 | 0.01 - 58 |

significant difference between regression coefficients (‘b’) and intercepts (‘a’) through Analysis of Covariance following Snedecor and Cochran (1967). The t-test (Snedecor and Cochran, 1967) was used to test whether the regression coefficients (‘b’) departed significantly from the isometric value of 3.

## Results and discussion

The length-weight equations derived for males, females and indeterminates of *P. bindus* are:

Males : $W = 0.00001318\ L^{3.0240}$ *(r = 0.9857)*

Females : $W = 0.00001342\ L^{3.0238}$ *(r = 0.9869)*

Indeterminates : $W = 0.00000919\ L^{3.0348}$ *(r = 0.9602)*

The length-weight equations derived for males, females and indeterminates of *S. insidiator* are:

Males : $W = 0.00002767\ L^{2.8804}$ *(r = 0.9898)*

Females : $W = 0.00003021\ L^{2.8846}$ *(r = 0.9923)*

Indeterminates : $W = 0.00002215\ L^{2.9053}$ *(r = 0.9833)*

The length-weight equations derived for males, females and indeterminates of *G. minuta* are:

Males : $W = 0.00002087\ L^{2.9225}$ *(r = 0.9937)*

Females : $W = 0.00002144\ L^{2.9175}$ *(r = 0.9864)*

Indeterminates : $W = 0.00001893\ L^{2.9522}$ *(r = 0.9859)*

Analysis of covariance revealed no significant difference between males, females and indeterminates in all the three species. Hence, the length-weight data of males, females and indeterminates of each species were pooled to derive singular length-weight equations for each species (Fig. 1, 2 and 3) as:

*P. bindus* $W = 0.000011989\ L^{3.0515}$ *(r = 0.9788)*

*S. insidiator* $W = 0.00002369\ L^{2.905}$ *(r = 0.9896)*

*G. minuta* $W = 0.00002088\ L^{2.9228}$ *(r = 0.9894)*

Statistical test for isometric growth ($H_0$:b=3) carried out using student’s ‘t’-test on the regression coefficient ‘b’ revealed that the values of b estimated for the three species do not deviate significantly from the isometric value of ‘3’ at 5% level (Table 2).

In view of the importance of length-weight relationships in understanding growth and stock dynamics of fish populations, it has been extensively studied in several species of fishes distributed in different parts of the world. Length-weight relationships in silverbellies have been derived from the Indo-Pacific regions, and the Indian sub-continent has been a major site for study of these fishes. James and Badrudeen (1981) gave detailed statistics of the length-weight relationship in *L. dussumieri* from the Gulf of Mannar, reporting ‘b’ values of 2.9591, 3.1732 and 3.3976 for males, immature females and mature females, respectively. Batcha and Badrudeen (1992) reported the value of ‘b’ to be 3.004 for *L. brevirostris* from the Palk Bay. Karthikeyan *et al*. (1989) describing the relation between length and weight in *L. jonesi* from Palk Bay,

Table 2. Test of significance of regression coefficients ‘b’

| Species | b | d.f. | t | t (*P=0.05*) | P |
|---|---|---|---|---|---|
| *L. bindus* | 3.0515 | (1, 740) | 0.1126 | 1.9631 | 0.455 |
| *S. insidiator* | 2.905 | (1, 860) | 0.0991 | 1.9627 | 0.461 |
| *G. minuta* | 2.9228 | (1, 1898) | 0.0673 | 1.9612 | 0.473 |

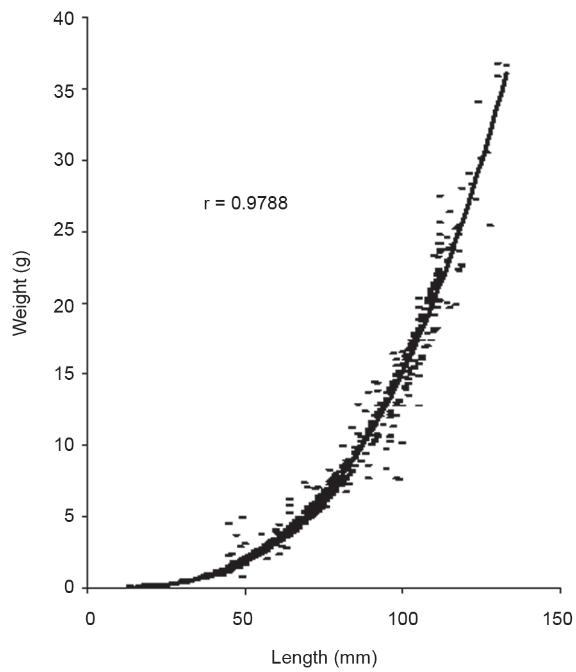


Fig. 1. Length-weight relationship in *P. bindus*

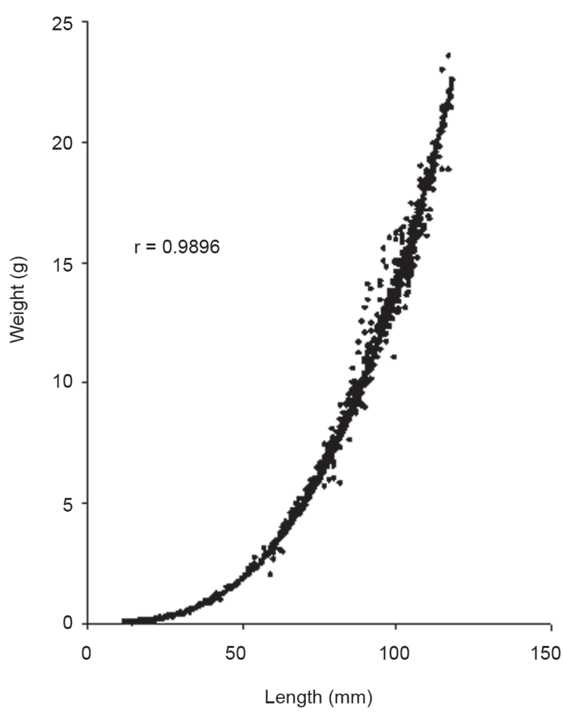


Fig. 2. Length-weight relationship in *S. insidiator*

reported 'b' to be 2.87. Balan (1963) reported the 'b' value to be 2.864 for *L. bindus* from Calicut coast of Kerala. Nagarajan (2000) who derived the length-weight relationship in *L. berbis*, *L. dussumieri*, *S. insidiator* and *G. minuta* from the Tuticorin coast estimated the 'b' values to be 3.0717,

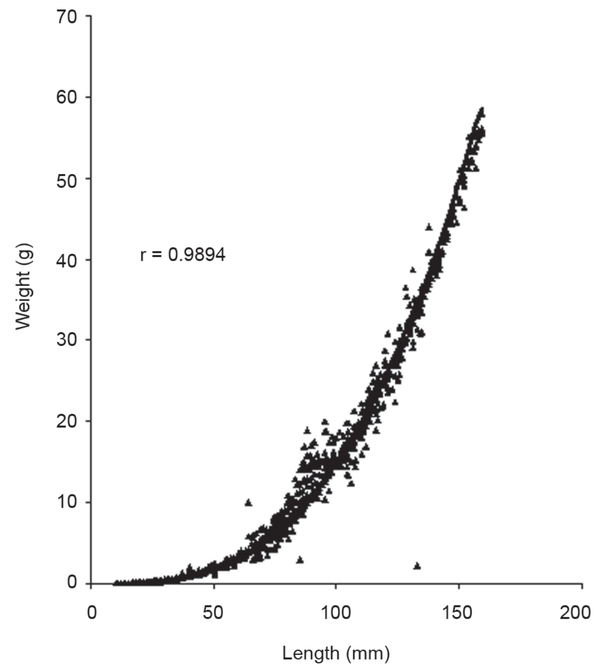


Fig. 3. Length-weight relationship in *G. minuta*

3.1245, 3.3032 and 3.0624 respectively. The length-weight relationship in *L. bindus* has been described from the Kakinada coast (Murty, 1983) and the West Bengal coast (Murty, 1986). From Parangipettai, Jayabalan and Krishna Bhat reported 'b' value of different stages of *G. minuta* which ranged from 2.5939 to 3.1629. The 'b' value was reported to be 2.97 from Kakinada and 3.286 from West Bengal. The value obtained in the present study was 3.05. Jayabalan (1988) derived the length-weight relationship in *S. insidiator* from Porto Novo and reported 'b' to be 2.864 and 2.906 for males and females respectively. Mazlan and Seah (2006) from Malaysia, reported 'b' value of *S. insidiator* as 2.457. Abraham *et al.* (2011) derived the length weight relationship of *S. insidiator* from Cochin, Kerala and reported 'b' value as 3.463. In the present study, the value of 'b' for *S. insidiator* derived was 2.8877. The value of the regression coefficient 'b' reported for *L. bindus*, *S. insidiator* and *G. minuta* from other parts of the Indian Ocean and Western/Central Pacific Ocean as listed in Fish Base 98 (Froese and Pauly, 1998) are seen to range mostly between 2.5 and 3.4. The values of 'b' obtained for the three species in the present study also fall in the same range, and there does not seem to be much variation in the growth patterns with differentiation of sexes and advancement of age in each of the three species.

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