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Length-Weight relationship and relative condition factor of *Puntius sophore* (Hamilton, 1822) and *Systomus sarana* (Hamilton, 1822) of Deepar Beel (wetland) of Assam, India

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Abstract
The present study reports the length-weight relationship, relative condition factor of two fish species *Puntius sophore* (Hamilton, 1822) and *Systomus sarana* (Hamilton, 1822) of Deepar Beel (wetland) of Assam. The fishes are separated into two groups-Sub Adult and adult stage. The growth performance of length-weight relationship is found high since the correlation coefficient 'r' exhibits high degree of relationship but shows negative allometric correlation. The negative allometric growth may be due to lower feeding proficiencies and/or may be due to environmental or seasonal incompatibility for proper growth of fishes. The present findings also indicate that the value of 'b' in all cases is lower than 3.0, being a constant for an ideal fish. The Kn value of Sub Adult *Puntius sophore,* Adult *Puntius sophore,* sub adult *Systomus sarana* and adult *Systomus sarana* are 0.93 - 1.07, 0.85 - 1.19, 0.90-1.13 and 0.86 - 1.06 respectively which are more or less similar.

Keywords: Length-Weight relationship, relative condition factor, *Puntius sophore, Systomus sarana*

1. Introduction
Growth is an inherit uniqueness of every living organism in nature along with time. As the growth is a function of length and weight, therefore growth is accompanied with increases of length or weight or both. The study of length-weight relationship of fishes is a basic tool for assessing the production, growth, stocking density, maturity, productivity of a particular habitat etc.

According to Brody, 1945 and Lagler, 1952, in an ideal environment the growth of fishes obeys the Cube law ($W=L^3$), where isometric growth of fishes occurs. However in natural environment, owing to various environmental factors, the length and weight relationship may deviate from the Cube law. Therefore, Le Cren, 1951 used a satisfactory formula modifying Cube law as $W = aL^b$ to calculate the length - weight relationship throughout the life history stages of fishes.

The two species *Puntius sophore* (Hamilton, 1822) [5] and *Systomus sarana* (Hamilton, 1822) [5], are the fishes which are available in Beels (Wetlands) of Assam.

2. Materials and Methods
A total number of 61 and 59 of various age of live samples of *Puntius sophore* and *Systomus sarana* were randomly collected from Deepar Beel (Wetland) located at $91^0 36^/$-$91^0 42^/$ East longitude and $26^0 06^/$ to $26^0 09^/$ North latitude from January, 2014 – March, 2014. Since male and female sexes are not distinguishable in all seasons, therefore length-weight relationships were calculated without separating the sexes. However, fishes of both the species were divided into two groups on the basis of length of the individual as Sub Adult (5-7 cm) and Adult (above 7 cm) for length-weight calculation. Total length of the fishes were measured with digital slide caliper 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 relationships were estimated by the following formula $W = aL^b$ (Le Cren, 1951) and this formula is expressed logarithmically as Log W = Log a + b Log L
Where, W is body weight of the fish; L is total length of the fish; 'a' is a constant showing the

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Initial growth index and 'b' is growth coefficient. Parameter 'a' and 'b' were calculated by the method of least square regression:

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

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

Relative condition factor (Kn) were estimated by following Le Cren (1951) formula, which is expressed as follows:

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

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
In the present study total length and body weight of Sub Adult *Puntius sophore,* Adult *Puntius sophore*, Sub Adult *Systomus sarana* and Adult *Systomus sarana* having size ranges from 5.1 to 6.9, 7.1 to 9.2, 5.1 to 6.9 and 7.1 to 10.3 cm in length respectively and having weight ranges from 5.86 to 8.38, 8.13 to 14.07, 5.72 to 9.38 and 8.41 to 15.68 gram in weight respectively. The value of 'a', 'b', mean ±SD of total length and body weight for Sub Adult *Puntius sophore,* Adult *Puntius sophore*, Sub Adult *Systomus sarana* and Adult *Systomus sarana* 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 length-weight relationship and relative condition factor (Kn) are depicted in Figure-1 and Figure-2. The result of logarithmic length-weight relationship for *Puntius sophore* (Sub Adult and Adult) and *Puntius sophore* (Sub Adult and Adult) under the present study is as follows during the period of investigation in Deepar Beel.

Puntius sophore (Sub Adult) - Log W = 0.12 + 0.94 Log L

Puntius sophore (Adult) – Log W = -0.44 + 1.59 Log L

Systomus sarana (Sub Adult) – Log W = -0.087 + 1.22 Log L

Systomus sarana (Adult) – Log W = -0.41 + 1.60 Log L

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

	Stage	Weight range(g)	Size range(cm)	Mean±SD BW(g)	Mean±SD TL(cm)	Value of 'a'	Value of 'b'
Puntius sophore	Sub Adult (n=25)	5.86-8.38	5.1-6.9	5.86-8.38	6.02±0.54	0.12	0.94
	Adult (n=36)	8.13-14.07	7.1-9.2	10.17±1.54	8.17±0.59	-0.44	1.59
Systomus sarana	Sub Adult (n=23)	5.72-9.38	5.1-6.9	7.61±0.94	6.23±0.53	-0.087	1.22
	Adult (n=36)	8.41-15.68	7.1-10.3	12.07±1.86	8.46±0.82	-0.41	1.60

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

Species	Stage	Value of 'r'	Kn range	Mean ± SD of Kn
Puntius sophore	Sub Adult (n=25)	0.91**	0.93-1.07	1.00±0.04
	Adult (n=36)	0.81**	0.85-1.19	1.01±0.08
Systomus sarana	Sub Adult (n=23)	0.84**	0.90-1.13	1.00±0.06
	Adult (n=36)	0.98**	0.86-1.06	0.99±0.04

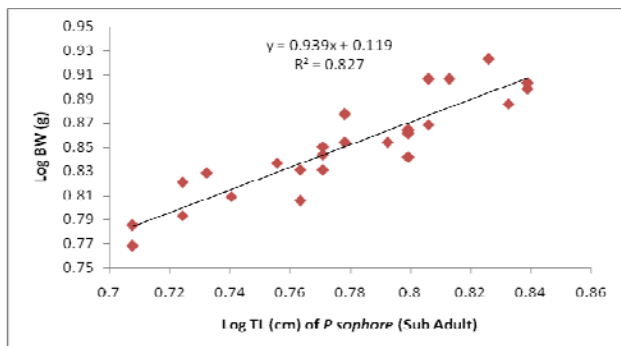**.Correlation is significant at the 0.01 level (2-tailed).

Fig 1 (a): Relation between Log Total Length (cm) and Log Body Weight (g) of *P sophore* (Sub Adult)
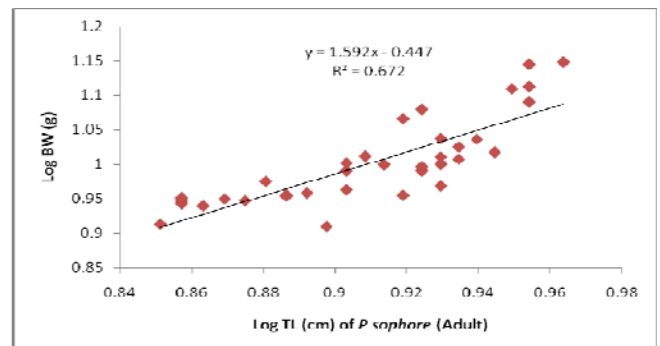

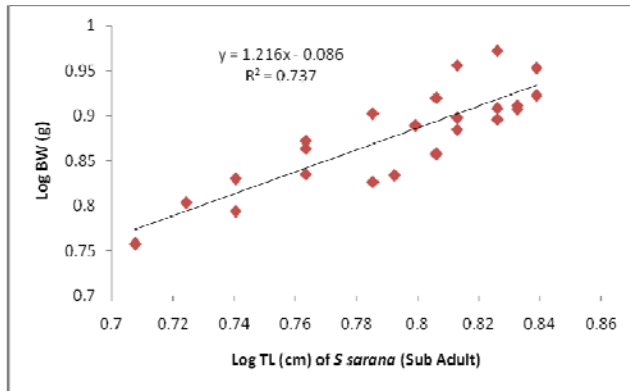**Fig 1 (b):** Relation between Log Total Length (cm) and Log Body Weight (g) of *P sophore* (Adult)

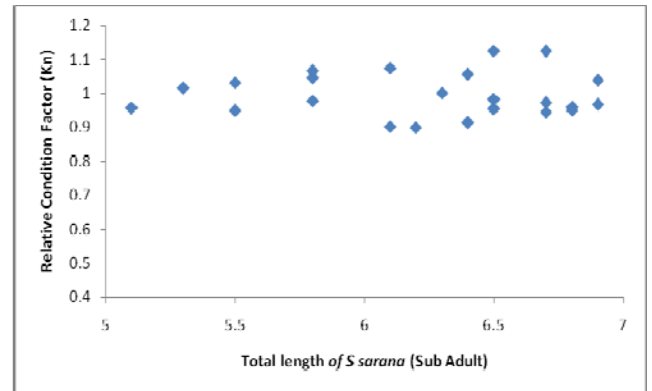**Fig 1 (c):** Relation between Log Total Length (cm) and Log Body Weight (g) of *S sarana* (Sub Adult)

Fig 2 (c): Relative condition factor (Kn) in relation to total length (cm) of *S sarana* (Sub Adult)
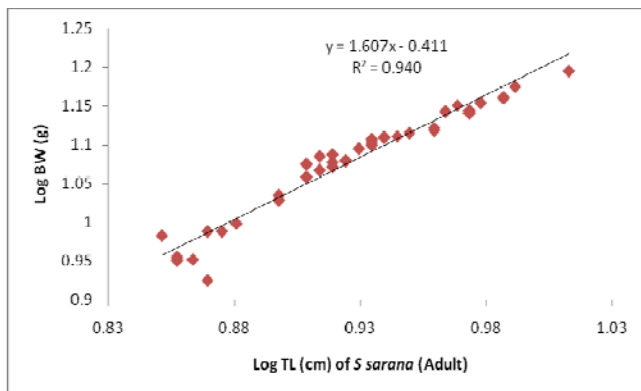

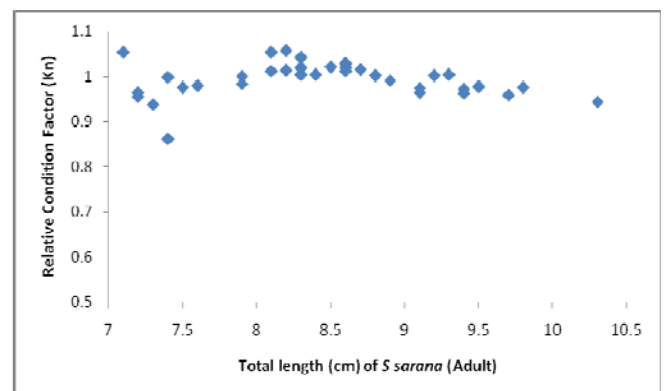**Fig 1 (d):** Relation between Log Total Length (cm) and Log Body Weight (g) of *S* sarana (Adult)

Fig 2 (d): Relative condition factor (Kn) in relation to total length (cm) of *S sarana* (Adult)
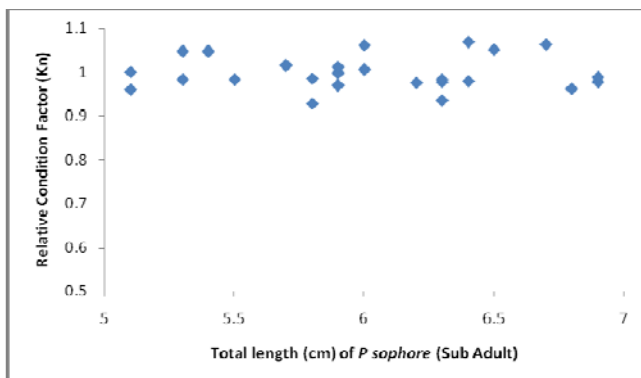

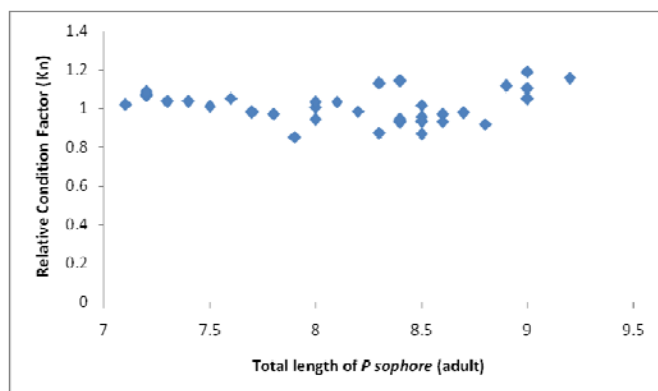**Fig 2 (a):** Relative condition factor (Kn) in relation to total length (cm) of *P sophore* (Sub Adult)

Fig 2 (b): Relative condition factor (Kn) in relation to total length (cm) of *P sophore* (Adult)

4. Discussion

The present investigation reveals that the growth performance of all the stages of experimental fishes are found high since the correlation coefficient 'r' exhibits high degree of correlation between the length-weight relationship although the growth being negative allometric in all cases (Table-1&2). 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. Soni and Kathal, 1953; [15], Kaur, 1981; [9], Saikia *et al.,* 2011; [14], Bura Gohain and Goswami, 2013; [4], Deka and Bura Gohain, 2015 [5], observed the higher proficiencies in feeding, availability of food and other associated factors for positive allometric growth in different fishes.

Degree of variation of exponential value of length-weight relationship indicated by 'b' value in Adult *Systomus sarana* (1.60) is the highest followed by Adult *Puntius sophre* (1.59). However, the lower values of 'b' are observed in both the Sub Adult stages of the two species (Table-1). The correlation coefficient 'r' in *Systomus sarana* (Adult) is the closest to 1.0 (0.98) followed by Sub Adult *Puntius sopohre* (0.91), Sub Adult *Systomus sarana* (0.84) and Adult *Puntius sophore* (0.81). This indicates that Adult *Systomus sarana* has the highest degree of relationship in growth performance and the least in Sub Adult *Puntius sophore.* It is interesting that Adult stage of *Systomus sarana* maintains the highest degree of exponential growth (Table-1) and correlation coefficient (Table-2) during the experimental period in Deepar Beel. In *Systomus sarana* the value of exponent 'b' and correlation coefficient (r) remain higher in the adult stage; but in *Puntius sophore* value of exponent 'b' is higher in Adult stage and correlation coefficient (r) in Sub Adult stage. In all cases the

value of exponent 'b' are not found in normal ranges between 2.5 and 4.0 as suggested by Hile, 1936 and Martin, 1949 and not even between 2.5 and 3.5 as reported by Froese, 2006 for most fishes. The present study also indicates that 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.

Condition, 'fatness' or well-being of fish expressed by Kn-factor, which is an index 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]. Fish with high value of 'Kn' are heavy for its length, while with low 'Kn' are lighter (Bagenal and Tesch, 1978) [2]. 'Kn' value greater than 1 indicates better condition of fish (Le Cren, 1951). The Kn value of Sub Adult *Puntius sophore,* Adult *Puntius sophore,* Sub Adult *Systomus sarana* and Adult *Systomus sarana* are 0.93 - 1.07, 0.85 - 1.19, 0.90-1.13 and 0.86 -1.06 respectively. Thus the present investigation reveals that the relative condition factor (Kn) is interestingly similar (Table-2) in all cases.

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