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Length-weight relationship and relative condition factor of *Gudusia chapra* (Hamilton, 1822) of Dalani Beel (wetland) of Assam, India

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Abstract
The present study relates to the length-weight relationship of *Gudusia chapra* (Hamilton, 1822) of Dalani Beel of Assam. The finding shows that the correlation coefficient 'r' exhibits positive correlation between total length and body weight with coefficient correlation 'r' approaching towards +1, although the growth performance exhibits negative allometric correlation which may be due to lower feeding proficiencies and/or may be due to environmental and/or seasonal incompatibility for proper growth of fishes. In this investigation the value of 'b' in *Gudusia chapra* for adult and sub adult is 2.81 and 0.92 respectively. The Kn value for adult and sub adult ranged from 0.63 to 1.45 and 0.71 to 1.28 respectively, with an average value of 1.00 ± 0.10 for former and 0.99±0.14 for the later.

Keywords: Length-Weight relationship, relative condition factor, *Gudusia chapra,* Dalani beel

1. Introduction
Growth is an important and unique characteristic of all living beings and is a function of length and weight. During the growth, both length and weight of organisms increases simultaneously as the length and weight being positively correlated with each other. Study of length-weight relationship has good significance in fishery science since it acts as an important parameter for assessing growth rate, general well-being, appearance of first maturity, onset of spawning, status of stock variation etc. of fishes (Le Cren, 1951) [17].
In general, when fishes grow isometrically, the Cube law ($W=L^3$) (Brody, 1945 [4]; Lagler, 1952 [16]) is followed. However, there is every chance of departure of expected length-weight relationship from Cube's law due to various factors prevailing in the environment; that changes the whole characteristics of water, where fishes inhabit. Thus, Le Cren in 1951 [17] modified Cube's law as $W = aL^b$ which finally gives an acutely precise result for easy calculation of length - weight relationship for the entire life history stages of fishes.
Gudusia chapra, Indian river shad, is known as Koroti in Assamese which is a species of fish under family Clupeidae, occurring in rivers, ponds, beels, ditches of India, Bangladesh Pakistan and Nepal. The body of the fish is fairly deep with dark blotch behind gill opening, often followed by a series of spots along flank. The fish is beautiful with silvery colour and delicious in taste. It is a surface dweller and feeds on a wide range of food items such as phytoplankton, Zooplankton and Debris. It is distributed in most the Beels (wetlands) of Bramhaputra valley of Assam. The information about length-weight relationship and relative condition factor is scanty on *Gudusia chapra* and therefore it is an attempt to study length weight relation of the species.

2. Materials and Methods: For evaluation of length-weight relationship 200 live samples of *Gudusia chapra* of various age groups were randomly collected from Dalani beel (located at $26^0 16^/ 3^{//}$ N and $90^0 31^/ 22^{//}$ E) from Febraury 2017 to April, 2017. The fishes were separated as adults and sub-adults and thereafter their lengths and weight were measured. For estimating the total length, fishes were measured with a digital slide caliper from tip of the snout to the tip of the longest ray of caudal fin of the fish and body weight were measured nearest to 0.01 g with the help of standard digital balance individually after blot drying. The length – weight relationships were calculated by using the formula $W = aL^b$ (Le Cren, 1951 [17]) and this formula is expressed logarithmically as

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

Where, W = body weight of the fish; L = 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:

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

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

Relative condition factor (Kn) were estimated by following Le Cren (1951) [17] formula and is expressed as follows:

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

Where W = observed weight

^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 this investigation total length and body weight of adult *Gudusia chapra* and sub adult *Gudusia chapra* is ranging from 7.1 to 12.95 and 1.42 to 3.52 cm in length and 3.56 to 19.66 and 1.42 to3.52 g in weight respectively. The value of initial growth index 'a' is -0.29 in sub adult and -1.85 in adult. The growth coefficient indicated by 'b' is 0.92 and 2.81 in sub adult and adult respectively. The total length and body weight with mean ± SD for adult and sub adult *Gudusia chapra* are given in the Table-1. The value of coefficient of correlation 'r' is 0.73 in sub adult and 0.93 in adult *Gadusia chapra*. The relative condition factor (Kn) ranges between 0.71 and 1.28 in sub adult with an average of 0.99±0.14 and in adult it is found between 0.63 and 1.45 with an average of 1.00±0.10 (Table-2). The regression graph of length-weight relationship and relative condition factor (Kn) of sub adult and adult are depicted in Figure-1(a&b) and Figure-2(a&b) respectively. The result of logarithmic length-weight relationship for adult and sub adult of *Gudusia chapra* under the present study is as follows during the period of investigation in Dalani beel.

Gudusia chapra (Sub Adult) - Log W = - 0.29 +0.92 Log L

Gudusia chapra (Adult) - Log W = - 1.85 +2.81 Log L

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

Fish Species	Total no. of fish sample	Weight Range (g)	Size Range (cm)	Mean±SD BW (g)	Mean±SD TL (cm)	Value of 'a'	Value of 'b'
Gudusia chapra	Sub Adult (n=59)	1.42 to3.52	1.42 to 3.52	2.79±0.56	6.36±1.01	- 0.29	0.92
	Adult (n=141)	3.56to19.66	7.1 to 12.95	6.01±2.18	8.52±0.90	- 1.85	2.81

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

Fish Species	Total no. of fish sample	Value of 'r'	Kn range	Mean ± SD of Kn
Gudusia chapra	Sub Adult (n=59)	0.73	0.71-1.28	0.99±0.14
	Adult (n=141)	0.93	0.63-1.45	1.00±0.10

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

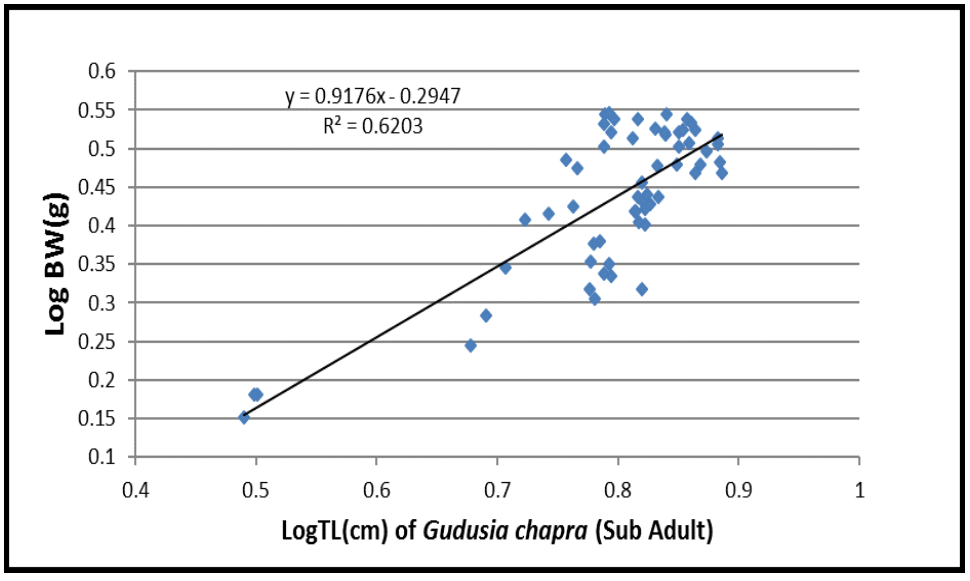

Fig 1(a): Relation between Log TL (cm) and Log BW (g) of *Gudusia chapra* (Sub Adult)

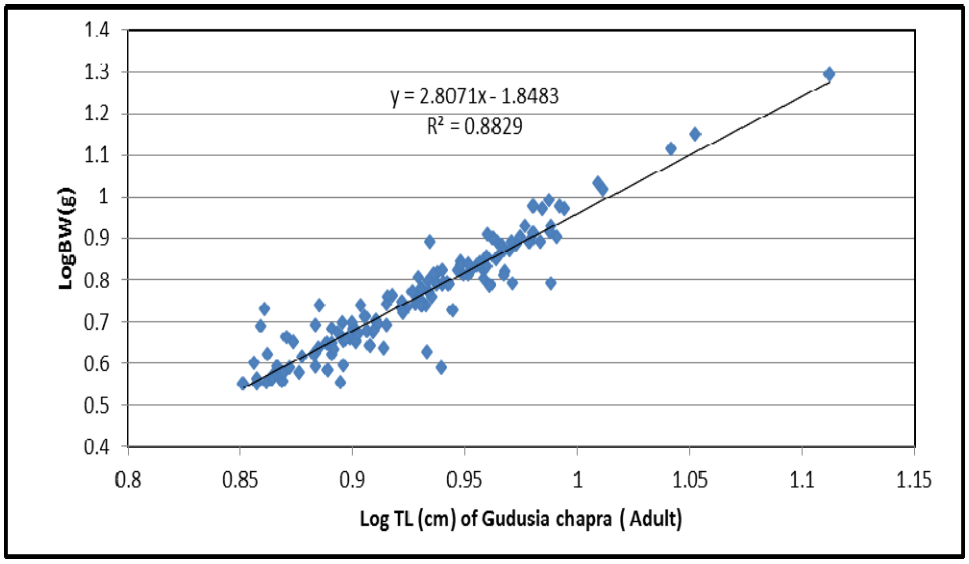

Fig 1(b): Relation between Log TL (cm) and Log BW (g) of *Gudusia chapra* (Adult)

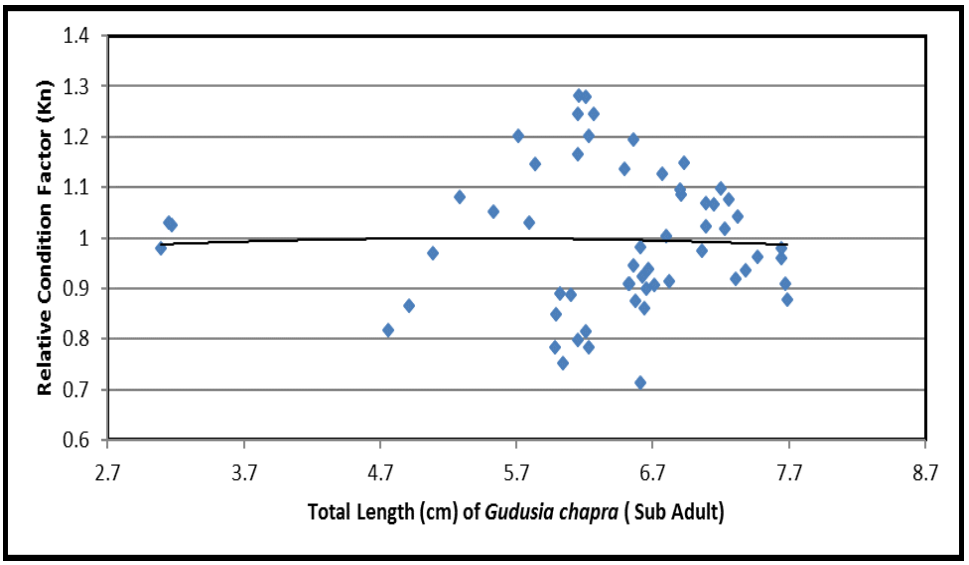

Fig 2(a): Relative condition factor (Kn) in relation to total length (cm) of *Gudusia chapra* (Sub Adult)

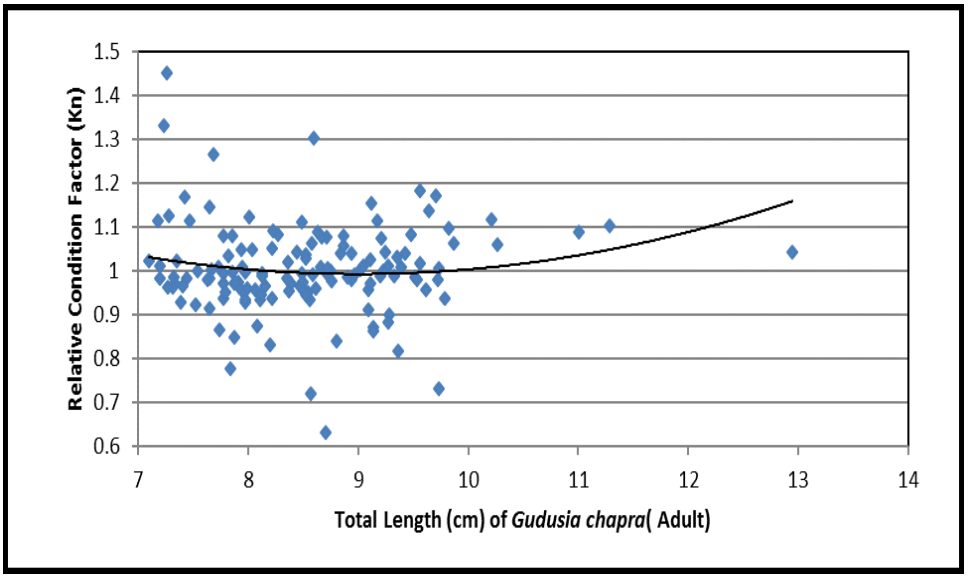

Fig 2(b): Relative condition factor (Kn) in relation to total length (cm) of *Gudusia chapra* (Adult)

4. Discussion: The present study reveals that the growth performance in *Gudusia chapra* is quite high since the correlation coefficient 'r' exhibits positive correlation between the length-weight relationships, although the growth being negative allometric which may be due to lower feeding proficiencies and/or with unsuitable environmental condition including physico-chemical parameters (Das *et al.,* 2015 [7]; Das *et al.,* 2015 [8]; Kalita *et al.,* 2016 [14]). Moreover the breeding season during the experimental period may not be suitable for proper growth of fishes. However, Soni and Kathal, 1953 [22]; Kaur 1981 [15]; Saikia *et al.,* 2011 [21]; Bura Gohain and Goswami, 2013 [5] Deka and Bura Gohain, 2015 [9]; Das *et al.,* 2015 [6]; Rahman *et al.,* 2015 [20] observed the effect of availability of food, higher proficiencies in feeding and many other related factors responsible for positive allometric growth.

Degree of variation of exponential value of length-weight relationship indicated by 'b' value in adult *Gudusia chapra* is 2.81 followed by sub adult which is 0.92 The lower value of 'b' is observed in the sub adult stages of *Gudusia chapra* is not found in the normal range between 2.5 and 4.0 (Hile, 1936 [12] and Martin, 1949 [18]) and between 2.5 and 3.5 (Froese, 2006 [10]). Variation in 'b' value may be due to feeding (Le Cren, 1951 [17]), developmental stages of gonads (Weatherly, 1972 [23] and Hile 1936 [12]) specially the ovary affect the weight and state of maturity (Frost, 1945 [11]) etc. 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. As the 'b' value is deviated from 3 in this investigation, it shows the growth is not isometric indicating the fish gets thinner as it grows larger.

Kn is an index to monitor feeding intensity and growth rate of fish (Oni *et al.,* 1983 [19]) 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 [17]). In the present study on *Gudusia chapra,* Kn value for sub adult is ranged from 0.71 to1.28 and for adult it is 0.63 to 1.45 with an average of 0.99±0.14 and 1.00±0.10 respectively. Kn value for most of the fishes were less than 1 which indicates that the fishes were not in a better condition. However, the relative condition factor is observed to decrease slightly and smoothly from lighter to heavier fish first to attain minimum in medium sized fish samples and increase sharply to attain maximum near to the heaviest fish (Figure-2) which does not support with the result of Bhatta and Goswami, 2014 [3] who noticed reverse phenomenon in their study on *Channa aurantimaculata* where peak Kn value is recorded in medium sized fishes. However, Rahman *et al.,* 2015 [20] in female *Anabas testudineus* and Das *et al.,* 2015 [8] in male *Heteropneustes fossilis* also recorded more or less similar trend where 'Kn' decrease from lower sized fish exhibiting the lowest value at medium fish and thereafter steadily increase to get the highest value in bigger fishes.

5. Conclusion: The present study indicates the growth performance in sub adult stage of *Gadusia chapra* is not good. However, in adult stage though the growth performance is negative allometric, but the same is found in the normal range. The growth rate and feeding intensity shown by Kn value suggests that most of the fishes are not in good condition.

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