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Length-Weight relationship and relative condition factor of *Rita rita* (Hamilton, 1822), *Pangasius pangasius* (Hamilton, 1822) and *Chitala chitala* (Hamilton, 1822) of Brahmaputra river system of Assam, India

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Abstract
The present study reports the length-weight relationship, relative condition factor of three important fish species *Rita rita* (Hamilton, 1822), *Pangasius pangasius* (Hamilton, 1822) and *Chitala chitala* (Hamilton, 1822) of Brahmaputra river system. The growth performance of all the 3 fishes are found high since the correlation coefficient 'r' exhibits high degree of relationship where *Pangasius pangasius* and *Chitala chitala* shows positive allometric correlation and *Rita rita* negative allometric correlation. The present study also indicates that the value of 'b' in all fishes deviate from 'cube law' as it remains constant at 3.0 for an ideal fish. The Kn value *Rita rita, Pangasius pangasius* and *Chitala chitala* are 0.78 - 1.55, 0.85 - 1.30 and 0.79 -1.24 respectively.

Keywords: L-W relationship, relative condition factor, *Rita rita, Pangasius pangasius, Chitala chitala*

1. Introduction
In Universe, growth is the inherit characteristics of every living organism in nature along with time. As the growth of an organism increases, its length or weight or both increases simultaneously. In fishery science, study of length-weight relationship of fishes is a basic tool for assessing its production, growth, productivity of the habitat, stocking density, maturity etc.
According to Brody, 1945 and Lagler, 1952, the growth of fishes obeys the Cube law ($W=L^3$) only in ideal environmental condition where fish grows isometrically, but in natural environment, due to various environmental factors, the length and weight relationship may deviate from from the Cube law. Therefore, Le Cren, 1951 used a satisfactory formula to over the Cube law as $W = aL^b$ for calculating the length - weight relationship throughout the life history stages of fishes.
All the three species *Rita rita* (Hamilton, 1822) [6] (Rita), *Pangasius pangasius* (Hamilton, 1822) [6] (Pangus) and *Chitala chitala* (Hamilton, 1822) [6] (Chital) are the fishes of Brahmaputra river basin. Chital (a featherbacks) is a near threatened (NT) fish species and the other two cat fishes although not endangered but distributed sparsely in the river Brahmaputra. All the species are very delicious and have very good local market value in Assam.

2. Materials and Methods
A total number of 23, 18 and 22 of various age of live samples of Rita, Pangus and Chital were collected randomly from Brahmaputra River system from April, 2013 – March, 2014. Since male and female sexes could not be distinguished in all the seasons, therefore they are combined together of both the sexes for calculating length-weight relationship. Total length of the fishes were measured nearest to 0.1 cm with standard measuring scale from tip of the snout to tip of the caudal fin and body weight were measured nearest to 0.01 g with the help of standard digital balance individually. The length – weight relationship was estimated by the following formula $W = aL^b$ (Le Cren, 1951) [10] and this formula is expressed logarithmically as $\text{Log } W = \text{Log } a + b \text{ Log } L$
Where, W = Body weight of the fish, L = Total length of the fish, 'a' = a constant being the initial growth index and 'b' = growth coefficient. Parameter 'a' and 'b' were calculated by method of least square regression:

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

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

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

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

Where W = observed weight
^W = calculated weight derived from length-weight relationship.
The mean, standared deviation and Correlation coefficient of total length and body weight were calculated with the help of Microsoft Office 7 and SPSS software (version-16).

3. Results

In the present study total length and body weight of Rita, Pangus and Chital having size ranges from 18.1 to 41.3, 45.3 to 56.8 and 41.1 to 78.0 cm in length and having weight ranges from 100.20 to 800.45, 740.95 to 1800.85 and 300.24 to 2100.42 gram in weight respectively. The value of 'a', 'b', mean ±SD of TL and BW for Rita, Pangus and Chital are given in the Table-1. The value of 'r' and mean±SD of Kn are given in the Table-2. The regression graph of LWR and relative condition factor (Kn) are depicted in Figure-1 and Figure-2. The result of logarithemic length-weight relationship for Rita, Pangus and Chital under the present study is as follows during the period of investigation in Brahmaputra river system:

Rita -Log W = - 1.23 + 2.55 Log L
Pangus – Log W = -2.78 + 3.43 Log L
Chital – Log W = -2.52 + 3.11 Log L

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

Species	Weight range(g)	Size range(cm)	Mean±SD BW(g)	Mean±SD TL(cm)	Value of 'a'	Value of 'b'
Rita (n=23)	100.2 - 800.45	18.1 - 41.3	371.29±191.16	30.0 ± 5.95	-1.23	2.55
Pangus (n=18)	740.95 -1800.85	45.3 - 56.8	1167.71±320.46	50.19±3.60	-2.78	3.43
Chital (n=22)	300.24-2100.42	41.1-78	1087.09±636.63	58.22±12.00	-2.52	3.11

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

Species	Value of 'r'	Kn range	Mean ± SD of Kn
Rita (n=23)	0.96**	0.78 - 1.55	1.01 ± 0.16
Pangus (n=18)	0.89**	0.85 - 1.30	1.00 ± 0.12
Chital (n=22)	0.98**	0.79 -1.24	1.01 ± 0.12

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

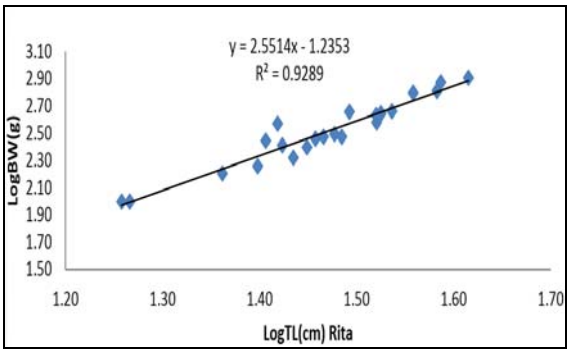

Fig 1: Relation between Log Total Length (cm) and Log Body Weight (g) of Rita

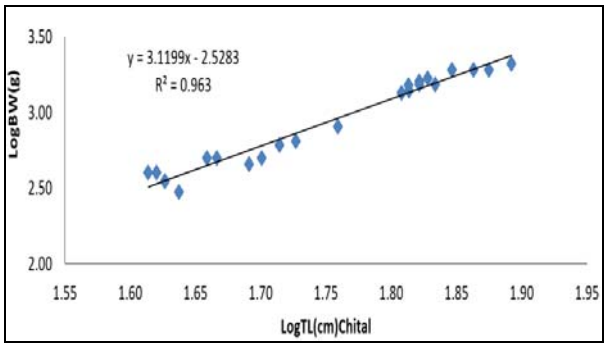

Fig 3: Relation between Log Total Length (cm) and Log Body Weight (g) of Chital

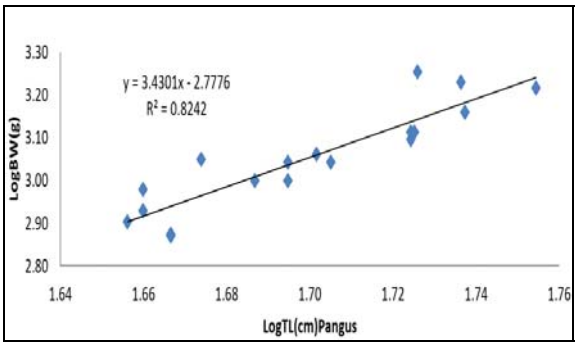

Fig 2: Relation between Log Total Length (cm) and Log Body Weight (g) of Pangus

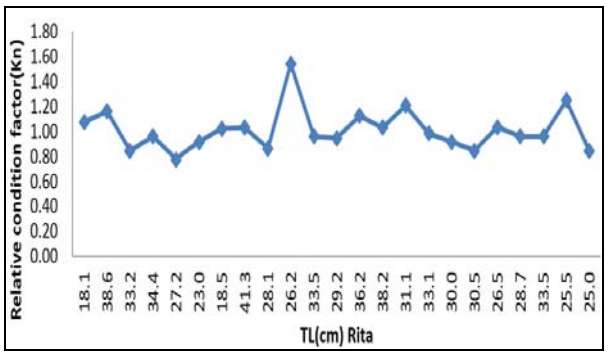

Fig 4: Relative condition factor (Kn) in relation to total length (cm) of Rita

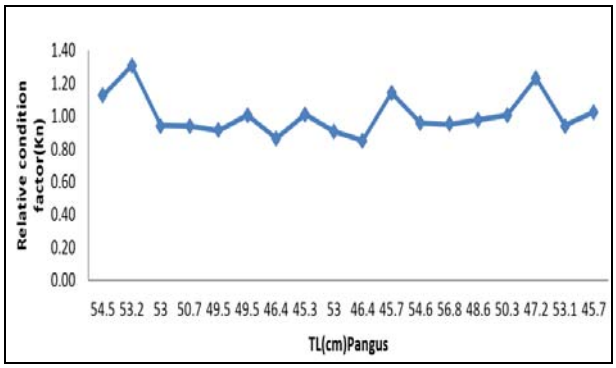

Fig 5: Relative condition factor (Kn) in relation to total length (cm) of Pangus

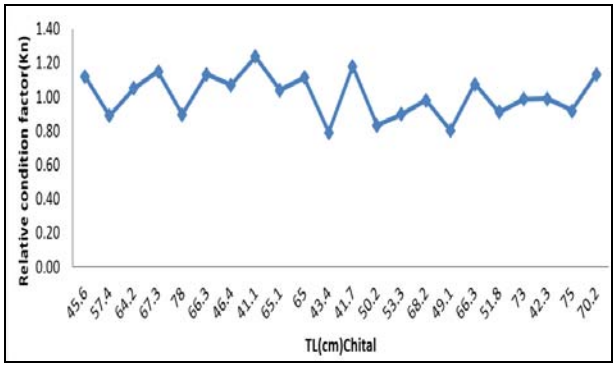

Fig 4: Relative condition factor (Kn) in relation to total length (cm) of Chital

4. Discussion

The present investigation reveals that the growth performance of all the 3 fishes are found high since the correlation coefficient 'r' exhibits high degree of positive allometric correlation between the L-W relationship in pungus and chital although it is negative allometric in rita (Table-1&2). The positive allometric growth observed in Pungus and Chital may be due to higher feeding proficiencies (Soni and Kathal, 1953; Kaur, 1981; Saikia *et al.,* 2011) [15, 8, 14]. Bura Gohain and Goswami, 2013 also observed the effect of availability of food and other associated factors responsible for positive allometric growth in different stages of *Clarius magur* (Hamilton, 1822) [6].

Degree of variation of exponential value of L-W relationship indicated by 'b' value in Pangus (3.43) is the highest followed by chital (3.11) and rita (2.55). However, correlation coefficient 'r' in chital is the closest to 1.0 (0.98) followed by rita (0.96) and pungus (0.89). This indicates that chital has high degree of relationship in growth performance than rita and the least in pungus although it is interesting that pungus has the highest degree of exponential growth (Table-1). The value of exponent 'b' is found to be in normal ranges between 2.5 and 4.0 in all three fishes as suggested by Hile, 1936 and Martin, 1949 and between 2.5 and 3.5 as reported by Froese, 2006 for most fishes. The present study also indicates that the value of 'b' in all fishes deviate from 'cube law' as it remains constant at 3.0 for an ideal fish (Allen, 1938) [1] in a particular environmental condition.

'Condition', 'fatness' or well-being of fish expressed by Kn-factor, which is an index used to monitor feeding intensity and growth rate (Oni *et al.,* 1983) [13] is based on hypothesis that heavier fish for a given length are in better condition (Bagenal and Tesch, 1978) [2]. According to Le Cren, 1951, 'Kn' greater than 1 indicates good general condition of fish. Fish with high value of 'Kn' are heavy for its length, while with low 'Kn' are lighter (Bagenal and Tesch, 1978) [2]. However, in the present investigation it has been found that the relative condition factor (Kn) is interestingly similar (Table-2) in all three fishes studied.

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