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LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR IN *SETIPINNA PHASA* (HAMILTON-BUCHANAN) FROM THE BAY OF BENGAL, BANGLADESH

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Abstract: The length-weight relationship and relative condition factor of S. *phasa,* collected from Loitraghat and Patenga fish landing centers of Chittagong, were studied between December, 1992 and November, 1993. The values of the exponent in the length-weight equations estimated separately for both sexes indicated t hat the differences in the exponential indices of total length in males and females were statistically not significant. The general equation, thus, was derived from the data pooled from both the sexes. The unified equation showed that the general length-weight relationship in S. *phasa* is nearly close to the cube law. The general length-weight relationship found to be log W = -2.524 + 3.149 log TL or $W = 0.00299^{3.149}$. The mean values of relative condition factor (K_n) were found to be 1.0057 $\pm$0.1169 and 1.00163 $\pm$0.0576 in male and female respectively.

Keywords: Length-weight relationship; Condition factor; Bay of Bengal; Gangetic anchovy; *Setipinna phasa*

Introduction

The Gangetic anchovy *S. phasa* (Hamilton-Buchanan 1822) is locally known as 'phasa' or 'ram phasa'. It belongs to the family Engraulidae under the order Clupeiformes. The fish is distributed along the tidal rivers, estuaries and shallow coastal regions of Bangladesh (Shafi and Quddus, 1982) and former Burma (Myanmar) and undivided India (Day, 1889). The fish contributes significantly to commercial fishery in Chittagong coast round the year and consumed in fresh and dry condition.

The determination of a precise mathematical relationship between length and weight of fish has numerous applications in fishery biology. With the help of the derived equation, one measure can be converted into the other (Jhingran, 1968). This relationship is mostly described with the 'cube law' where weight of a fish equals the cube of its length. However, as the form and specific gravity of animals are not constant, the empirical observations do not strictly follow the cube law (Jhingran, 1968). The departures from the general 'cube law' relationship between length and weight are used in fishery biology to investigate environmental suitability, racial discriminations, general well-being or relative robustness of fish by means of a condition factor (Hile, 1936). The condition factor also serves as a useful index of the nutritional and biological cycle viz. gonadal development, spawning etc. of the species (Jhingran, 1972).

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Although *S. phasa* contributed significantly to the commercial fisheries, no effort has been made in studying its biology from Bangladesh. However, the length-weight relationship and condition factor of the fish have been studied from Indian tidal rivers by Jhingran (1972). The present study embodies observations on the length-weight relationship in terms of total length and standard length and relative condition factor of *S. phasa* for both the sexes from the Bay of Bengal, Bangladesh.

Materials and Methods

A total of 611 specimens, ranging from 1 to 3 1.9 cm were randomly collected once a month from Loitraghat and Patenga fish landing centers between December, 1992 and November, 1993. The fish was identified following Day (1889), and Shafi and Quddus (1982). After bringing to the laboratory, the samples were thoroughly washed with clean water and excessive water was dried with blotting paper. The length of the fish was measured to nearest 0.1 cm from the tip of the snout to the end of the tail for total length, and to the base of the caudal fin for standard length. The weight of the individual fish was measured to nearest 0.001 g with a precision single pan balance.

For finding out the possible variable relationships of length and weight of the species the samples were sexed and sorted into size groups with 1cm class interval. Sexuality of the specimens was determined by examining morphometric conditions of the gonads such as size, shape and colour in fresh condition following Jhingran (1961). The average total length (TL), standard length (SL) and weight of each size group was calculated for both male and female fish, and the data were fitted into the Le Cren's (1951) formula $W = aL^n$ or logarithmically $\text{Log } W = \log a + n \log L$, where, W = weight of fish; L = length (TL/SL) of fish; a = intercept and ^{n} = regression coefficient.

The data were split under male and female and the length-weight curve was fitted to the data by the method of least squares for both the sexes. For computing K_n values in different size-class the average weight of several specimens in 1cm group was computed. The relative condition factor (K_n) was calculated from the following formula:

$K_n = w/W$. where, w = observed weight; W = calculated weight.

Results and Discussion

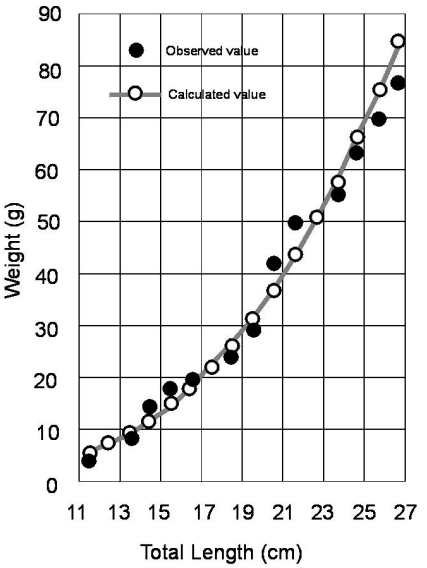
Length-weight relationship: Out of 611 fish specimens, 285 were males and 326 were females. Total length of the fishes varied from 11.1 to 26.8 cm in male and 14.2 to 31.9 cm in female while standard length varied between 9.2 and 23.8 cm, and 12.3 and 28.8 cm in male and female respectively. The weight of the fishes varied from 4.2 to 81.5 g in male and 11.6 to 180.6 g in female. Scatter diagrams of total length versus weight and standard length versus weight in male and female S. *phasa* are presented in Figures 1 through 4. The equations for TL and W, and SL and W relationship in male and female fish were found to be as follows:

(a) Total Length versus Weight:

(i) For male fish: $W = -57.258 + 4.86\ TL\ (r = 0.98)$

$\log W = -2.613 + 3.192 \log TL\ (r = 0.99)$

or $W = 0.002438\ TL^{3.192}$



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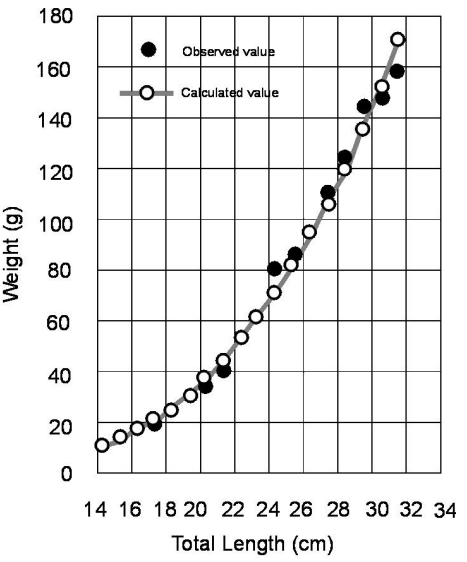

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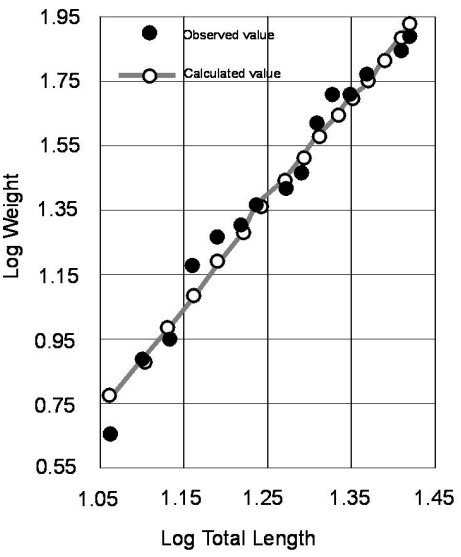

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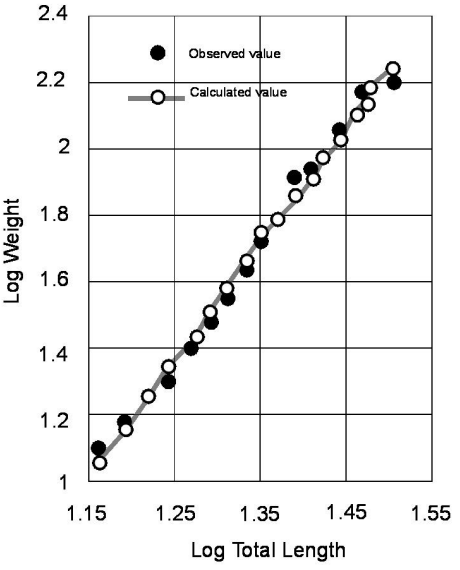
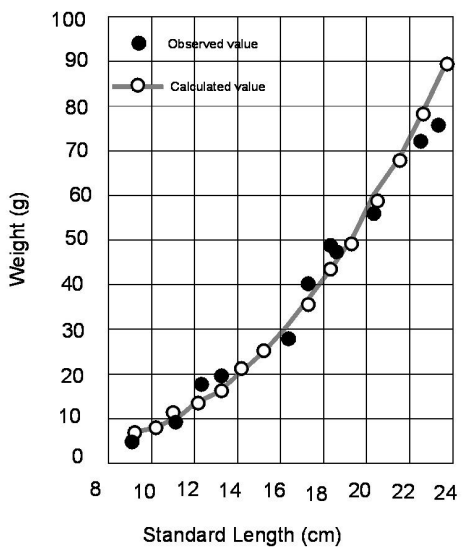
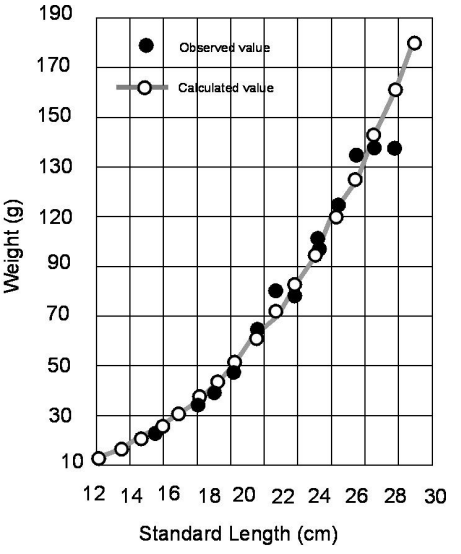


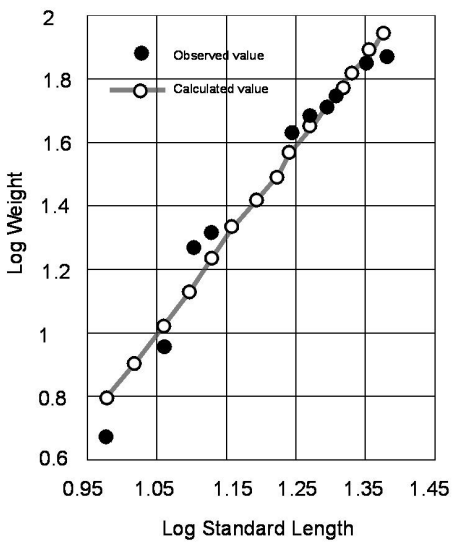
2 (b)

Fig.- 1. The arithmetic relationship between total length and weight in (a) male and (b) female of *S. phasa.*

Fig.- 2. The logarithmic relationship between total length and weight in (a) male and (b) female of *S. phasa.*







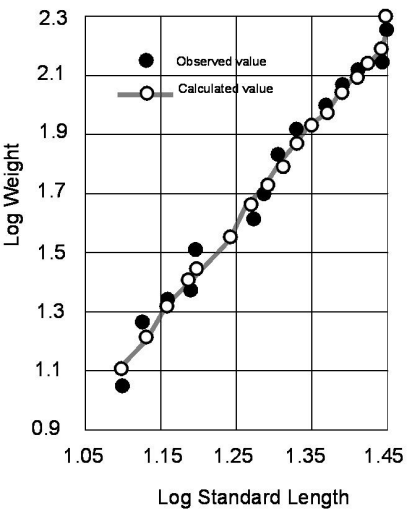


Fig.- 3. The arithmetic relationship between standard length and weight in (a) male and (b) female of *S. phasa.*

Fig.- 4. The logarithmic relationship between standard length and weight in (a) male and (b) female of *S. phasa.*

(ii) For female fish: $W = -139.24 + 9.111\ TL$ ($r = 0.97$)
$\log W = -2.937 + 3.449 \log TL$ ($r = 0.99$)
or $W = 0.001156\ TL^{3.449}$

(b) Standard Length versus Weight:

(i) For male fish: $W = -52.86 + 5.462\ SL$ ($r = 0.98$)
$\log W = -2.178 + 3.016 \log SL$ ($r = 0.98$)
or $W = 0.006637\ SL^{3.016}$

(ii) For female fish: $W = -131.916 + 10.145\ SL$ ($r = 0.97$)
$\log W = -2.44 + 3.133 \log SL$ ($r = 0.99$)
or $W = 0.00363l\ SL^{3.133}$

When the total and standard lengths of both male and female fishes were plotted against their corresponding weights on arithmetic scale, smooth growth curves were obtained (Fig.- 1 and 3); and a straight line was found when plotted on logarithmic scale (Fig.- 2 and 4).

The results for males and females were compared and it was found that the differences between the regression coefficients for male and female fishes were not significantly different at $p<0.05$ level. Thus, the entire length-weight data were pooled irrespective of sex into a single equation. The general equations for TL versus W, and SL versus W in *S. phasa* were worked out as follows:

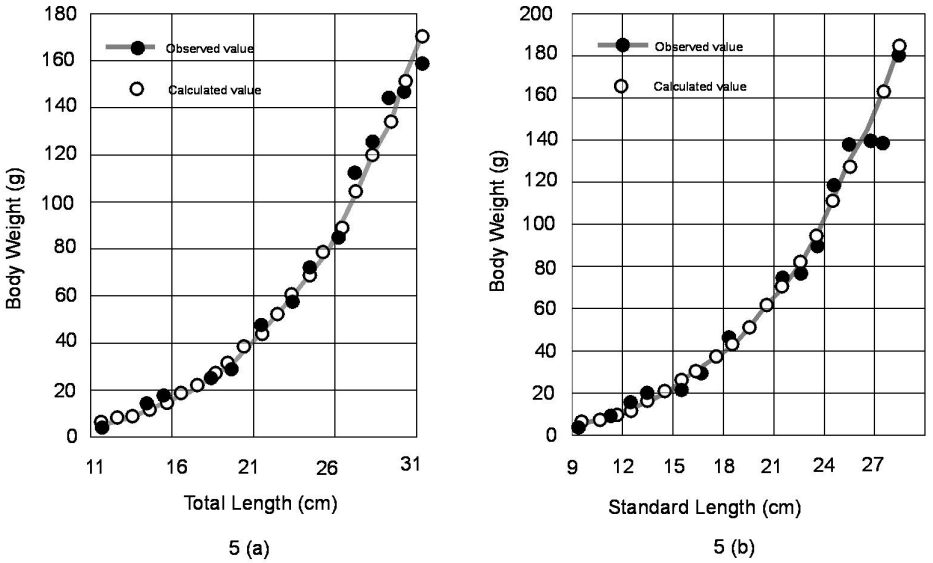
Total length vs. weight: $W = -105.912 + 7.562\ TL$ ($r = 0.945$)
$\log W = -2.524 + 3.149 \log TL$ ($r = 0.945$)
or $W = 0.002992\ TL^{3.149}$

Standard length vs. weight: $W = -99.845 + 8.468\ SL$ ($r = 0.95$)
$\log W = -2.316 + 3.135 \log SL$ ($r = 0.99$)
or $W = 0.004831\ SL^{3.135}$

The values of 'n' obtained from total length-weight and standard length-weight equations were also compared in a 't' test and it was found that the differences between the values of 'n' were not significant at $p<0.05$ level. Thus, any one of the above equations could be used to convert length into weight and vice-versa as they produce same results.

Scatter diagrams of TL and SL versus weight estimated from the unified general equation are shown in Fig.- 5 and Fig.- 6. The agreements between calculated and observed weight were generally satisfactory. The greatest discrepancies that occurred among the largest fish were due to small number of large specimens in samples.

In fish the values of regression coefficient 'n' generally lies between 2.5 and 4.0 (Hile, 1936). Only an ideal fish maintains the value of 'n' at 3 when there is no significant change in form and specific gravity during its life time (Martin, 1949). In most fishes, the value of 'n' has been reported more or less than 3 (Le Cren, 1951). It is evident that the value of 'n' at 3.135 or 3.149 in S. *phasa* from the Bay of Bengal closely follow the 'cube law' i.e. isometric growth is to be expected in the fish. Jhingran (1972) estimated the length-weight relationship in S. *phasa* from Indian rivers attributing the total length only. He reported the value of 'n' at 3.07166, 2.86969 and 3.03549 for male, female and combined male and female respectively. He also reported a non-significant difference in the value of 'n' between male and female fish. The variation in the value of 'n' between present study and that of Jhingran (1972) may be due to environmental features of the two geographical locations.



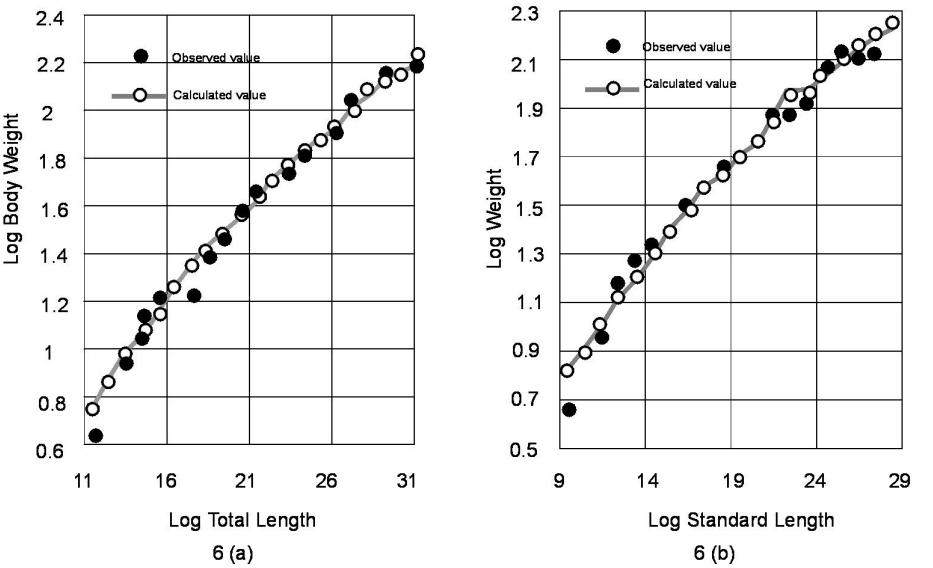


Fig.- 5. The arithmetic relationship between (a) total length and weight and (b) standard length and weight in *S. phasa.*

Fig.- 6. The logarithmic relationship between (a) total length and weight and (b) standard length and weight in *S. phasa.*

The significant coefficient of correlation between the measurements-- length and body weight of *S. phasa* in the present study agrees well with the results reported for *Trichiurus savala* (Bashirullah and Kader, 1970), *Gobioides rubicundus* (Kader, 1984), *Gudusia chapra* (Jhingran, 1968) and for *Thryssa hamiltonii* and *T. mystax* (Hussain and Ali, 1989).

Relative condition factor (K_n): From the average weight of several specimens in 1cm length group, the relative condition factor was computed sex-wise and the results are shown in Fig.-7. The relative condition factor is found to fluctuate at different size group in both sexes. The K_n values ranges from 0.7767 to 1.2241 (mean 1.0057$\pm$SD 0.1169), and 0.9315 to 1.1315 (mean 1.00163$\pm$SD 0.0576) in male and female respectively. Among the two peaks in K_n values for either sexes, the first peak at 14.5 cm in male and female, and the second peak at 21.5 and 24.5 cm in male and female. The first peak in K_n value could be the minimum length at first maturity for both the sexes.

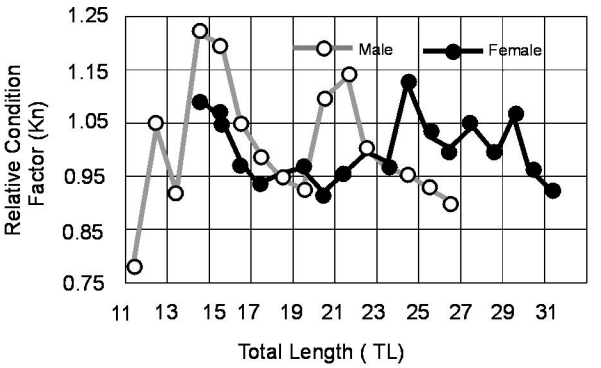


Fig.- 7. Relative condition factor of male and female *S. phasa* in different length group.

According to Hart (1931), the point of inflexion on a curve showing the fluctuations in K_n values is a good indication of the length at which sexual maturity attained. The inflexion point in *S. phasa* in the present study is found to be at 14.5 cm for both the sexes (Fig.-7) which implies that males and females may attain sexual maturity at the same length group. However, Jhingran (1972) reported the attainment of sexual maturity in the same species at 14.0 and 16.0 cm for male and female respectively from Indian waters.

The poor variation in the K_n values (0.7767 to 1.2241) may be due to either small sample size, different maturity stages, partial spawning, difference in the weight of undigested food in the alimentary canal or changes in the fat content in the body tissue (Jhingran, 1972) which is the subject for further study.

References

Bashirullah, A.K.M. and Kader, M.A., 1970. The length-weight relationship and condition of *Trichiurus savala* Cuv. and Val. *Pakistan J. Sci. Res.,* 13(4): 414-419.

Day, F., 1889. *The Fauna of British India,* Vol. 2: Fisheries. William Dawson and Sons Ltd., London, 458pp.

Hart, J.L., 1931. The growth of the whitefish, *Coregonus clupeaformis* (Mitchill). *Contr. Canad. Biol. and Fish.,* 6(2): 429-444.

Hile, R., 1936. Age and growth of the cisco, *Liucichthya artedi* (Le Sueur), in the lakes of the northern highlands, Wisconsin. *Fish. Bull. US.,* 48(19): 211-317.

Hussain, N.A. and Ali, T.S., 1987. Some biological aspects of *Thryssa hamiltonii* and *Thryssa mystax* in Khor Al-Zubair, Northwest Arabian Gulf. *Indian J. Fish.,* 34(2): 152-163.

Jhingran, A.G., 1961. Studies on the maturity and fecundity of the Gangetic anchovy, *Setipinna phasa* (Hamilton). *Indian J. Fish.,* 8: 291-311.

Jhingran, A.G., 1968. The length-weight relationship and K factor of *Gudusia chapra* (Hamilton) from the Ganga river system. *Proc. Nat. Acad. Sci. India,* 38(B), III & IV: 249-263.

Jhingran, A.G., 1972. Fluctuations in the ponderal index of the Gangetic anchovy, *Setipinna phasa* (Hamilton) from the Ganga river system. *J. Inland Fish. Soc. India,* 5: 14-19.

Kader, M.A., 1984. Studies on *Gobioides rubicundus* Hamilton-Buchanan from the Karnafully estuary. Ph. D. Thesis, University of Chittagong, 178 pp.

Le Cren, A.H., 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch *Perca fluviatilis. J. Anim. Ecol.,* 20: 201-219.

Mia, G.K., 1984. Length-weight relationship and condition factor in the air-breathing catfish, *Heteropneustes fossilis* (Bloch). *Bangladesh J. Zool.,* 12(1): 49-52.

Martin, W.R., 1949. The mechanics of environmental control of body form in fishes. *Univ. Toronto Stud. Biol.,* 58: 1-91.

Shafi, M. and Quddus, M.M.A., 1973. The length-weight and length-girth relationships and condition in the carp *Labeo nandina* (Hamilton-Buchanan). *Bangladesh J. Agr. Sci.,* 2(2): 34-37.

Shafi, M. and Quddus, M.M.A., 1974. The length-weight and length-girth relationships and condition in *Hilsa ilisha* Hamilton-Buchanan (Clupeidae). *Bangladesh J. Zool.,* 2(2): 179-185.

Shafi, M. and Quddus, M.M.A., 1982. *Bangladesher Mathso Sampad* (Fisheries Resources of Bangladesh). Bangla Academy, Dhaka, pp. 47-48.