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A comparison of length-weight relationship and relative condition factor among three groups of *Leiodon cutcutia* (Hamilton, 1822) of Diplai Beel (wetland) of Assam, India

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Abstract
The present study reports the length-weight relationship, relative condition factor among adult male, adult female and sub adult group of of *Leiodon cutcutia* (Hamilton, 1822) of Diplai Beel (wetland) of Assam. The fishes were first separated into two groups-sub adult and adult stage (male and female). The growth performance of length-weight relationship has been found high since the correlation coefficient 'r' exhibits a high degree of relationship (0.94 in adult female and 0.93 in both sub adult and adult male) and shows all types growth pattern among different groups where positive allometric correlation (b=3.32) is observed in female adult, negative allometry (b=2.44) in sub adult and very interestingly isometric growth (b=3.00) in male adult. The Kn value for adult male and female of *Leiodon cutcutia* are 0.87 to 1.35 and 0.78 to 1.26 respectively, whereas in sub adult it is from 0.83 to 1.35.

Keywords: Length-Weight relationship, relative condition factor, *Leiodon cutcutia,* Diplai Beel

1. Introduction
The study of length-weight relationship is an importance parameter in fishery science, as it helps to understand the general well being as well as growth patterns in a fish population. The length-weight relationship of fish varies with various factors like status of stock variation, appearance of first maturity and time of spawning (Le-Cren, 1951)[16] as well as the condition of life in aquatic environment where they inhibit.

According to Brody, 1945[4] and Lagler, 1952[15], 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[16] used an alternating formula modifying Cube law as W = aL^b to calculate the length - weight relationship throughout the life history stages of fishes.

Leiodon cutcutia (Hamilton-Buchanan) is considered as a trash fish in the Indo-Gangetic basin (Karmakar and Biswas, 2014)[13] under the order Tetraodontiformes and family Tetraodontidae which is commonly known as Gangatop in Assam. The species
is widely distributed throughout the plains of north eastern region of India and is neglected because of its poor food value. However, the fish is a potential aquarium fish inhibiting generally in river and beel (wetland) of Assam. The work on length-weight relationship of *Leiodon cutcutia* has been reported from upper Assam (Karmakar and Biswas, 2014)[13], where seasonal b value was found between 0.476 in pre-monsoon and 1.622 in post-monsoon in male; between 0.986 in winter and 3.086 in monsoon in female. Karmakar and Biswas, 2014 [13] also reported the result of condition factor 'K' which was ranged from 2.66-6.722 in case of males and from 2.362-7.048 in female specimens. The condition factor 'K' seasonally varied from 3.864 (monsoon) to 6.279 (winter) in male and from 3.196 (pre-monsoon) to 3.628 (winter) in female which was reported from Neematighat of Jorhat District of Assam (Karmakar and Biswas, 2014[13]). Therefore, the present communication is an attempt to report the length-weight relationship of *Leiodon cutcutia* from lower Assam of India.

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2. Materials and Methods: A total of 183 number of individuals of *Leiodon cutcutia* were randomly collected from Diplai Beel (Wetland) (located at latitude $26^0 17^{/} 31^{//}$ North and longitude $90^0 19^{/} 14^{//}$ East) from February, 2017 to May, 2017. Male and female sexes were distinguished by dissecting each specimen after measuring their length and weight. Fishes were divided into two groups on the basis of length of the individual as sub adult (below 5 cm) and adult (above 5 cm) for length-weight calculation. Total length of the fishes was 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) [16] 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 initial growth index and 'b' is growth coefficient. Parameter 'a' and 'b' were calculated by the method of least square regression:

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

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

Relative condition factor (Kn) were estimated by following Le Cren (1951)[16] formula is expressed as follows:

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

Where W = observed weight

W^c = 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 adult (male and female) and sub adult samples having size ranges from 5.54-7.93, 5.01-9.38 and 3.22-5.68 cm in length and having weight ranges from 4.9-15.32, 3.38-35.90 and 1.26-4.98 gram in weight respectively. The value of initial growth index 'a' is -1.10 in sub adult stage, -1.49 in male adult and -1.73 in adult female *Leiodon cutcutia* (Table-1). The growth coefficient indicated by 'b' is 2.44 in sub adult, abjectly 3.00 in adult male and 3.32 in adult female *Leiodon cutcutia* (Table-1). The total length and body weight for sub adult and adult (both male and female) are given in the Table-1. The value of coefficient of correlation 'r' is 0.93 in both sub adult and male adult stage of *Leiodon cutcutia*. However, in adult female the coefficient of correlation 'r' is 0.94, which is slightly more than the other two stages of *Leiodon cutcutia* (Table-1). The relative condition factor 'Kn' is found in the range between 0.83 and 1.35 with an average of 1.02±0.11 in sub adult stage of *Leiodon cutcutia*, 0.87 and 1.35 with an average of 1.01±0.09 in adult male and 0.78 and 1.26 with an average of 0.99±0.11 in adult stage of female (Table-2) The regression graph of length-weight relationship are depicted in Figure-1 (a,b,c) and the relative condition factor (Kn) in Figure-2 (a,b,c). The result of length-weight relationship of *Leiodon cutcutia* (sub adult and adult) during the present study is as follows in Diplai Beel.

Leiodon cutcutia (Sub Adult) - Log W = -1.1+ 2.44 Log L
Leiodon cutcutia (Adult, Male) – Log W = -1.49 + 3.00 Log L
Leiodon cutcutia (Adult, Female) – Log W = -1.73 + 3.32 Log L

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

Species	Stage	Weight range(g)	Size range(cm)	Mean±SD BW(g)	Mean±SD TL(cm)	Value of 'a'	Value of 'b'
Leiodon cutcutia	Sub Adult (n=46)	1.26-4.98	3.22-5.68	3.01±0.87	4.37±0.51	-1.10	2.44
	Adult (male) (n=49)	4.9-15.32	5.54-7.93	8.35±2.21	6.30±0.50	-1.49	3.00
	Adult (female) (n=88)	3.38-35.90	5.01-9.38	10.79±5.58	6.66±0.92	-1.73	3.32

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
Leiodon cutcutia	Sub Adult (n=46)	0.93	0.83-1.35	1.02±0.11
	Adult (male) (n=49)	0.93	0.87-1.35	1.01±0.09
	Adult (female) (n=88)	0.94	0.78-1.26	0.99±0.11

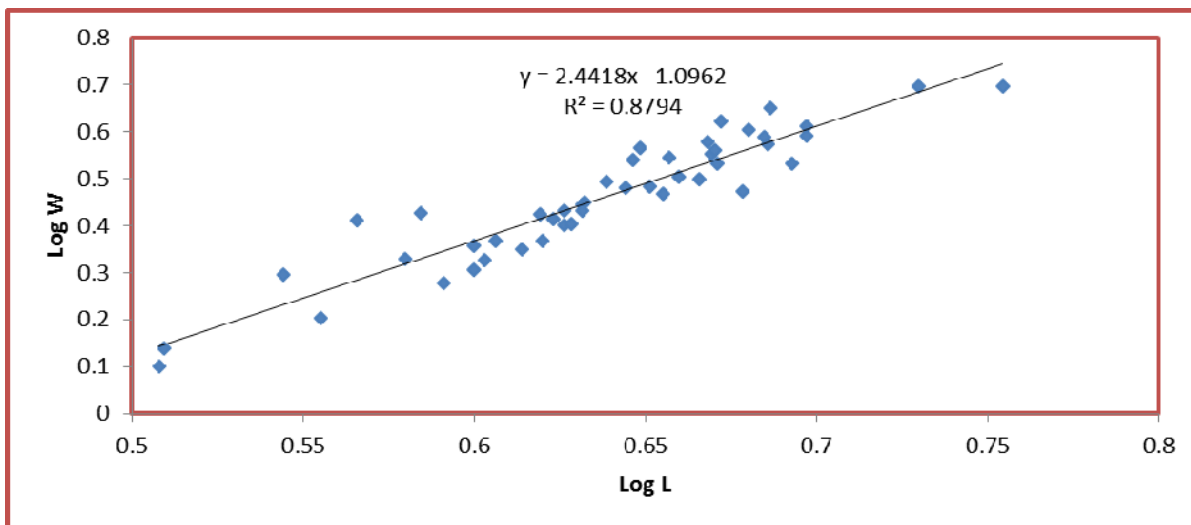**.Correlation is significant at the 0.01 level (2-tailed).

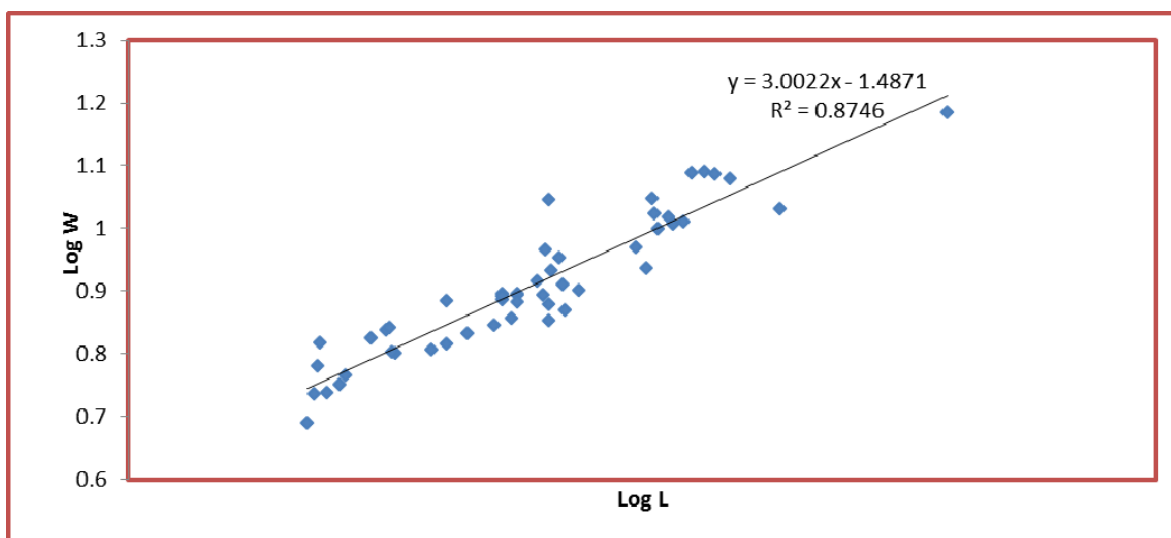**Fig 1(a):** Relation between Log TL (cm) and Log BW (g) of *Leiodon cutcutia (*Sub Adult)

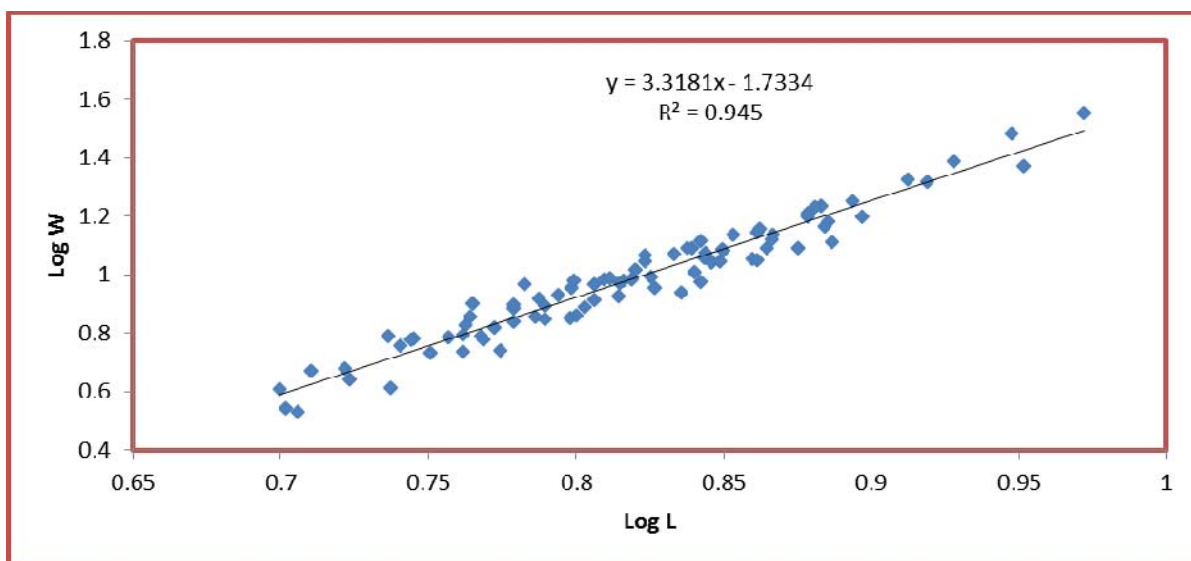**Fig 1(b):** Relation between Log TL (cm) and Log BW (g) of *Leiodon cutcutia* (Adult) male

Fig 1(c): Relation between Log Total Length (cm) and Log Body Weight (g) of *Leiodon cutcutia* (Adult) female
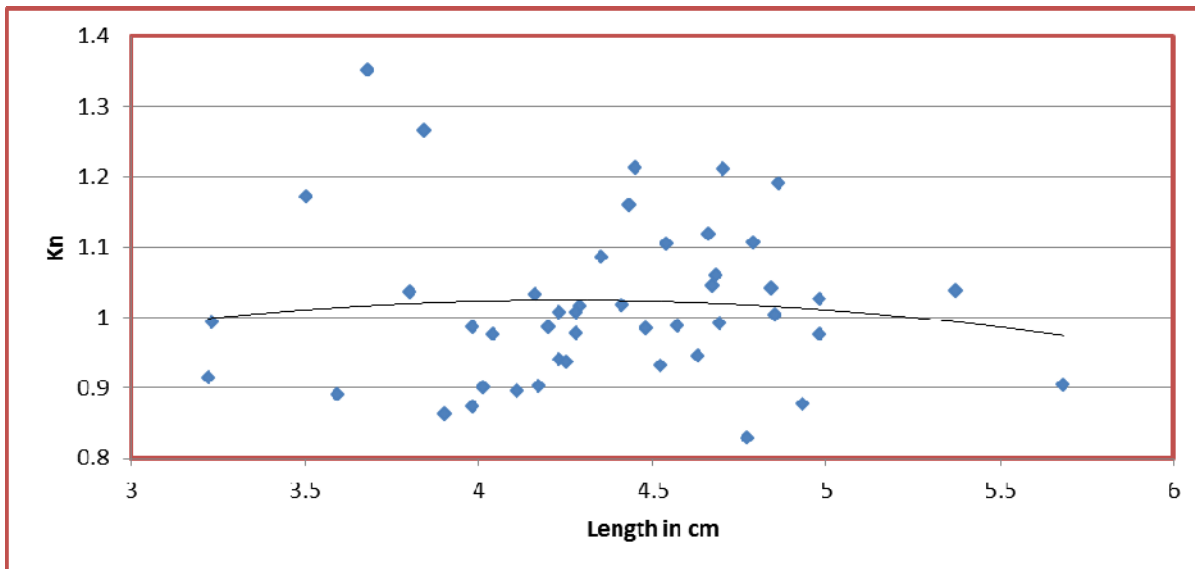
Fig 2(a): Relative condition factor (Kn) in relation to total length (cm) of *Leiodon cutcutia* (Sub Adult)
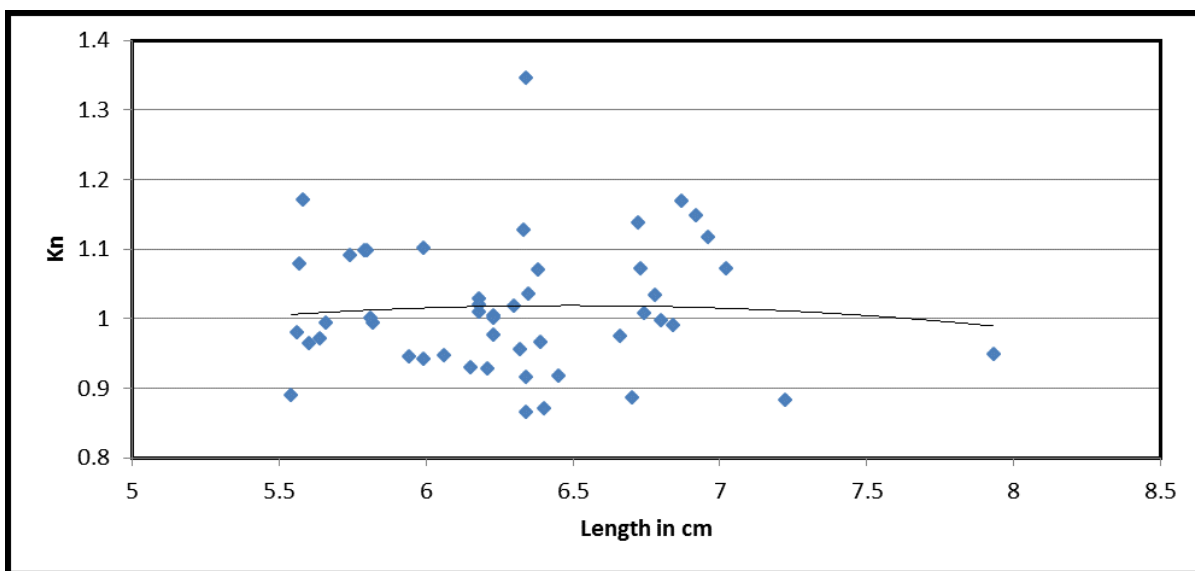

Fig 2(b): Relative condition factor (Kn) in relation to total length (cm) of *Leiodon cutcutia* (Adult) male
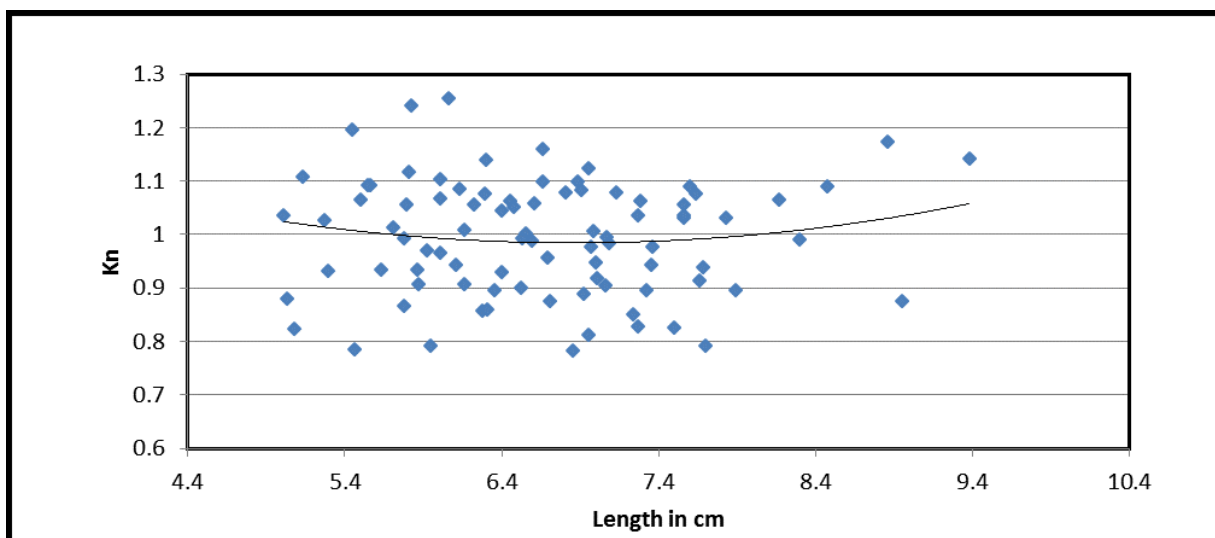

Fig 2(c): Relative condition factor (Kn) in relation to total length (cm) of *Leiodon cutcutia* (Adult) female

4. Discussion

The present finding reveals that the growth performance of all the three groups of experimental fish is found high with more or less similar value of 'r' (coefficient of correlation) between the length-weight relationship. The growth coefficient 'b' indicates the positive allometric growth in case of female *Leiodon cutcutia* and negative allometric in sub adults. It is very amazing to note that male *Leiodon cutcutia* shows isometric relationship (Table-1) during present investigation showing the favorable environmental, geographical and ecological characteristics of the present investigation. The present study, therefore, interestingly suggests that the value of 'b' does not deviate from 'cube law' for adult male *Leiodon cutcutia* as it remains constant at 3.00 for an ideal fish (Allen, 1938) [1] in a particular environmental condition unlike adult female and sub adult form.

The growth pattern so observed in adults may be due to good feeding proficiencies along with the environment including season of experiment are favorable for proper growth of fishes. Soni and Kathal, 1953[21]; Kaur, 1981[14]; Saikia *et al.,* 2011[20]; Bura Gohain and Goswami, 2013 [5]; Deka and Bura Gohain, 2015[7], Rahman *et al.,* 2015[19]; Kalita *et al.,* 2016[11]; Kalita *et al.,* 2016[12] observed the higher proficiencies in feeding, availability of food and other associated factors for positive allometric growth in different fishes.

Degree of variation of growth coefficient 'b' in *Leiodon cutcutia* adult female (3.32) is the highest, followed by adult male (3.00) and Sub adult (2.44). However, the lower value of 'b' is observed in the sub adult stage of *Leiodon cutcutia* (Table-1). The correlation coefficient 'r' in adult female *Leiodon cutcutia* is the closest to 1.0 (0.94) followed by adult male and sub adult (0.93). This indicates that adult female *Leiodon cutcutia* has the highest degree of relationship in growth performance and the least in adult male and sub adult *Leiodon cutcutia*. It is interesting that adult female *Leiodon cutcutia* maintains the highest degree of exponential growth (Table-1) and correlation coefficient (Table-2) during the experimental period in Diplai Beel. Except sub adult *Leiodon cutcutia* the value of exponent 'b' are found in normal ranges between 2.5 and 4.0 as suggested by Hile, 1936 [10] and Martin, 1949 [17] and between 2.5 and 3.5 as reported by Froese, 2006 [8] for most fishes.

Relative condition factor expressed by 'Kn' is an index to monitor feeding intensity and growth rate (Oni *et al.,* 1983) [18], which explains 'Condition', 'fatness' or well being of a fish which 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 relative condition factor (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) [16]. The Kn value of sub adult *Leiodon cutcutia,* adult male and female *Leiodon cutcutia* are in the range from 0.83 - 1.75, 0.87 - 1.35, and 0.78-1.26 respectively. Thus the present investigation also reveals that the Kn is more or less similar (Table-2) in all three defined groups of *Leiodon cutcutia*. However, in female, Kn is observed to decrease slightly from lighter to heavier fish first to attain minimum in medium sized fish samples and increase steadily to attain maximum near to the heaviest fish (Figure-2) which does not corroborate with the result of Bhatta and Goswami, 2014 [3] who reported a reverse phenomenon where peak Kn value is recorded in medium sized fishes of *Channa aurantimaculata.*. However, Rahman *et al.,* 2015[18] in *Anabas testudineus* (female) and Das *et al.,*

2015 [6] in *Heteropneustes fossilis* (male) noticed a more or less similar trend where 'Kn' is found to be decreased from lighter fish exhibiting the lowest value at medium weight fish and thereafter steadily increase to get the highest value in bigger fishes. Notwithstanding in sub adult and male adult, however, the case is reversed where peak Kn value is recorded in medium fish which is found to be increased smoothly from lighter fishes.

5. Conclusion

The presence of all three patterns of growth performance i.e. negative allometric in sub adult stage, isometric in adult male and positive allometric in adult female in *Leiodon cutcutia* is very amazing. Except in sub adult stage, the growth performance indicated by 'b' value is found in the normal range. The growth rate and feeding intensity shown by 'Kn' value suggests that all the three groups of fishes maintains more or less a similar range of fluctuations and most of them are in good condition.

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