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Impact of gonad weight on the condition of hilsa shad, *Tenualosa Ilisha* (Hamilton, 1822) in Bangadesh

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Abstract

The hilsa shad, *Tenualosa ilisha* (Hamilton, 1822) is an important anadromous clupeid fish species from the western division of the Indo-Pacific region. The present study dealt with the impact of gonad weight of hilsa shad using monthly samples over a calendar year from January to December 2009 from the river Tentulia flowing through Barisal district in Bangladesh. The results revealed that all length-weight relationships were highly correlated (r>0.891). In case of male, the parameters of equations (q) varied monthly from 0:0025 to 0.0233. And the slope of equations (b) varied from 2.77 to 3.27. In case of female, the coefficient of equations (a) varied monthly and it ranged from 0:0092 to 0.0178and the slope of equations (b) varied from 2.86 to 3.39. The In case of male (bw-gw), the parameters of equations (q) varied monthly from 0:0096 to 0.0289. And the slope of equations (b) varied from 2.73 to 3.66. In case of female(bw-gw), the coefficient of equations (a) varied monthly and it ranged from 0:0018 to 0.0375 and the slope of equations (b) varied from 2.63 to 3.48.The generalized length-weight relationship was fitted with the pooled data of all monthly samples for male and female separately which were $BW = 0.0098TL^{3.0283}$ and $BW = 0.00881TL^{3.0749}$, respectively. The generalized length-weight relationship was fitted with the pooled data of all monthly samples for male(bw-gw) and female(bw-gw) separately which were $BW = 0.0094TL^{3.0382}$ and $BW = 0.0096TL^{3.0239}$, respectively. The higher value of regression co-efficient (b) was found either due to maturation of gonad or due to favorable feeding environment. Monthly relative condition factors based on CF_{BW} the values ranged from 0.87 to 121for male In case of female the relative condition factors based on CF_{BW} ranged from 0.70 to 1.12. Monthly relative condition factors based on CF_{BW} the values ranged from 0.85 to 1.22for male (bw-gw). In case of female (bw-gw) the relative condition factors based on CF_{BW} ranged from 0.75 to 1.29.

Keywords: Body weight, gonad, hilsha shad, relations and parameter

Introduction

Bangladesh is called ‘country of hundred rivers’. It has 290 rivers (54 are international) and numerous ponds, beels, haors, baors, lakes, flood plains, brackish and marine water bodies. Bangladesh is very rich in aquatic biodiversity.The aquatic habitats of Bangladesh can be broadly categorized as follows- (i)Inland open waters (Rivers, estuarine area, Beels & haors, kaptai lake, flood plains; (ii)Inland closed waters (ponds, Baors, Brackish water farms); (ii)Marine waters. Total area of inland waters is 4.31 million ha which contains 260 fresh water species, 12 exotic fish species and 24 prawn species. Total area of

coastal water is 2.61 million hectare and marine water area is 1.66 million km^2 where 475 marine fish species and 36 species are available. In 2008-2009, the fisheries sector in Bangladesh contributes 22.23 % to the countries agricultural production and earns second highest foreign exchange of the country. The total fish production of Bangladesh was estimated at 2.701 million metric tons. Inland open water fisheries contributed 41.61% of the total fish production (DOF, 2010).

Inland capture fisheries are one of the main sources of animal protein in Bangladesh. They cover an area of 4.57 million ha, of which 88% comprises open-water capture fisheries and 12% closed-water systems such as ponds where most fish are deliberately stocked. The vast inland water resources comprise 22,614 million ha of haors, 1, 14,161 ha of beels, almost 5,488 ha of baors and 2,832,792 ha are flooded in the monsoon. Bangladesh produced about 2.8 million metric tons of fish per year and about 82% of the total production comes from inland resources of which about 38% from culture and 35.52% from capture fisheries (Anonymous, 2010).The world fishery is mainly marine, which occupies more than 97% of the total fisheries; freshwater fisheries constitute only about 2.5%. But in Bangladesh freshwater fisheries constitute around 70% and marine fisheries together with brackish-water occupy the rest. Marine fishing industries though have undergone a period of changes in the past 40 years elsewhere but are still predominantly traditional in Bangladesh. For the duration of the last 40 years traditional fishing boats got only an engine fixed to gain more mobility and marine fishing vitally remains coastal fishing in Bangladesh where a few species are targeted and which often leads to over exploitation. Hence, the marine fisheries zone of Bangladesh is roughly above 200,000 km^2, which is larger than the total area of the country. Marine fisheries can be classified into 2 categories, pelagic and demersal. Hilsa includes into pelagic categories which has additional significance than other categories in Bangladesh.

The large number of small fish species are still available in both open and closed inland waters amongst them Hilsa (ilish) any of the members of the genus Tenualosa of the family Clupeidae, order Clupeiformes. Locally known as Ilish, the fish has been designated as the national fish of Bangladesh. The body is strongly compressed and moderately deep with dorsal and ventral profile equally Up to 60 cm, but commonly found specimens measure 35 to 40 cm Hilsa is the only one species which is contributed to earn the highest amount of foreign currency in Bangladesh. Length-weight relationships (LWR) also provide basic information in fisheries biology, being useful to determine the weight of an individual fish of known length or total weight from length-frequency distribution, and to compare specific growth among different regions (Forese, 1998; Koutrakis 2003)

Materials and Methods

Study Area:

The Tentulia River is distributed in Barisal town. Tentulia. Barisal district is located in south-central Bangladesh, with an area of 13295.55 km^2, latitude 22.8° and longitude 90.5°.

Fish Sampling:

Samples were bought once a month over a calendar year from January to December 2009, about 100 fishes covering various size groups were ensured at each event.

Dissection of gonad and sex determination

Fishes were identified as male and female by observing the gonads with naked eye. The males have gonads with smooth exterior, while the females have gonads with a rough exterior. Both left and right gonads were measured together to the nearest 0.01g. Thereafter, the gonads were preserved with 10 % formalin in small vials

Establishment of length-weight relationship

The relationship between the standard length (SL) and body weight (BW) of fish was estimated by using the equation:

$$BW = aSL^b$$

Where,
BW=Body weight of fish in (g)
SL=Standard length of fish in (cm)
a=Constant (intercept)
b=an exponent indicating isometric growth when equal to 3.

This power curve equation was converted into linear form by the use of natural logarithms, such as-

$$Ln\ BW = Ln\ a + b\ (Ln\ SL)$$

This equation is the same form as the linear equation Y= a + bX. Ln BW is equal to the dependent variable (Y), Ln SL the independent variable (X), b the regression coefficient or slope and Ln a is the intercept. Then the data is pooled as a linear regression by plotting LnW against LnL.The slope, b is estimated from the above straight-line equation by:

$$b= [n\sum XY - \sum X\sum Y] / [n\sum X^2 - (\sum X)^2]$$

The intercept, a is estimated by: a= Y- bX

The correlation coefficient, r is estimated to express the degree of linear association or correlation between the standard length and body weight, by;

$$r= [n\sum XY - \sum X\sum Y] / \sqrt{([n\sum X^2 - (\sum X)^2] [n\sum Y^2 - (\sum Y)^2]}$$

The coefficient of determination, r^2, which shows the proportion of the variability in the X observation, is calculated from the square of the correlation coefficient. The constant a in the power curve was estimated as: a= exp (a)

A power curve of best fit is drawn through points representing the predicted weight for range of arbitrarily chosen values for length; that is, by substituting the value of a, the chosen value of L, and the value of b in the power equation $W= aL^b$. A smooth line is drawn through the points is the power curve, which describes the relationship between length (L) and weight (W).

A length-weight relationship for fish species shows a large amount of variation or scatter around the fitted curve. The variance of the slope (b) may be estimated using the following equation as:

$$Sb^2= [1/ (n-2)] [(Sy^2/Sx^2)-b^2]$$

The value of the slope for entire population can be obtained by using a value of't' from statistical tables with n-2 degrees of freedom, at the 95% confidence level as:

$$b \pm t*Sb.$$

Determination of condition factors

The condition of fishes in a monthly sample was examined by relative condition factor. The smoothed predicted body weight BW_{pred}, for mean standard length of all the fishes of monthly sample has been computed from the generalized length-weight relationship equation, $BW=aSL^b$. The relative condition factor was calculated as the monthly values of mean body weight compared with the general predicted value for fish of the same mean standard length.

$$CF_{BW}= BW/BW_{pred}$$

Where, BW = observed body weight and BW_{pred} = calculated body weight or predicted body weight to be computed from length-weight equations.

Results

The generalized length-weight relationship

Male

Weight and total length pooled from all monthly samples of unsexed, *T. ilisha* collected over the study period from January 2009 to December 2009. The regression line revealed that the Intercept and the slope were.0098 and 3.0382 respectively, the correlation coefficient and the coefficient of determination were 0.984 and 0.9968 respectively. The power curve that best fitted the observed data was drawn through the points representing the calculated weight obtained from the equation $BW = 0.0098TL^{3.0283}$ for a set of arbitrarily chosen length. The correlation coefficient indicated that there was a high degree of correlation between standard length and body weight in the sample since it was close to 1, and its positive value reflected that the slope is positive. The coefficient of determination suggested that 96.88% of the variation in body weight was due to variation in standard length.

Female

Weight and total length pooled from all monthly samples of unsexed, *T. ilisha* collected over the study period from January 2009 to December 2009. The regression line revealed that the Intercept and the slope were.00.0088 and 3.3.0749 respectively, the correlation coefficient and the coefficient of determination were 0.986 and 0.973 respectively. The power curve that best fitted the observed data was drawn through the points representing the calculated weight obtained from the equation $BW = 0.00881TL^{3.0749}$ for a set of arbitrarily chosen length. The correlation coefficient indicated that there was a high degree of correlation between standard length and body weight in the sample since it was close to 1, and its positive value reflected that the slope is positive. The coefficient of determination suggested that 97.340% of the variation in body weight was due to variation in standard length.

Male (body weight - gonad weight)

Monthly relative condition factors of male fishes based on CF_{BW} varied from 0.85 to 1.22. The highest value was estimated in September 2009 and the lowest was in March 2009. The CF_{BW} obtained in May, August, October, and November 2009 were approximately similar and were .1.09, 1.12, 1.11 and 1.16 respectively. The condition of unsexed fishes differed a little among the months of March, May, September, November 2009 and the data denoting the conditions of those months ranged from 0.85 to 1.22.The monthly changes in condition of male fishes are illustrated in Fig. 16 and it showed no definite tendency for an increase or decrease of relative condition factors among months over the study period. The relative condition suddenly reached to maximum in September and it decreased sharply in the subsequent month of March 2009. During the first three months of the study the relative condition showed fluctuating trend.

Female (body weight - gonad weight)

Monthly relative condition factors of female fishes based on CF_{BW} varied from 0.75 to 1.29. The highest value was estimated in April 2009 and the lowest was in February 2009. The CF_{BW} obtained in August, September, October, November, December, 2009 were approximately similar and were1.10, 1.18, 1.16, 1.10, 1.12 respectively. The condition of unsexed fishes differed a little among the months of February, April, March 2009 and the data denoting the conditions of those months ranged from 0.75 to 1.29.The monthly changes in condition of male fishes are illustrated in Fig. 16 and it showed no definite tendency for an increase or decrease of relative condition factors among months over the study period. The relative condition suddenly reached to maximum in April and it decreased sharply in the subsequent month of February 2009. During the first three months of the study the relative condition showed fluctuating trend.

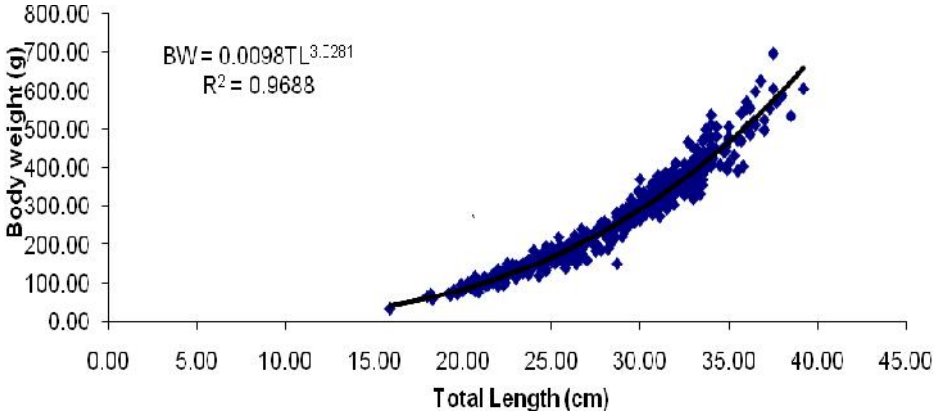

Fig.1. The generalized relationship between body weight (g) and total length (cm) in male hilsa shad, *T. ilisha*

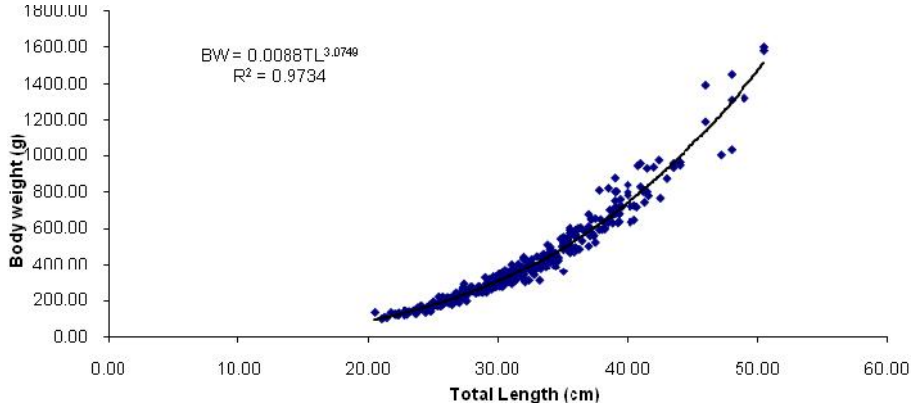

Fig.2. The generalized relationship between body weight (g) and total length (cm) in female hilsa shad, *T. ilisha*

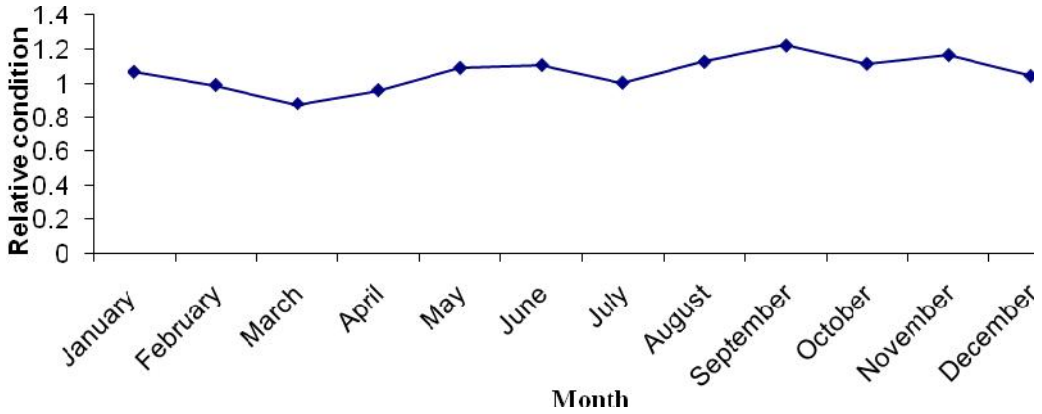

Fig.3. Monthly changes in condition factors of male (BW-GW) hilsa shad, *T. ilisha* based on $CF_{BW.}$

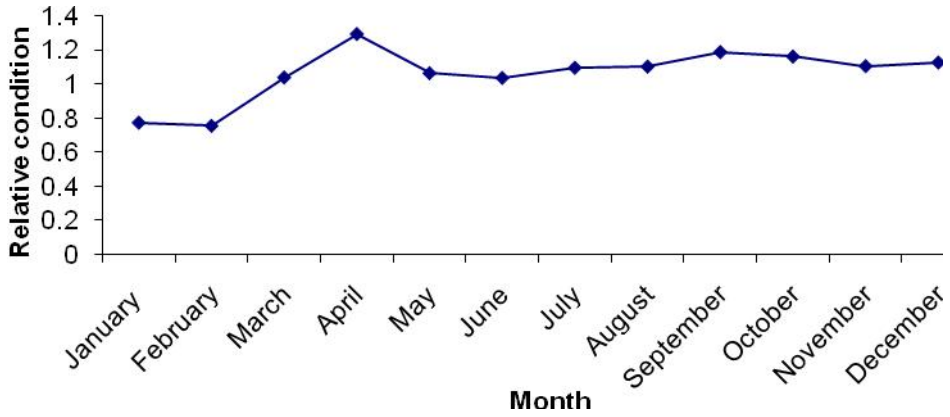

Fig.4. Monthly changes in condition factors of female (BW-GW) hilsa shad, *T. ilisha* based on $CF_{BW.}$

Discussion

The hilsa shad, *T .ilisha* (Hamilton, 1822) is an important anatropous clupeid fish species from the western division of the Indo-Pacific region. The present study dealt with the impact of gonad weight of hilsa shad using monthly samples over a calendar year from January to December 2009 from the river Tentulia flowing through Barisal district in Bangladesh. A summary of monthly changes of the parameters of their length-weight relationship equations for both male and female fishes of barred hilsa shad, *T. ilisha* were described separately in this study. The monthly changes in conditions were then described, and finally, some of the results are summarized, compared and discussed as an illustration of the monthly cycle in the barred spiny eel in the river Tentulia.

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