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Length-weight relationship and relative condition factor of *Heteropneustes fossilis* (Bloch) of Deepar Beel, a Ramsar site of Assam, India

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Abstract

The present study relates the length-weight relationship, relative condition factor of fish species *Heteropneustes fossilis* (Bloch) of Deepar Beel, a Ramsar site of Assam. The fish is separated into male and female to compute length-weight relationship and relative condition factor separately. The correlation coefficient 'r' exhibits high degree of relationship of growth performance of length-weight relationship in both the sexes although the allometric growth shown by 'b' value is negative. The negative allometric growth observed may be due to lower feeding proficiencies and/or may be the environment or the season of experiment are not suitable for proper growth of fishes. Moreover, the growth so occurred may be the result of loss of energy for breeding purpose of the present study. The 'b' value being a constant for an ideal fish deviates significantly in male but slightly in female. The Kn value with more or less similar value in both the sexes show good general condition of the fish with more or less similar value in both male and female. The Kn value of male *Heteropneustes fossilis* ranges between 0.63 and 1.91 with an average of 1.08 ± 0.37 where in female between 0.62 and 1.89 with an average of 0.99 ± 0.21 . In female the relative condition factor (Kn) increases from lighter to heavier, but in male declines initially from size range 5.41-7.15 cm TL, exhibit the minimum value at medium sized fish (11-12 cm TL) and thereafter steadily incline to get the maximum value in bigger fish having size range of about 17-18 cm TL.

Keywords: Length-Weight relationship, relative condition factor, *Heteropneustes fossilis*

1. Introduction

Growth is an integrated physiological response encompassing both external environmental conditions (food quality and quantity, temperature, water quality) and internal physiological status (health, reproductive state). Measures of fish growth may reflect ecosystem status and habitat quality. Growth is a function of length and weight, it is accompanied with increases of length or weight or both.

Under various environmental factors, the length-weight relationship deviates from the cube law ($W=L^3$; Brody, 1945)^[4]. In 1951, Le Cren used a formula for the study of length-weight relationship through the life history stages of fishes.

The *Heteropneustes fossilis* (Bloch) is found mainly in ponds, ditches, swamps and marshes, but sometimes occur in muddy rivers. The fish is omnivorous and can breed in confined waters during the monsoon months. *Heteropneustes fossilis* is an important indigenous species to Indo-Pak-Bangladesh sub-continent which is also known as Asian stinging cat fish.

2. Materials and Methods: In the present study 128 number of live samples of *Heteropneustes fossilis* of various age groups were collected from different spot of Deepar Beel located at 91°36'-91°42' East longitude and 26°6' to 26°09' North latitude; from April, 2015 to July, 2015. Length-weight relationships were computed after separating the male (n=61) and female (n=67). After separation, total lengths of the fishes were measured from tip of the snout to tip of the caudal fin with a digital slide caliper and body weight was measured with the help of a standard digital balance individually. The length-weight relationships were estimated following the formula $W = aL^b$ (Le Cren, 1951), which is expressed logarithmically as

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$$\text{Log } W = \text{Log } a + b \text{ Log } L$$

Where, W is the body weight of the fish; L is the total length of the fish; 'a' is a constant showing the initial growth index and 'b' is growth coefficient. Parameter 'a' and 'b' were calculated by method of least square regression:

$$\text{Log } a = \frac{\sum \text{Log } W \cdot \sum (\text{log } L)^2 - \sum \text{Log } L \cdot \sum (\text{Log } L \cdot \text{Log } W)}{N \cdot \sum (\text{Log } L)^2 - (\sum \text{Log } L)^2}$$

$$\text{Log } b = \frac{\sum \text{Log } W - N \cdot \text{Log } a}{\sum \text{Log } L}$$

Relative condition factor (Kn) were estimated by following Le Cren (1951) formula as expressed below:

$$\text{Kn} = \frac{W}{\hat{W}}$$

Where W = observed weight
 \hat{W} = calculated weight derived from length-weight relationship.

The mean, standard deviation and Correlation coefficient of total length and body weight were calculated with the help of SPSS software (version-16) and Microsoft Office 7.

3. Results and Discussion: From the study, it reveals that the total length of *Heteropneustes fossilis* (male and female) ranges between 5.41 and 18.6 cm in male whereas 5.9 and 19.1 cm in female. The total body weight ranges from 6.54 to 29.23 g in male and 2.42 to 33.67 g in female. The value of 'a', 'b', mean \pm SD of total length and body weight for *Heteropneustes fossilis* are given in the Table-1. Degree of variation of exponential value of length-weight relationship indicated by 'b' value in female is significantly more than male. However, in both the cases the 'b' value indicates negative allometry, although female (b=2.71) is more or less in a good condition in the experiment. The negative allometric growth observed may be due to lower feeding proficiencies and/or may be the environment or the season of experiment are not suitable for proper growth of fishes (Das *et al.*, 2015)^[6]. Moreover, the growth so occurred may be the result of loss of energy due to loss of extra energy for breeding in the present study. The negative allometric growth due to loss of energy in gonad development at breeding season is also reported by Das *et al.*, 2015^[5].

Table 1: Mean \pm Standard deviation of Body weight (BW) and Total length (TL), value of 'a' and 'b'.

Species	Weight range(g)	Size range(cm)	Mean \pm SD W(g)	Mean \pm SD TL(cm)	Value of a	Value of b
<i>Heteropneustes fossilis</i> (male)	6.54-29.23	5.41-18.6	13.69 \pm 6.21	13.24 \pm 2.70	-0.32	1.27
<i>Heteropneustes fossilis</i> (female)	2.42-33.77	5.9-19.1	14.92 \pm 7.93	13.67 \pm 2.78	-1.96	2.71

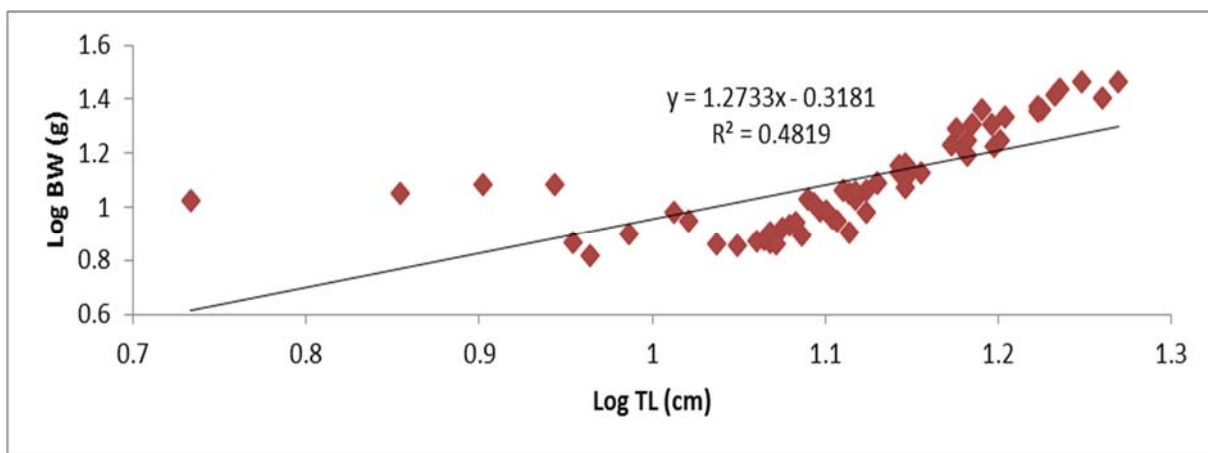


Fig 1(a): Relation between Log Total Length (cm) and Log Body Weight (g) of *Heteropneustes fossilis* (male)

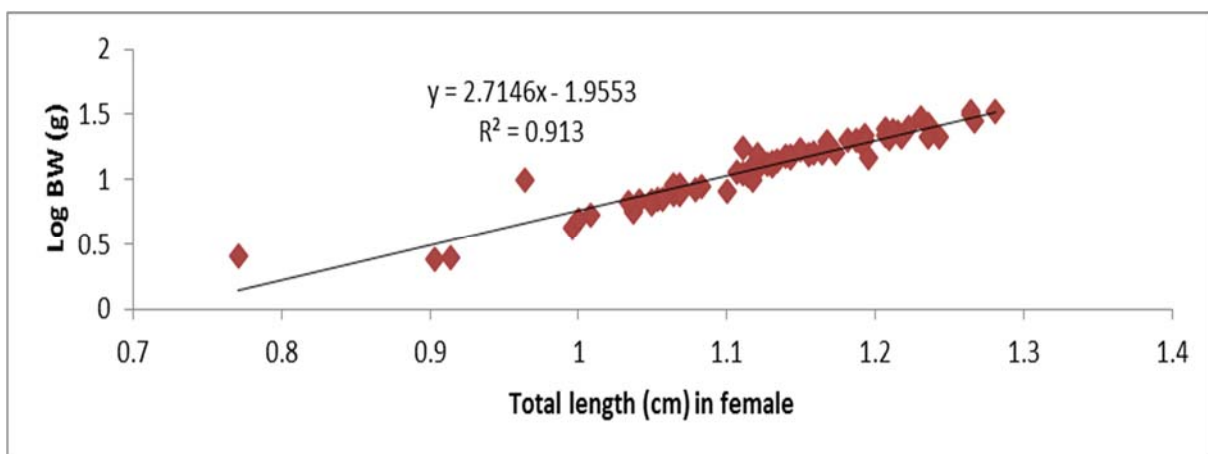


Fig 1(b): Relation between Log Total Length (cm) and Log Body Weight (g) of *Heteropneustes fossilis* (female)

The correlation coefficient 'r' in female is the closest to 1.0 (0.946) followed by male (0.803). This indicates that male *Heteropneustes fossilis* has the highest degree of relationship in growth performance. It is interesting to note that male *Heteropneustes fossilis* maintains higher degree of exponential growth (Table-1) and correlation coefficient (Table-2) during experimental period in Deepar Beel. In case of female the value of exponent 'b' is found in normal ranges between 2.5 and 4.0 as suggested by Hile, 1936 and Martin, 1949 and between 2.5 and 3.5 as reported by Froese, 2006 for most fishes. Notwithstanding, the value of 'b' in male is 1.27 which is not in normal range as stated above. However, in both male and female the value of 'b' deviate from 'cube law' as it remains constant at 3.0 for an ideal fish (Allen, 1938) [1] in a particular environmental condition.

The result of logarithmic length-weight relationship in *Heteropneustes fossilis* under the present study is as follows during the period of investigation in Deepar Beel.

Heteropneustes fossilis (male) - $\log W = -0.32 + 1.27 \log L$
Heteropneustes fossilis (female) - $\log W = -1.96 + 2.71 \log L$

The value of 'r' and mean±SD of Kn are given in the Table-2. The regression graph of length-weight relationship and relative condition factor (Kn) are depicted in Figure-1 (a & b) and Figure-2 (a & b). Kn- factor is an index to monitor feeding intensity, well-being and growth rate (Oni *et al.*,

1983) of fishes which is based on hypothesis that heavier fish for a given length are in better condition (Bagenal and Tesch, 1978) [2]. Generally 'Kn' value greater than 1 indicates better condition of fish (Le Cren, 1951). That means high value of 'Kn' indicates heavy fish for its length, while with low 'Kn' are lighter (Bagenal and Tesch, 1978) [2]. The Kn value of male *Heteropneustes fossilis* ranges between 0.63 and 1.91 with an average of 1.08 ± 0.37 where in female between 0.62 and 1.89 with an average of 0.99 ± 0.21 . The present study also reveals that the relative condition factor (Kn) is more or less similar (Table-2) in both sexes. In female *Heteropneustes fossilis* the relative condition factor (Kn) increases from lighter to heavier fish [Figure-2 (a)], which clearly indicate that the general well-being and growth is good. The increase of length and weight corresponds with the increase of Kn value is also reported by Yousuf and Khurshid, 2008 [14]. However, the relative condition factor in male declines initially from size range 5.41-7.15 cm TL, exhibit the minimum value at medium sized fish (11-12 cm TL) and thereafter steadily incline to get the maximum value in bigger fish having size range of about 17-18 cm TL [Figure-2 (b)] which contradicts with the result of Bhatta and Goswami, 2014 where peak Kn value is recorded in medium sized fishes of *Channa aurantimaculata*. Nevertheless, Rahman *et al.*, 2015 [13] also reported the similar trend of growth performance in relation to relative condition factor in female *Anabas testudineus*.

Table 2: Value of Correlation coefficient 'r', Kn range and Mean ± Standard deviation of condition factor 'Kn'.

Species	Sex	Value of 'r'	Kn range	Mean ± SD of Kn
<i>Heteropneustes fossilis</i>	Male (n=61)	0.803**	0.63-1.91	1.08±0.37
	Female (n=67)	0.946**	0.62-1.89	0.99±0.21

** Correlation is significant at the 0.01 level (2-tailed).

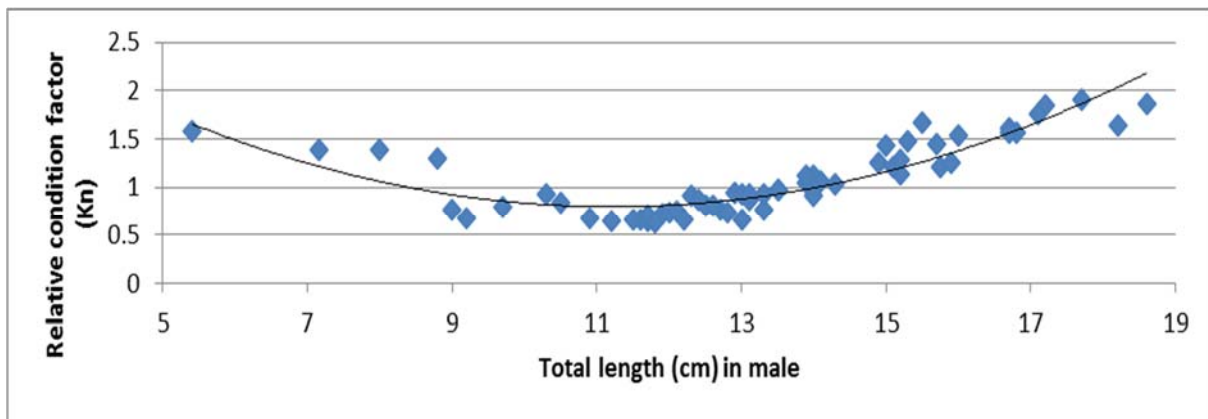


Fig 2(a): Relative condition factor (Kn) in relation to total length (cm) of *Heteropneustes fossilis* (male)

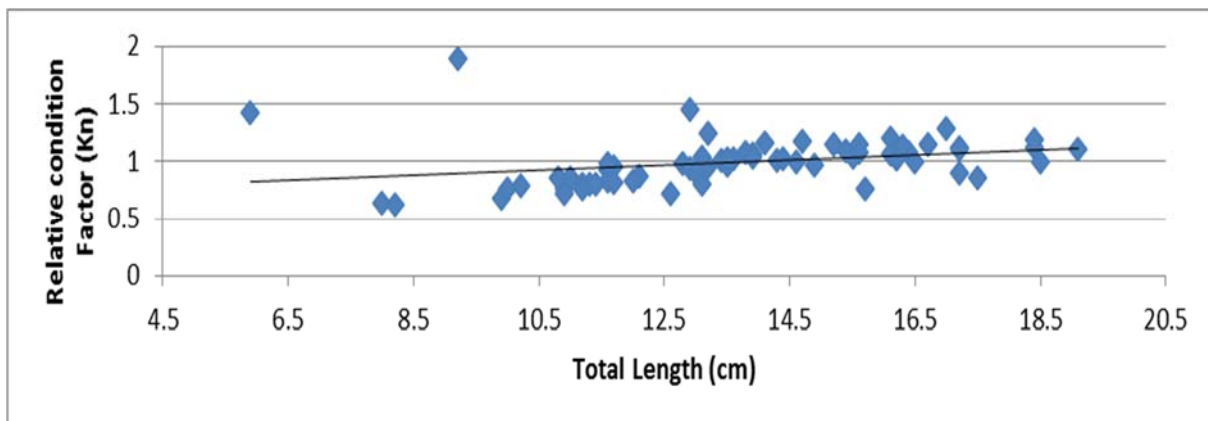


Fig 2(b): Relative condition factor (Kn) in relation to total length (cm) of *Heteropneustes fossilis* (female)

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