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Length-weight relationship and Relative condition factor of *Barilius bendelisis* (Hamilton, 1807) and *Barilius barna* (Hamilton, 1822) from Manu River, Tripura, India

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Abstract

The present investigation documents the relationship between Total length (TL)-Weight (W), Standard length (SL)-Weight (W) and Total length (TL)-Standard length (SL) for two bariline fish species from Manu River, Tripura. The study has been done on 80 samples of *Barilius bendelisis* with size ranged from 4.30 to 15.55 cm and 77 samples of *Barilius barna* with size ranged from 4.62 to 10.19 cm in total length for a period of 12 months. The Total length (TL)-Weight (W) relationships were found to be $W=0.0100 TL^{2.99}$ and $W=0.0081 L^{3.14}$ for *Barilius bendelisis* and *Barilius barna* respectively. The Mean relative condition factors (K_n) were found to be 1.014 ± 0.023 and 1.043 ± 0.025 for *Barilius bendelisis* and *Barilius barna* respectively which shows the good health and condition of the fishes.

Keywords: Total length-Weight relationship, *Barilius bendelisis*, *Barilius barna*, Mean Relative condition factor, Manu, Tripura

1. Introduction

The Manu River is the longest river of Tripura having a total length of 167 km. It originates from the Sakhon range and moves northward and enters Bangladesh at Kailasahar. From this river, [1] reported about 28 fish species and out of which 6 are from genus *Barilius*. Fishes of the genus *Barilius* are freshwater fishes of the family Cyprinidae (Order Cypriniformes). *Barilius bendelisis* and *Barilius barna* are generally called as Indian hill trout and characterized by their relatively elongate compressed body, blue-black bars or spots on the body and dorsal fin inserted behind the middle of the body [2]. They thrive in shallow, clear and cold waters [3]. They have food as well as ornamental values and some play a significant role in capture fisheries [4]. Study of length-weight relationship has a number of important applications like it helps in fish stock assessment, in the estimation of biomass from the observed length, in the estimation of the condition of the fish and also for comparisons of life histories of certain species between different regions [5]. The present study was undertaken with the objective to estimate the length-weight relationships for 2 species of genus *Barilius* collected from the Manu River Tripura, India.

2. Materials and methods

A total of 153 fish samples (80= *Barilius bendelisis* and 73= *Barilius barna*) were collected from different sampling sites of the Manu river using cast net during the time period between October, 2016 to September, 2017 (1 year) under COE-FAB project. The specimens were brought to the laboratory to study the length-weight relationship. The total lengths (TL) and standard length (SL) to the nearest 0.01 cm were recorded using a vernier caliper and weights (W) of the fish specimens were recorded to the nearest 0.01 gm using an electronic weighing machine. Fish species identification was done following [6-7]. The length-weight relationship was determined using the formula given by [8]:

$$W=aL^b$$

This could be further linearised by the application of natural logarithm as:

$$\ln W = \ln a + b \ln L$$

Where, W= weight of the fish in gm, L= Length of the fish in cm, a= intercept and b= regression coefficient.

In order to find out the significance of regression coefficient (b) student t-test was applied.

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Condition factor (K) was estimated using the formula:

$$K = 100 W/L^3$$

Further the relative condition factor (Kn) was calculated by using the formula:

$$Kn = W_0 / \hat{W}$$

Where W_0 = observed weight and \hat{W} = calculated weight.

All statistical analyses were done using Excel (2007).

3. Results

About 80 specimens of *B. bendelisis* and 73 specimens of *B. barna* are measured and their total length (TL) ranges between 4.30 cm-15.55 cm and 4.62 cm-10.19 cm respectively. All the regression parameters and descriptive statistics for the relationship between total length (TL)-Weight (W) and Standard length (SL)-Weight (W) for both the species are tabulated in Table 1 and Table 2 respectively. The 'b' values in TL-W relationship for *B. bendelisis* and *B. barna* is found to be 2.99 and 3.14 respectively. And the 'b' values in SL-W relationship for *B. bendelisis* and *B. barna* is found to be 2.90 and 3.21 respectively. All the 'b' values are found to be significant ($p<0.05$). The relationships between TL-W are plotted in fig.1-4 and SL-W is plotted in fig.5-8 for both the species. The TL-W scatter plot shows a curve line where as $\ln TL - \ln W$ shows a linear straight line. Like this the SL-W scatter plot shows curve line and $\ln SL - \ln w$ shows a linear straight line. All the linear and non-linear equations from TL-W and SL-W relationships are tabulated (Table 3). Table 4 reflects all the parameters for the relationships between TL and SL and these relations were plotted in fig.9-10 which shows a linear straight line. Relationship between total length (TL) and standard length (SL) was determined according to the Pearson correlation and regression method. The relationship was found to be:

$$\ln TL = 1.360 + 0.96 \ln SL \text{ (*B. bendelisis*)}$$

$$\ln TL = 1.234 + 1.02 \ln SL \text{ (*B. barna*)}$$

The mean condition factor (K) for *B. bendelisis* and *B. barna* are 1.001 ± 0.014 and 1.078 ± 0.011 respectively. And also the mean relative condition factor (Kn) for both *B. bendelisis* and *B. barna* are 1.014 ± 0.023 and 1.043 ± 0.025 respectively (Table 5). Fig.11-12 shows the different Kn values for different length group for both the species.

4. Discussion

The present study depicts TL-W relationship of *B. bendelisis* and *B. barna*, $TW = 0.0100 \times TL^{2.99}$ and $TW = 0.0081 \times TL^{3.14}$ correspondingly. The values of 'b' calculated for the two species were within the expected range of 2.5–3.5, as reported by [9]. For *B. bendelisis* ('b'=2.99), $b \approx 3$ indicates that the species grow equally in length and weight or the small sized specimens in the sample are in same nutritional condition as the larger one. LWR study on *B. bendelisis* have been reported by a number of workers from Beas River; Himachal Pradesh, Manas river; Assam and Kosi River; Uttarakhand [10-12] which reports a 'b' value of 3 or near to 3. These results support this present study. Whereas value of 'b' reported by [13] from Garhwal, Himalaya, India ($b = 2.84$) and [14] from Basistha River in Assam, India ($b = 3.21$) varied from the present study. The 'b' value for *Barilius barna* is 3.14, which indicate that the species grows higher in weight in comparison to the length or the smaller specimens are in better nutritional condition than the larger one. However [11] found 'b' value 2.89 which shows a contrast result to this finding. This variations in the 'b' value for both the species may be due to

the length ranges used, habitat, maturity of gonad, sex, study season, fullness of gut, methods of preservation and annual differences in the environmental conditions [15].

The mean condition factor (K) and mean relative condition factor (Kn) for both the species are one which indicates good health and condition of the fishes. The graph of Kn for both the species shows the variation of Kn among the different length group of fishes, which indicates the degree of food sources availability for each length group, age, sex, state of sexual maturity of the fish and environmental conditions of the habitat [16]. *B. bendelisis* has the highest Kn value of 1.163 and *B. barna* has the highest Kn value of 1.166 at length group 8-8.9cm and 10-10.9 cm respectively. This may represent the maturity stage of the species.

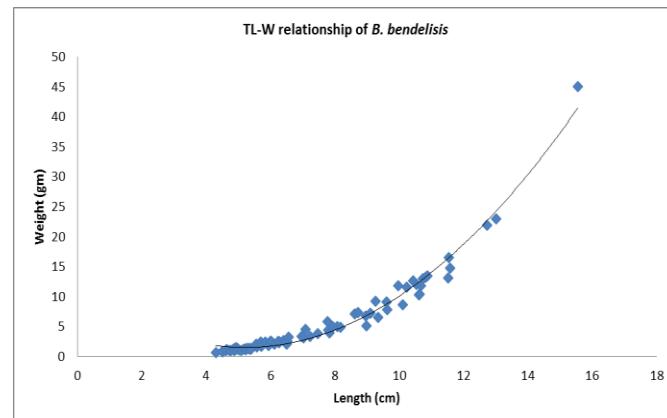


Fig 1: Total Length (TL)-Weight (W) relationship of *B. bendelisis*

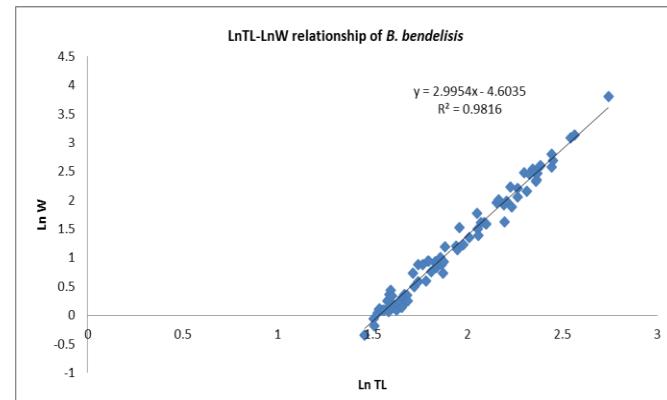


Fig 2: LnTL-LnW relationship of *B. bendelisis*

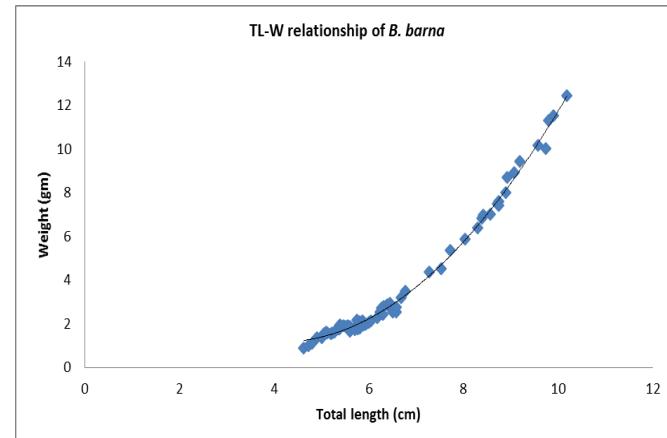
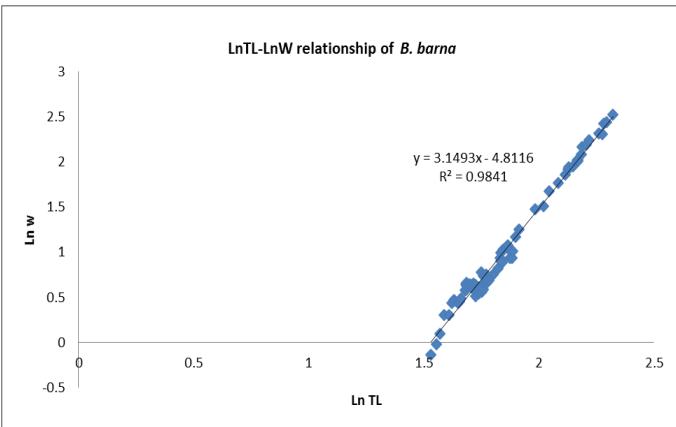
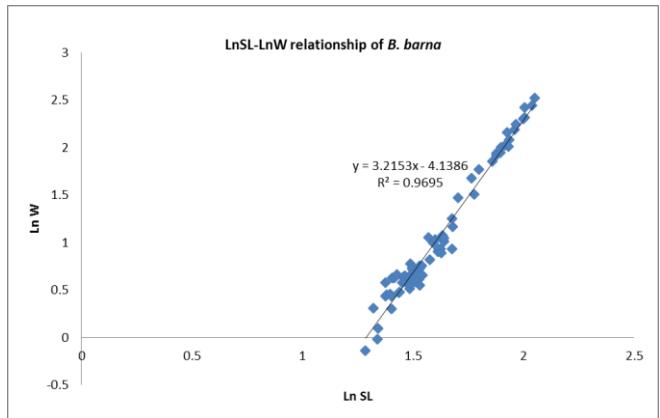
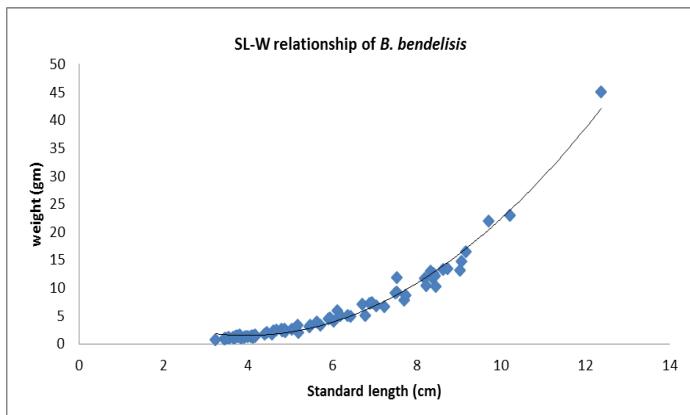
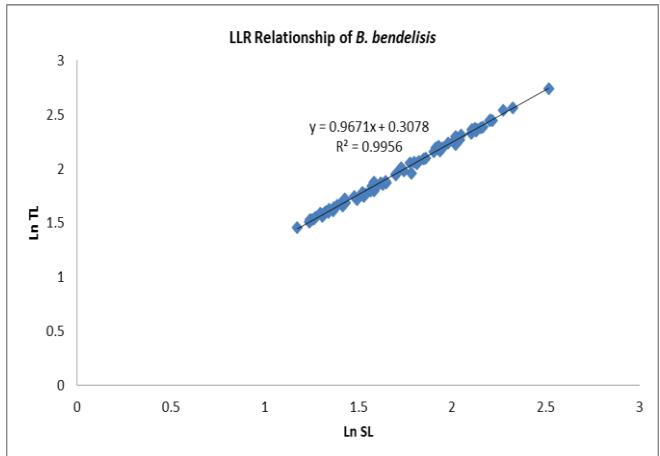
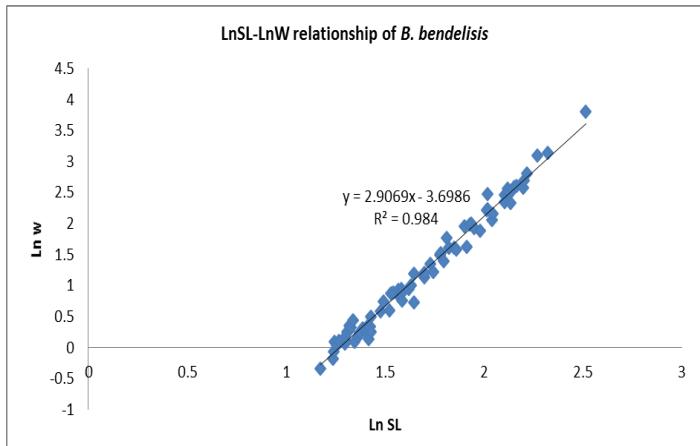
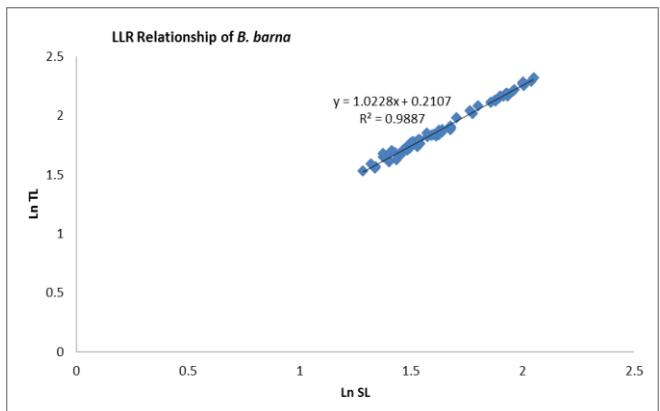
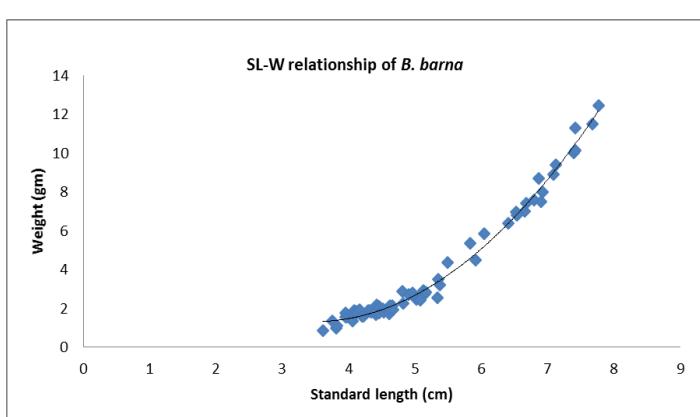
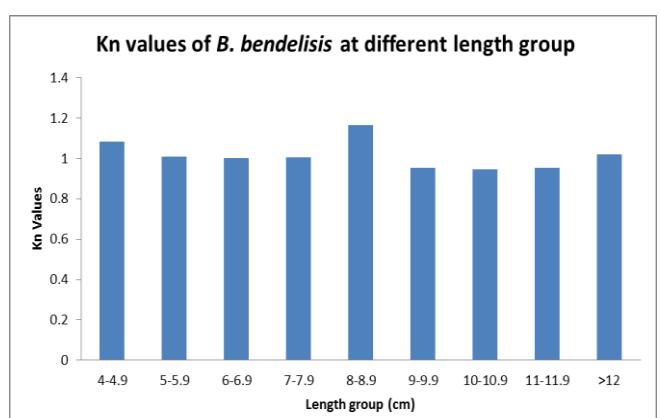
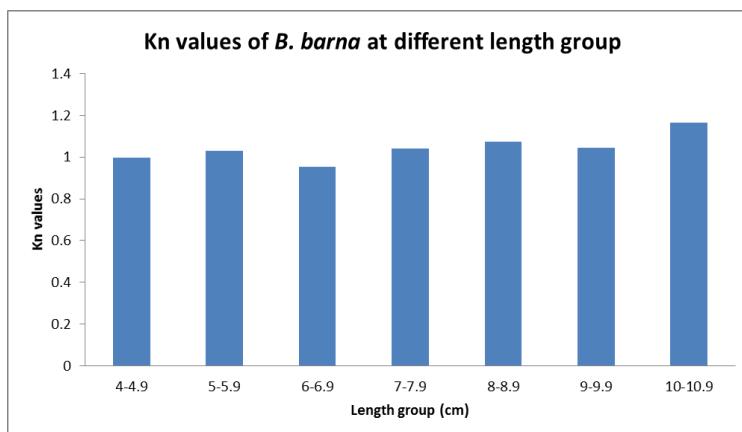


Fig 3: Total Length (TL)-Weight (W) relationship of *B. barna*

**Fig 4:** LnTL-LnW relationship of *B. barna***Fig 8:** LnSL-LnW relationship of *B. barna***Fig 5:** Standard Length (SL)-Weight (W) relationship of *B. bendelisis***Fig 9:** Ln TL- Ln SL relationship of *B. bendelisis***Fig 6:** LnSL-LnW relationship of *B. bendelisis***Fig 10:** Ln TL- Ln SL relationship of *B. barna***Fig 7:** Standard Length (SL)-Weight (W) relationship of *B. barna***Fig 11:** Kn values of *B. bendelisis* at different length group

**Fig 12:** Kn values of *B. barna* at different length group**Table 1:** All the regression parameters and 'b' values according to Ln TL and Ln W relationship

Species	Total Length range (cm)		Total Weight range (gm)		Regression parameters				R ²
	Minimum	Maximum	Minimum	Maximum	a	95% CL of a	b	95% CL of b	
<i>B. bendelisis</i>	4.30	15.55	0.71	45.06	0.0100	0.0083-0.0120	2.99	2.90-3.08	0.981
<i>B. barna</i>	4.62	10.19	0.87	12.45	0.0081	0.0068-0.0097	3.14	3.05-3.24	0.984

a: Intercept, b: Regression coefficient, CL: Confidence limit, R²: coefficient of determination**Table 2:** All the regression parameters and 'b' values according to Ln SL and Ln W relationship

Species	Standard Length range (cm)		Total Weight range (gm)		Regression parameters				R ²
	Minimum	Maximum	Minimum	Maximum	a	95% CL of a	b	95% CL of b	
<i>B. bendelisis</i>	3.23	12.37	0.71	45.06	0.0247	0.0214-0.0286	2.90	2.82-2.99	0.983
<i>B. barna</i>	3.61	7.76	0.87	12.45	0.0159	0.0128-0.0198	3.21	3.08-3.35	0.969

a: Intercept, b: Regression coefficient, CL: Confidence limit, R²: coefficient of determination**Table 3:** All the linear and non-linear equations from TL-W and SL-W relationship

Species	TL-W			SL-W			R ²
	Non-linear	Linear		Non-linear	Linear		
<i>B. bendelisis</i>	W=0.0100TL ^{2.99}	LnW= -4.60347+2.99LnTL		W=0.0247SL ^{2.90}	LnW= -3.6985+2.90LnSL		0.983
<i>B. barna</i>	W=0.0081L ^{3.14}	LnW= -4.81158+3.14LnTL		W=0.0159SL ^{3.21}	LnW= -4.138+3.21LnSL		0.969

TL: Total length, SL: Standard length, W: Weight

Table 4: TL-SL relationship of both the species

Species	N (No. of specimens)	LnTL=a+b LnSL		
		a	b	R ²
<i>B. bendelisis</i>	80	1.360	0.96	0.99
<i>B. barna</i>	73	1.234	1.02	0.98

TL: Total length, SL: Standard length

Table 5: Mean condition factor and mean relative condition factor of both the species

Species	Mean Condition Factor (K)	Mean Relative Condition Factor (Kn)
<i>B. bendelisis</i>	1.001±0.014	1.014±0.023
<i>B. barna</i>	1.078±0.011	1.043±0.025

5. Conclusion

This study was based on the samples collected from the riverine rater of Tripura. The 'b' value for *B. bendelisis* was found to be 2.99 which indicate isometric growth of the species. The 'b' value for *B. barna* was found to be 3.14 which indicate positive allometric growth of the species.

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