Length Weight Relationship of Four Commercially Important Marine Fishes of Northern Bay of Bengal, West Bengal, India

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ABSTRACT
Length-weight relationship of four commercially important marine fish species of four genus from four different families were estimated between July 2010 and July 2011 at three different fish landing centers of West Bengal. A total of 197 individual fishes of four species were measured. Length-weight relationship was established by the formulae: \( W = aL^b \). The ‘b’ values and ‘r’ values of length-weight relationship of *Tenualosa ilisha*, *Pampus argenteus*, *Scomberomorus guttatus* and *Osteogeneiosus militaris* were observed to be 3.109, 2.841, 2.894, 2.945 and 0.989, 0.987, 0.991, 0.992 respectively. The condition factor of all these four species were 1.141 ± 0.004 in *T. ilisha*, 0.649 ± 0.003 in *S. guttatus*, 1.623 ± 0.008 in *P. argenteus* and 0.941 ± 0.004 in *O. militaris*. There was a significant positive correlation between length and weight which indicates that all the four species maintain their shape throughout their life.

Key words: Length weight relationship, fish landing center, condition factor, Bay of Bengal.

INTRODUCTION
The length-weight relationship (LWR) is a very important parameter to understand the growth dynamics of the fish population. Length and weight data are useful standard results of any fish sampling program [15]. LWR of fishes are important in fisheries biology because they allow the estimation of the average weight of fish of a given length group by establishing a mathematical relation between the two parameters [5]. The LWR is particularly important in parameterizing yield equations and in estimations of stock size [1]. The exact relationship between length and weight differs among species of fish according to their inherited body shape, and within a species according to the condition (robustness) of individual fish [23]. The study of morphometric characters in fishes is important because they can be used for the differentiation of taxonomic units [3]. In fisheries science, the condition factor is used in order to compare the “condition”, “fatness” or wellbeing of fish [2]. The condition factor usually increases with sexual maturation. Pati [18] estimated length weight relationship of *P. argenteus* from Bay of Bengal (BOB). Biswas et al. [6] calculated the LWR along with the variation of condition factor of *Chanos chanos* in brackish water pond of Indian Sundarbans, West Bengal (WB). Sawant and Raje [22] estimated the LWR of *Arius caelatus* and *A. thalassinus* from Mumbia and Vishakhapatnam coast. Similar studies were done by Haimovici and Velasco [11], Muto et al [16], Harisson et al. [12], Volvich et al. [24], Rahman et al. [19], Ecotin et al [8], Kalayci et al. [13], Cherif et al. [7], Gökçe et al. [10] in other areas.

In this present study the length weight relationship was calculated along with the mean length and weight of four different fish species from the three main marine fish landing centers of West Bengal. The condition factor was also estimated to understand their condition of growth.

MATERIALS AND METHODS
Length-weight relationship of four marine fish species viz. *Tenualosa ilisha*, *Pampus argenteus*, *Scomberomorus guttatus* and *Osteogeneiosus militaris* were measured by a metric scale and a digital weighing machine of Wensar (TTB-3), capacity 3 kilograms and accuracy 0.01 gram. A total of 197 individual fishes were measured from July 2010 to July 2011 from Kakkidwp Fishing Harbour (21°51’56.80”N and 88°10’25.65”E) and Frasuregunje Fishing Harbour (21°34’45.91”N and 88°15’5.38”E) of District South24-Parganas and Digha-Mohana fish market (21°37’47.78”N and 87°32’35.19”E) lying in the District Purba Midnapur (Figure 1). The fishes were caught by gill net and trawl net from Bay of Bengal Large Marine Ecosystem.

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FIGURE 1. Figure shows the sites of the present study.

Length was measured in millimeters (mm) and weight was measured in grams (g). Total length was measured from the lower jaw to the tip of the tail; spread normally [24]. The minimum and maximum lengths and weights were also estimated. The length-weight relationship was established by the equation $W = aL^b$ [14], where $W$ is the weight of the fish, $L$ is the total length of the fish, ‘$a$’ is the exponent describing of the rate of change of weight with respect to length and ‘$b$’ denotes the weight at unit length. The ‘$a$’ and ‘$b$’ were also calculated from the $W = aL^b$ equation. When the parameter ‘$b$’ is equal to 3, the growth is called isometric but the growth is positive allometric when the ‘$b$’ value is more than 3 and negative allometric when the ‘$b$’ value is less than 3. The coefficient of condition has usually been represented by the letter K when the fish is measured and weighed in the metric system. The formula most often used is: $K = W\times100,000/L^3$, where: $W =$ the weight of the fish in grams; $L =$ the standard length of the fish in millimeters [25].

All the calculations were done by using Microsoft Office Excel 2010.

RESULTS AND DISCUSSION

The LWR of 1971 individual fishes of four different species of four different families have been detailed on Table 1.

A total of 550 individual of Hilsa Shad (Tenualosa ilisha) were measured during this study period and the mean length and mean weight of Hilsa Shad were 311.91 ± 2.58 mm and 387.71 ± 8.84 g simultaneously. The ‘$b$’ value of Hilsa Shad was 3.109 and the $r^2$ value was 0.9898. The length weight relationship of Hilsa Shad was found to be $W = 0.000006L^{3.109}$ (Figure 2) where the ‘$b$’ value is 3.109, so the growth of Hilsa Shad is observed to be positive allometric in nature. Reuben et al. [21] established the LWR of Hilsa Shad from northeast coast of India and the relationship is $W = 0.0003693321L^{2.3053}$. The LWR of Hilsa Shad, $W = 0.00305TL^{3.381}$ was calculated by Nurul Amin et al. [17] from Bangladesh water. In Hilsa Shad the condition factor was 1.141 ± 0.004, which indicate that the weight increases with the cube of length.
FIGURE 2. Length weight relationship of *Tenualosa ilisha*.

Indo-Pacific King Mackrel, (*Scomberomorus guttatus*) which is elongated in shape; its mean length was observed to be 375.54 ± 4.80 mm and the mean weight was 418.2 ± 15.3 g. In this present study 480 individual of *S. guttatus* were measured. The LWR of *S. guttatus* was $W = 0.00001 L^{2.894}$, where the $r^2$ value was 0.9915 (Figure 3), from this relationship it can be inferred that their growth is negative allometric in nature. According to Rashid et al. [20] the LWR of *S. guttatus* was $W = 0.0101 L^{2.862}$. The condition factor of *S. guttatus* was 0.649 ± 0.003, so its growth is poor, weight is not increasing with the length, that’s why it elongated in shape.

FIGURE 3. Length weight relationship of *Scomberomorus guttatus*. 

$$y = 0.000001x^{3.1099590}$$
$$r^2 = 0.9898588$$
$$n = 550$$

$$y = 0.000001x^{2.89445}$$
$$r^2 = 0.99153$$
$$n = 480$$
A total of 467 Silver Pomfret were measured during this study period. The mean length and mean weight were 205.14 ± 2.62 mm and 168.84 ± 6.63 g respectively. The growth of *P. argenteus* is negative allometric as its ‘b’ value was found to be 2.841 and the LWR was \( W = 0.00004*L^{2.841} \) (Figure 4). The \( r^2 \) value of length and weight was 0.9873. Pati [18] established the LWR for *P. argenteus* \( W=0.01340*L^{2.5307} \) for male and \( W=0.009523*L^{2.6920} \) for female. In 2009 Ghosh et al. [9] estimated the log transformation of LWR of *P. argenteus*, which is log \( W = -1.8052 + 3.050426 \log L \), where the ‘b’ value was 3.05026. Rahman et al. [19] estimated ‘a’ and ‘b’ values -1.1004 and 2.7931 respectively in *P. argenteus*. The growth of *P. argenteus* in Northern Bay of Bengal is quite good as its condition factor is 1.623 ± 0.008.

**FIGURE 4.** Length weight relationship of *Pampus argenteus*.

From the Bay of Bengal, Soldier Cat Fishes (*Osteogeneiosus militaris*) of various size groups were caught every year. Among 474 Soldier Cat Fishes, the mean length was 305.75 ± 4.04 mm and mean weight was 339.7 ± 16.1 g respectively. The LWR of *O. militaris* was \( W = 0.000013*L^{2.945} \) (Figure 5) where the ‘b’ value was 2.945 and the \( r^2 \) value was 0.9923. Sawant and Raje [22] estimated the LWR of *Arius caelatus* and *A. thalassinus* from Mumbai and Vishakhapatnam coast. For *A. caelatus* it is log \( W= -5.42954 + 3.173407 \log L \) (male); log \( W= -5.84139 + 3.335444 \log L \) (female), where the ‘r’ value is 0.979559 for male and 0.911744 for female. For *A. thalassinus* it is log \( W= -5.12893 + 3.029225 \log L \) (male); log \( W= -5.10804 + 3.04644 \log L \) (female). The condition factor in *O. militaris* was 0.941 ± 0.004, indicating that its growth has been more or less normal.

**TABLE 1.** Table shows the length weight relationship of four marine fishes.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
<th>Family</th>
<th>n</th>
<th>Mean Length (L) ± SE Mean</th>
<th>Mean Weight (W) ± SE Mean</th>
<th>( r^2 )</th>
<th>b</th>
<th>a</th>
<th>K ± SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hilsa Shad</td>
<td><em>Tenualos ilisha</em>, Hamilton, 1822</td>
<td>Clupeidae</td>
<td>550</td>
<td>311.91 ± 2.58</td>
<td>387.71 ± 8.84</td>
<td>0.9898</td>
<td>3.109</td>
<td>0.000006</td>
<td>1.141 ± 0.004</td>
</tr>
<tr>
<td>Indo-Pacific King Mackerel</td>
<td><em>Scomberomorus guttatus</em>, Bloch &amp; Schneider, 1801</td>
<td>Scombridae</td>
<td>480</td>
<td>375.54 ± 4.80</td>
<td>418.2 ± 15.3</td>
<td>0.9915</td>
<td>2.894</td>
<td>0.00001</td>
<td>0.649 ± 0.003</td>
</tr>
<tr>
<td>Silver Pomfret</td>
<td><em>Pampus argenteus</em>, Euphrasen, 1788</td>
<td>Stromateidae</td>
<td>467</td>
<td>205.14 ± 2.62</td>
<td>168.84 ± 6.63</td>
<td>0.9873</td>
<td>2.841</td>
<td>0.00004</td>
<td>1.623 ± 0.008</td>
</tr>
<tr>
<td>Soldier Cat Fish</td>
<td><em>Osteogeneiosus militaris</em>, Limnaeus, 1758</td>
<td>Ariidae</td>
<td>474</td>
<td>305.75 ± 4.04</td>
<td>339.7 ± 16.1</td>
<td>0.9923</td>
<td>2.945</td>
<td>0.00013</td>
<td>0.941 ± 0.004</td>
</tr>
</tbody>
</table>
FIGURE 5. Length weight relationship of *Osteogeneiosus militaris*.

CONCLUSIONS

The length-weight relationship is very important for proper exploitation and management of the population of fish species [4]. The LWR of these commercially important marine fishes helps to manage their stock in the Northern Bay of Bengal. From the length weight relationship study it is clear that the growth of *T. ilisha* is positive allometric in nature and in case of *P. argenteus, S. guttatus* and *O. militaris* it is negative allometric in nature and the length and the weight of all the four species are significantly correlated. It indicates that the all the four species maintain their shape throughout their life. From the perspective of condition factor the growth of *P. argenteus* and *T. ilisha* is excellent whereas the growth of *O. militaris* is more or less stable but the weight of *S. guttatus* is not increasing with the length, probably because of environmental stress caused by the low salinity of the Hugli estuary.

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REFERENCES


