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Length-weight relationship and relative condition factor of *Macrognathus aral* (Bloch and Schneider, 1801) from Deepor Beel of Guwahati, Assam

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Abstract
The present study deals to calculate the length-weight relationship and the relative condition factor of a fish species *Macrognathus aral* (Bloch and Schneider, 1801) collected from Deepar Beel (wetland) of Assam. The fishes are separated into male and female to calculate the length-weight relationship separately along with relative condition factor (Kn). The growth performances estimated from the length-weight relationship are found high in both the sexes as the coefficient of correlation 'r' exhibits high degree of relationship. The positive allometric growth is shown by female whereas more or less isometric growth (b=2.99) by male. The positive allometric growth in female and isometric growth in male may be an indication for higher feeding proficiencies and better environmental as well as seasonal condition. The present findings also indicate that the value of 'b' in both the sexes is less deviated from 3.0, which is a constant for an ideal fish which suggest good environment and season for the fish to grow in the particular habitat. The Kn values in both the sexes are more or less similar which indicate good general condition of the fish.

Keywords: *Macrognathus aral*, length-weight relationship, relative condition factor, Deepor Beel

1. Introduction
Macrognathus aral (Bloch and Schneider, 1801) is commonly known as peacock eel. The fish is long and eel like with a long fleshy snout with a rounded tail fin which is separated from both dorsal and anal fin. The fish is marked with two long dark bands on either side of the body. Body color is brownish to yellowish ventrally and there are 3-11 ocelli at the base of the dorsal fin. *Macrognathus aral* is distributed to India, Pakistan, Bangladesh, Sri Lanka, Myanmar and Nepal (Talwar and Jhingran, 1991) [1] and has a high demand as an ornamental fish with its playful behavior, brilliant coloration and eye-catching body shape (Das and Kalita, 2003) [2].

Growth is an integral and inherent part in the life history of any living organism. Length-weight relationship of any fish species is considered as a significant biological parameter in Fishery Science to know the proper stock variation, growth rate determination, maturity timing as well as the time of spawning. Growth is correlated with the increase of either length or weight or both. That is why growth can be considered as a function of length and/or weight. Length and weight relationship of fish is an important character to be used in taxonomy and fish stock assessment (Goel *et al.*, 2011) [3]. According to Arslan *et al.*, 2004 [4], accurate measurement of length is easier than weight in the field and therefore weight can be predicted later on using the length-weight relationship. The variation of expected weight or length of any individual or any group of fish is regarded as an indication of the general well-being of the fish as well as gonadal development (Mathur and Bhatara, 2007) [5], thus proving information of the breeding biology. The relative condition factor can also be calculated from the actual weight and experimental weight derived from length-weight relationship, which gives information on well being of a fish which is also used as an index of growth and feeding intensity (Fagade, 1979) [6]. Anyanwu *et al.*, 2007 [7] suggests that a fish for a given length with higher weight are said to be in better condition which in fact is based on the hypothesis that heavier fish of a given length are in better condition (Bagenal and Tesch, 1978) [8]. The ideal environmental condition, fish shows isometric growth pattern following Cube Law ($W=L^3$) (Brody, 1945; Lagler, 1952) [9, 10] but in natural environment the ideal environmental condition is scarce as there are many climatic as well as anthropogenic factors which deviates the cube

law. Therefore, the length-weight relationship is calculated modifying the Cube Law as per Le Cren, 1951 [11] which is mathematically expressed as $W = a L^b$ where W=weight of the fish in grams and L= length of fish in cm.

Although, the study on length-weight relationship is adequate for most fish species in tropics and sub- tropics region (Martine- Smith, 1996 [12]; Ecoutin *et al.*, 2005 [13]; Harrison, 2009 [14], there is not much work on length-weight relationship on Mastacembelidae family from this north eastern region of India (Chakraborty and Goswami, 2016) [15]. So the present investigation is an attempt to study the length-weight relationship as well as relative condition factor of *Macrognathus aral* from Deepor Beel (wetland) of Assam.

2. Materials and Methods: 119 number of individuals of *Macrognathus aral* of varying size with various age of live samples were collected randomly from Deepar Beel (Wetland) located at $91^0 36/$-$91^0 42/$ East longitude and $26^0 6/$ to $26^0 09/$ North latitude from January, 2020 – March, 2020 out of which 56 are male and 63 were female. The individual lengths of the fishes were measured by digital slide caliper. The total lengths (TL) were taken from the tip of the snout to tip of the caudal fin and the body weights (BW) were measured nearest to 0.01 g with the help of standard digital balance (Systronic make). The length – weight relationships were estimated following Le Cren, 1951 [11] formula $W = aL^b$ and were expressed logarithmically as Log W = Log a + b Log L;

Where, W stands for body weight of the fish; L = total length of the fish; 'a' = a constant to denote the initial growth index and 'b' being the growth coefficient. Parameter initial growth index (a) and growth coefficient (b) were calculated by least square regression methods as follows:

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

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

Relative condition factor denoted by 'Kn' was also estimated following Le Cren (1951) [11] follows:

$$\text{Kn} = \frac{W_o}{W_c}$$

Where

W_o = observed weight and
W_c = calculated weight from length-weight relationship formula.

The mean, standard deviation (SD) and coefficient of correlation (r) of TL and BW were calculated using SPSS software (version-16) and Microsoft Office 7.

3. Results: The total length of *Macrognathus aral* in male is in the range from 9.5 to 15.3 cm with an average of 12.0±1.02 cm and in female from 10.0 to 15.9 cm with an average of 13.27±1.40 cm (Table-1). The body weight ranges between 2.57 and 11.79 gram in male with an average of 5.84±1.59 gram whereas in female it ranges between 3.33 and 15.93 gram with an average of 8.77±2.80 gram (Table-1). The initial growth index (a) and growth coefficient (b) are recorded as -2.47 and 2.99 in male *Macrognathus aral*. However, in female *macrognathus aral* the value of 'a' is -2.51 and 'b' is 3.06 (Table -1). It is interesting to note that the female are larger and heavier with greater growth coefficient (b) value. The value of coefficient of correlation 'r' (0.94 in male and 0.96 in female) and relative condition factor 'Kn' (1.00±0.096 in male and 1.01±0.090 in female) is found to be more or less similar (Table-2). In Figure-1&2, the regression graph of length-weight relationship and relative condition factor (Kn) are depicted respectively in male and female. The calculation of logarithmic length-weight relationship formula from the present study on *Macrognathus aral* is as follows –

Macrognathus aral (male) - Log W = -2.47 + 2.99 Log L
Macrognathus aral (female) - Log W = -2.51 + 3.06 Log L

Table 1: Showing Mean ± Standard deviation of Body weight (BW) and Total length (TL) with the value of 'a' and 'b'.

Fish Species	Sex	Weight Range (g)	Mean±SD BW (g)	Size Range (cm)	Mean±SD TL (cm)	Value of 'a'	Value of 'b'
Macrognathus aral	Male (n=56)	2.57-11.79	5.84±1.59	9.5-15.3	12.00±1.02	-2.47	2.99
	Female (n=63)	3.33-15.93	8.77±2.80	10.0-15.9	13.27±1.40	-2.51	3.06

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

Species	Sex	Value of 'r'	Kn range	Mean ± SD of Kn
Macrognathus aral	Male (n=56)	0.94	0.83-1.29	1.00±0.096
	Female (n=63)	0.96	0.83-1.27	1.01±0.090

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

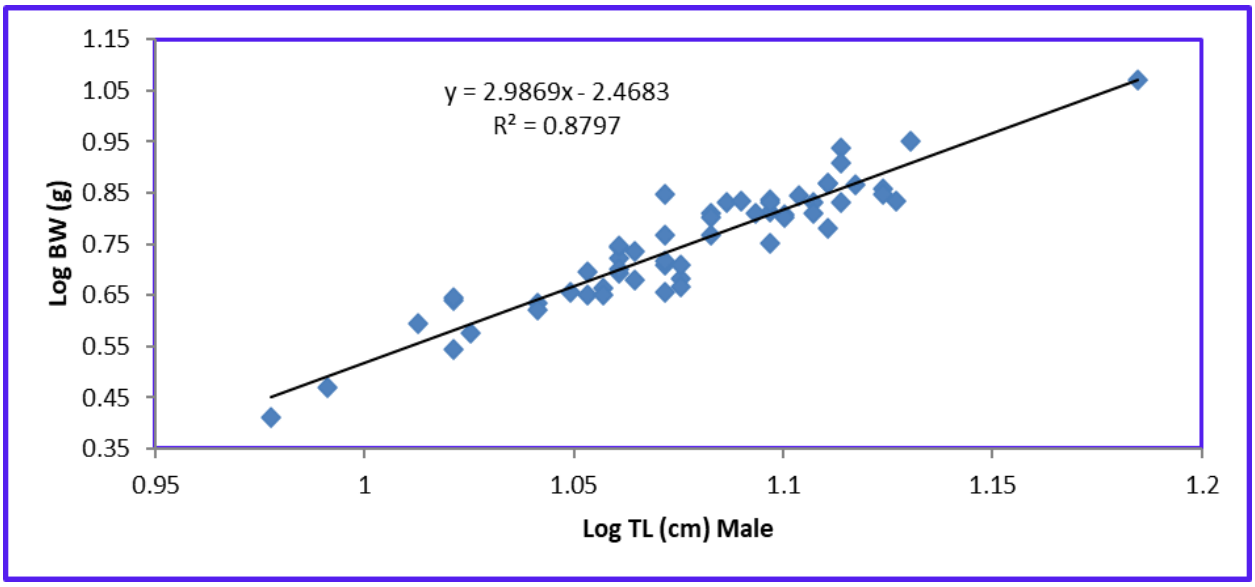

Fig 1(a): Relation between Log TL in cm and Log BW in g of *M aral* (male)

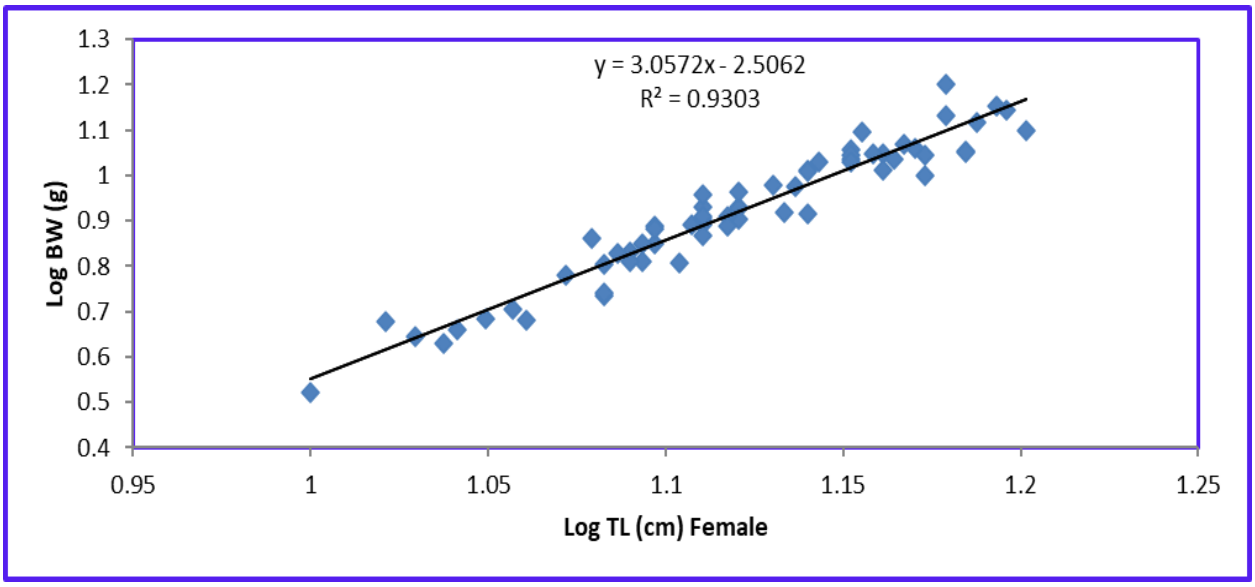

Fig 1 (b): Relation between Log TL in cm and Log BW in g of *M aral* (female)

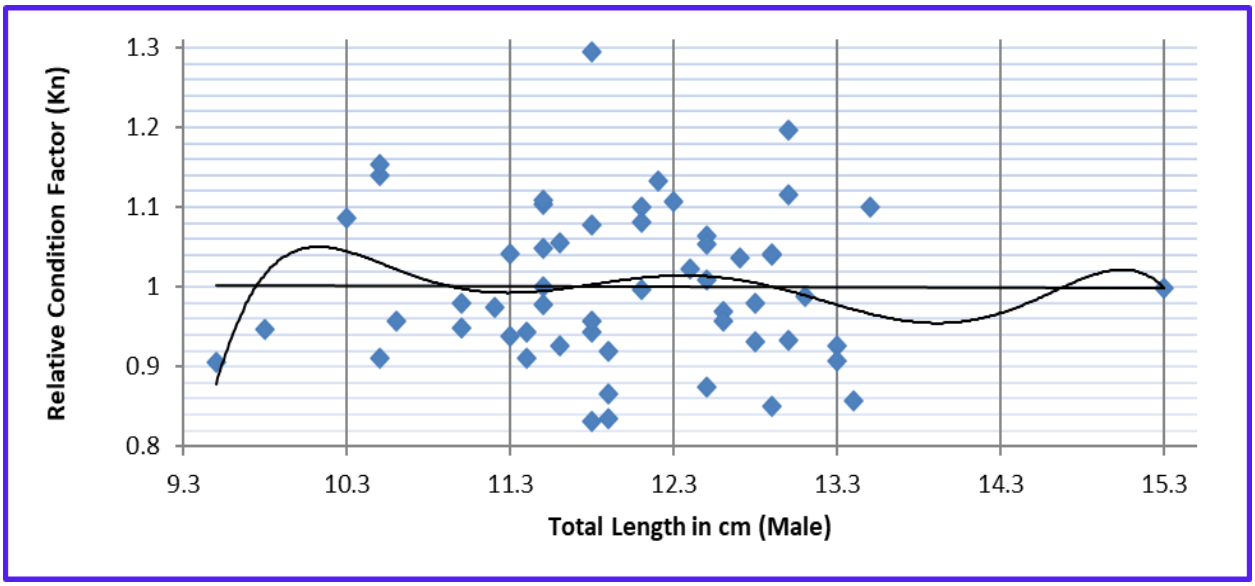

Fig 2 (a): Relative condition factor (Kn) in relation with total length (cm) of *M aral* (male)

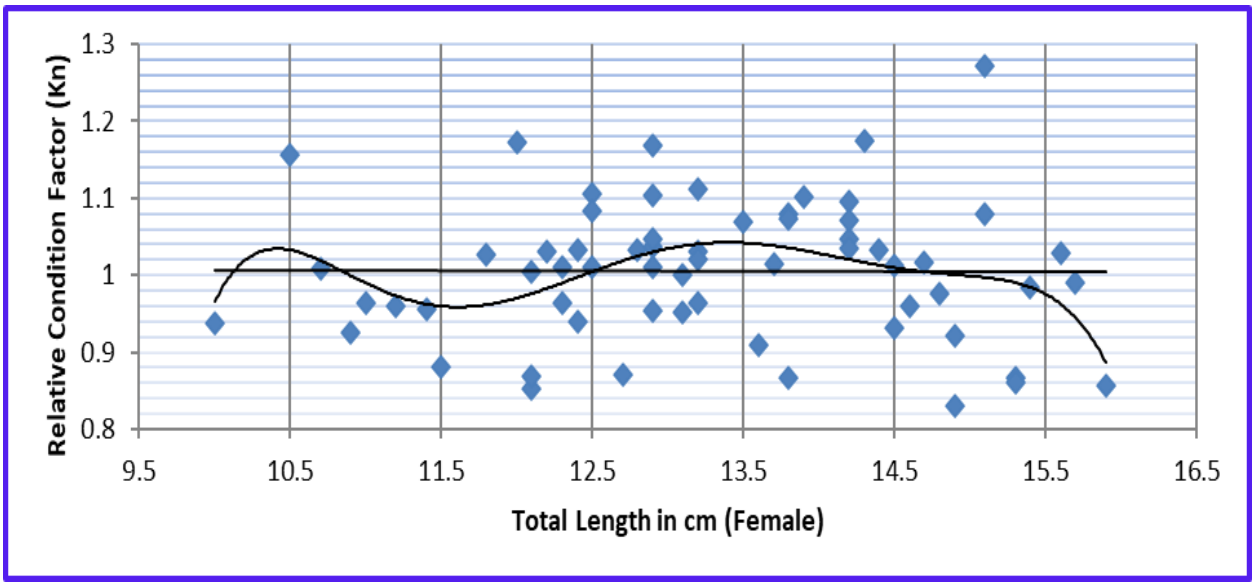

Fig 2(b): Relative condition factor (Kn) in relation with total length (cm) of *M aral* (female)

4. Discussion

The present investigation is an attempt to study the length-weight relationship in both male and female of a fish species *Macrognathus aral* commonly called peacock eel. The study reveals that the growth performance in both sexes are found high as the coefficient of correlation (r) exhibits high degree of relationship (r=0.94 in male and r=0.96 in female) between the length-weight relationships which in the present study is very close to 1.0.

The growth coefficient of length-weight relationship indicated by 'b' value in female *Macrognathus aral* is above 3 (3.06); which designate positive allometric growth while in male an interesting (2.99) results is observed which is very near to 3.00 indicating more or less isometric growth which is a rare phenomenon. The isometric growth is also observed by Singha *et al.*, 2017 [16] in adult male of a fish species *Leidon cutcutia* studied at Diplai Beel during February, 2017 to May, 2017. The positive allometric growth reported for the same species from Dora Beel of Assam (Chakraborty and Goswami, 2016) [15] is also observed in the present study may be due to better feeding proficiencies and good environmental condition. Soni and Kathal, 1953 [17]; Kaur, 1981 [18]; Saikia *et al.*, 2011 [19]; Bhatta and Goswami, 2014 [20]; Das *et al.*, 2015 [21] Deka and Bura Gohain, 2015 [22] also observed the availability of food with higher feeding proficiencies and other associated factors for positive allometric growth in different fishes. However, many studies suggested that negative allometric growth in fishes is observed during breeding season which may be the result of loss of energy due to gonad development. In the present study this may be a reason where there is no negative allometric growth in both sexes of the studied fish.

It is interesting to note that the value of growth coefficient 'b' (Table-1) and coefficient of correlation 'r' (Table-2) remain higher in female *Macrognathus aral* than male. However, in both male and female the value of growth coefficient 'b' is found in the normal ranges between 2.5 and 4.0 as suggested by Hile, 1936 [23] and Martin, 1949 [24] and between 2.5 and 3.5 as reported by Froese, 2006 [25] for most of the fishes. The present study also reveals that the value growth coefficient 'b' deviate very less from 'cube law' as it remains constant at 3.0 for an ideal fish (Allen, 1938) [26] in a particular environmental condition.

The relative condition factor (Kn) is an index for the monitoring of feeding intensity as well as growth rate (Oni *et al.*, 1983) [27] which express the 'Condition', 'fatness' or well being of a fish species which is based on hypothesis that heavier fish for a particular length are in better condition (Bagenal and Tesch, 1978) [8]. Fish with higher value of relative condition factor 'Kn' are heavy for its length, while the lower 'Kn' is lighter (Bagenal and Tesch, 1978) [8]. However, Le Cren, 1951[11] suggested that 'Kn' value greater than 1 indicates better condition of fish in a particular environmental condition. The present study reveals a similar range of 'Kn' value between 0.83 and 1.29 in male *Macrognathus aral* with an average of 1.00±0.096 and in female is 0.83 and 1.27 with an average of 1.01±0.090 (Table-2). The study also reveals that there is a beautiful trend of increase in Kn value in medium sized fishes [Figure-2(a) and Figure-2(b)] which is contradictory with Das *et al.*, 2015 [28] where a reverse phenomenon is reported for male *Heteropneustes fossilis.*

5. Conclusion

Growth performances of *Macrognathus aral* in both sexes are high as coefficient of correlation shows high degree of relationship between the length-weight relationships which is very close to 1.0. The growth coefficient of length-weight relationship in female *Macrognathus aral* is above 3 which designate positive allometric growth while in male an interesting and rare result (2.99) is observed which is very near to 3.00 indicating more or less isometric growth showing ideal environmental condition to grow in that particular experimental period; although this value may change in breeding period which is an indication of morphometric alteration. The general well being of fish along with change in environment as well as morphometric alteration can be judged from length-weight relationship.

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