



Original Article

Study of Morphometric Characteristics of Freshwater Putul, *Botia lohachata* in Kompo River of Bagmara, Rajshahi, Bangladesh

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Abstract

This study described about the morphometric characteristics of *Botia lohachata*, collected from the Kompo River at Rajshahi, were studied for a period of four months from July to October 2014. Length frequency distributions, length-length relationships, length-weight relationship, sex ratio, Fulton's condition factor and fecundity of *B. lohachata* were studied in the present study. This is the maiden research conducted on *B. lohachata* in Bangladesh. The highest mean total lengths were 61.16 ± 4.77 mm (combined sex), 63.80 ± 4.79 mm (female) and 58.17 ± 3.30 mm (male). Maximum 43.34% female fishes were belonging to the length category of 61-65 mm where as 61.41% male were belonging to 56-60 mm. Similar findings are also presented for standard length, fork length, body depth, dorsal length, pectoral length, pelvic length and anal length. Linear relationships were also studied among mentioned lengths. Strong positive correlations were observed in all cases. The highest mean body weight was weight 2.67 ± 0.71 g (October) in combined sex, this value was 3.10 ± 0.59 in female (September) and 2.25 ± 0.38 g in male (September). Strong positive correlations were also observed between total length and body weight. Observed value of sex indicated that 54% specimens were female and remaining 46% were male. The value of chi square (χ^2) was 2.4 at 1 degree of freedom ($p < 0.005$) strongly indicated that the observed sex ratio not differs significantly from the expected ratio (1:1). The Fulton's condition factors In case of combined sexes, the highest condition factor 1.156 ± 0.126 was recorded in month of October, female highest condition factor 1.190 ± 0.136 and male highest condition factor 1.135 ± 0.103 . [Journal of Science Foundation 2019;17(1):15-33]

Keywords: *Botia lohachata*; Kompo River; length-weight relationship; condition factor

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Introduction

The morphometric study of fishes is becoming prominent all over the world to fulfill the lacuna of the knowledge on biological aspects of fishes. Therefore fisheries biologists are turning their eyes to these aspects from various points of view. Length-weight relationships for fish have been used extensively to provide information on the condition of fishes, their isometric or allometric growth, in the analysis of ontogenetic change, compare life histories of fish between regions as well as other aspects of fish population dynamics. In fisheries biology, length-weight relationships useful for conversion of growth-in-length equations of growth-in-weight for use in stock assessment models and to estimate stock biomass from limited sample sizes (Binohlan and Pauly, 1998; Koutrakis and Tsikliras, 2003; Ecoutin *et al.*, 2005).

The length weight (LWR) of fishes in a given geographic zone is important in fisheries biology because it allows estimation of the average weight at a given length. LWR parameters can also be used as indices of fish condition for life-history comparisons of different regions (Petraakis and Stergiou, 1995).

Length-weight relationships for fish were originally used to provide information on the condition of fish and to determine whether somatic growth was isometric or allometric (Le Cren, 1951; Ricker, 1975). All living animals have a tendency to maintain symmetrical growth of its different body parts in relation to one another. It is generally known that all parts are dependent on the length of the body *i.e.* growth of the body parts are proportional to the growth of total length. But the total length of the body is not dependent on all other body parts. So morphometric measurements of fishes and the study of statistical relationship among them are essential for taxonomic study of species (Tandon *et al.*, 1993).

Morphometric character is the character based on measurement. In fish, measurements are taken on a straight line basis, not around the curve of body with the exception of such measurements specifically intended to measure roundness, e.g. girth. Any measurements should be defined or referenced to a standard work as some may include soft parts or only be from bony margin to bony margin. Some measurements include total length (TL), standard length (SL), head length (HL) etc.

Methodology

The study was conducted in the Kompo river of Bagmara upzalia under Rajshahi district. Bagmara is located at 24.5639°N and 88.8083°E (Figure a). Fish specimens were collected for four months from July 2014 to October, 2014.



Figure a: Map of Bagmara upazila under Rajshahi district (blue circle showing the study area).

Sampling framework: A total of fifty (50) specimens were collected every month for study of different parameters regarding biology of *Botia lohachata*. Fish specimens were collected with the help of fishermen who used their own fishing nets, traps and crafts to harvest target species in the river Kompo. Collected specimens were brought to the Laboratory of the Department of Fisheries and preserved in 10% formalin solution for further study. The specimens were preserved in labeled plastic and glass jars. No physically damaged specimens were selected for the study.

Length and Weight Measurements: The measurements of different lengths were made with the help of an electric slide calipers. Body weight (BW) was weighted by a digital balance to the nearest 0.01 g. The LWR for BW was calculated using the equation, $BW = aSL^b$, where coefficient a is the intercept in the y-axis, and the regression coefficient b is an exponent indicating isometric growth when equal to 3. However, following morphometric characters were measured in the present study- TL, SL, BD, PcL, PvL, AL, DL, TW.

Meristic characters: In the present study following meristic characters were recorded-Fin rays, Barbels, Lateral line scale.

Descriptive characters: Shape of the body, the orientation of the paired and unpaired fins, Coloration of body, Sexually dimorphic characters

Length-length relationships: Total length (TL), standard length (SL), fork length (FL), Dorsal length (DL), Pectoral length (PcL), Pelvic length (PvL) and Anal length (AL) were used to make the relationships, TL vs. SL, TL vs. FL, SL vs. FL, TL vs. DL, TL vs. PcL, TL vs. PvL, TL vs. AL by linear regressions for both males and females separately.

Length-weight relationship: The relationship between weight and length was calculated using the expression: $W = aL^b$, where the W is the body weight (g), L the standard length (cm), a intercept of the regression and b is the regression coefficient (slope). Parameters a and b of the weight-length relationship will be estimated by linear regression analysis based on natural logarithms: $\ln(W) = \ln(a) + b \ln(L)$.

Statistical analyses: Statistical analyses were done using computer software Statistical Package for Social Science (SPSS) version 16.00 and Microsoft Excel 2010.

Condition factor: The Fulton's condition factor (K) was calculated using the following equation, $K = 100 \times (W/L^3)$ (Htun-Han 1978).

Sex Ratio: The ratio between male and female was analyzed using the monthly samples from July to October 2015. A chi-square test was applied to identify the sex ratio from expected value of 1:1 (male: female).

Result and Discussion

Length-frequency distribution: The total length (TL), standard length (SL), fork length (FL), dorsal length (DL), pectoral length (PcL), pelvic length (PvL) and anal length (AL) of *Botia lohachata* were studied. Month and sex based length frequency distributions of these lengths are presented here.

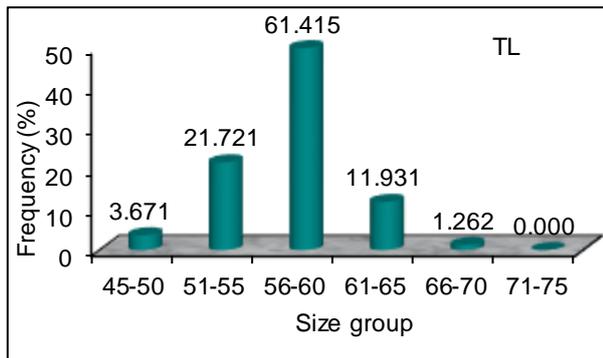
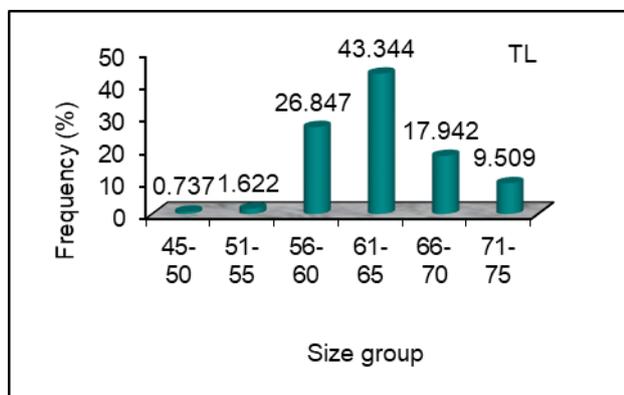
Total length: In case of combined sexes, the highest total length was found in the month of September and the mean (\pm SD) value was 61.16 ± 4.77 mm. The second highest value 61.04 ± 5.26 mm was recorded in month October. The lowest mean total length 58.84 ± 4.79 mm was recorded in month July (Table 1). The highest TL for male was recorded highest 58.17 ± 3.30 mm in the month September and lowest 55.71 ± 2.96 mm in the month July. On the other hand the highest TL for female was found as 63.80 ± 4.79 mm (October) and lowest TL 61.73 ± 4.34 mm (July) (Table 1).

The sex-wise length frequency distributions shown in figure I (male), figure II (female) and III (combined). In case of male, maximum 61.415 % fishes were belonging to the length category of 56-60 mm followed by 51-55mm 21.721% and 61-65mm 11.931% (Figure I).

Table 1: Various Analyses Regarding Total Length (mm) of *Botia lohachata* During Study Months

Month	Sex	n	Min	Max	Total Length (mm)	
					Mean±SD	95% CL
July	Male	24	46	60	55.71±2.96	54.46-56.96
	Female	26	55	71	61.73±4.34	59.98-63.48
	Combined	50	46	71	58.84±4.79	57.48-60.20
August	Male	25	46	83	57.52±6.55	54.82-60.22
	Female	25	50	69	61.76±3.70	60.23-63.29
	Combined	50	46	83	59.64±5.68	58.03-61.25
September	Male	23	52	64	58.17±3.30	56.75-59.60
	Female	27	57	71	63.70±4.36	61.98-65.43
	Combined	50	52	71	61.16±4.77	59.81-62.51
October	Male	20	50	62	57.14±2.67	55.93-58.36
	Female	30	55	74	63.80±4.79	62.01-65.59
	Combined	50	50	74	61.04±5.26	59.55-62.53

On the other hand, in case of female specimens, maximum 43.344% fishes were belonging to the length of 61 to 65 mm followed by 56-60 mm 26.847% and 66 to 70 mm 17.942% (Figure II). In combined sex, maximum 41.896% fishes were belonging to the length of 56 to 60 mm followed by 61 to 65mm 29.680% and 51 to 55 mm and 66 to 70 mm 10.68% (Figure III).

**Figure I: Frequency distribution of male fishes (n=92) according to their total length****Figure II: Frequency distribution of female fishes (n=108) according to their total length**

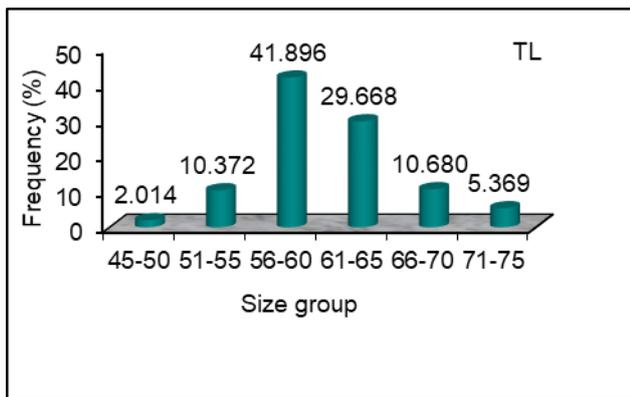


Figure III: Frequency distribution of combined fishes (n=200) according to their total length

Fork length: Details analysis of the length of *Botia lohachata* are presented in table 2. In case of combined sexes, the highest fork length was found in the month of September and the mean (\pm SD) value was 55.28 ± 4.35 mm. The second highest value 54.38 ± 4.54 mm was recorded in month October. The lowest mean total length 52.96 ± 4.39 mm was recorded in month August (Table 2). The highest FL for male was recorded highest 53.00 ± 3.13 mm in the month September and lowest 50.56 ± 3.04 mm in the month August. On the other hand the highest FL for female was found as 57.22 ± 4.34 mm (September) and lowest 55.27 ± 3.86 mm (July) (Table 2).

Table 2: Various Analysis Regarding Fork Length (mm) of *Botia lohachata* During Study Months

Month	Sex	n	Min	Max	Total Length (mm)	
					Mean \pm SD	95% CI
July	Male	24	41	68	50.79 \pm 4.71	48.80 to 52.78
	Female	26	50	63	55.27 \pm 3.86	53.71 to 56.83
	Combined	50	41	67	53.12 \pm 4.81	51.75 to 54.49
August	Male	25	41	57	50.56 \pm 3.04	49.30 to 51.82
	Female	25	44	69	55.36 \pm 4.26	53.60 to 57.12
	Combined	50	41	69	52.96 \pm 4.39	51.71 to 54.21
September	Male	23	48	61	53.00 \pm 3.13	51.65 to 54.35
	Female	27	50	65	57.22 \pm 4.34	55.50 to 58.94
	Combined	50	48	65	55.28 \pm 4.35	54.04 to 56.52
October	Male	20	44	55	51.14 \pm 2.43	50.03 to 52.25
	Female	30	51	66	56.57 \pm 4.28	54.97 to 58.17
	Combined	50	44	66	54.38 \pm 4.54	53.09 to 55.67

Standard Length: Details analysis of the length of *Botia lohachata* are presented in table 3. In case of combined sexes, the highest standard length was found in the month of September and the mean (\pm SD) value was 47.26 ± 4.08 mm. The second highest value 47.16 ± 4.07 mm was recorded in month October. The lowest mean total length 45.42 ± 3.73 mm was recorded in month July (Table 3).

The highest SL for male was recorded highest 44.83 ± 2.10 mm in the month September and lowest 43.13 ± 2.46 mm in the month July. On the other hand the highest SL for female was found as 49.33 ± 4.23 mm (September) and lowest SL 47.54 ± 3.46 mm (July) (Table 3).

Table 3: Various Analysis Regarding Standard Length (mm) of *Botia lohachata* During Study Months

Month	Sex	n	Min	Max	Total Length (mm)	
					Mean±SD	95% CI
July	Male	24	36	45	43.13±2.46	42.09 to 44.16
	Female	26	42	54	47.54±3.46	46.14 to 48.93
	Combined	50	36	54	45.42±3.73	44.36 to 46.48
August	Male	25	36	51	43.32±2.78	42.17 to 44.47
	Female	25	38	60	47.92±3.88	46.32 to 49.52
	Combined	50	36	60	45.62±4.07	44.46 to 46.78
September	Male	23	41	48	44.83±2.10	43.92 to 45.74
	Female	27	43	63	49.33±4.23	47.66 to 51.01
	Combined	50	41	63	47.26±4.08	46.10 to 48.42
October	Male	20	38	52	44.43±2.80	43.15 to 45.70
	Female	30	42	57	49.03±3.68	47.66 to 50.41
	Combined	50	38	57	47.16±4.07	46.00 to 48.32

Body Depth: Details analysis of the body depth of *Botia lohachata* are presented in table 4. In case of combined sexes, the highest body depth was found in the month of October and the mean (\pm SD) value was 11.00±1.20 mm. The lowest mean body depth 10.54±1.05 mm was recorded in month August. (Table 4). The highest Bd for male was recorded highest 10.39±0.72 mm in the month September and lowest 10.20±1.00 mm in the month August. On the other hand the highest Bd for female was found as 11.58±1.17 mm July and lowest 10.88±1.01 mm August (Table 4).

Table 4: Various Analysis Regarding Body Depth (mm) of *Botia lohachata* During Study Months

Month	Sex	n	Min	Max	Total Length (mm)	
					Mean±SD	95% CI
July	Male	24	8	11	10.33±0.87	9.97 to 10.70
	Female	26	9	14	11.58±1.17	11.10 to 12.05
	Combined	50	8	14	10.98±1.20	10.64 to 11.32
August	Male	25	8	12	10.20±1.00	9.79 to 10.61
	Female	25	9	13	10.88±1.01	10.46 to 11.30
	Combined	50	8	13	10.54±1.05	10.24 to 10.84
September	Male	23	9	12	10.39±0.72	10.08 to 10.70
	Female	27	10	13	11.48±0.98	11.10 to 11.87
	Combined	50	9	13	10.98±1.02	10.69 to 11.27
October	Male	20	9	12	10.33±0.86	9.94 to 10.72
	Female	30	9	14	11.47±1.17	11.03 to 11.90
	Combined	50	9	14	11.00±1.20	10.66 to 11.34

Dorsal Length: Details analysis of the length of *Botia lohachata* are presented in table 5. In case of combined sexes, the highest dorsal length was found in the month of September and the mean (\pm SD) value was 24.68±1.83 mm. The lowest mean dorsal length 23.60±1.96 mm was recorded in month July (Table 5).

The highest DL for male was recorded highest 23.57±1.34 mm in the month September and lowest 22.58±1.44 mm in the month July. On the other hand the highest DL for female was found as 25.63 ±1.67 mm (September) and lowest 24.54±1.92 mm (July) (Table 5).

Table 5: Various analysis regarding dorsal length (mm) of *Botia lohachata* during study months

Month	Sex	n	Min	Max	Total Length (mm)	
					Mean±SD	95% CL
July	Male	24	19	26	22.58±1.44	21.97 to 23.19
	Female	26	22	29	24.54±1.92	23.76 to 25.32
	Combined	50	19	29	23.60±1.96	23.04 to 24.16
August	Male	25	19	26	22.72±1.46	22.12 to 23.32
	Female	25	20	27	24.76±1.48	24.15 to 25.37
	Combined	50	19	27	23.74±1.78	23.23 to 24.25
September	Male	23	21	26	23.57±1.34	22.98 to 24.15
	Female	27	23	29	25.63±1.67	24.97 to 26.29
	Combined	50	21	29	24.68±1.83	24.16 to 25.20
October	Male	20	20	25	22.90±1.26	22.33 to 23.48
	Female	30	23	29	25.33±1.63	24.73 to 25.94
	Combined	50	20	29	24.32±1.92	23.77 to 24.87

Pectoral Length: Details analysis of the length of *Botia lohachata* are presented in table 6. In case of combined sexes, the highest pectoral length was found in the month of September and the mean (\pm SD) value was 12.06 ± 0.87 mm. The lowest mean pectoral length 11.80 ± 0.83 mm was recorded in month August (Table 6). The highest PcL for male was recorded highest 11.76 ± 0.60 mm in the month August and lowest 11.48 ± 0.75 mm in the month October. On the other hand the highest PcL for female was found as 12.52 ± 0.85 mm (September) and lowest 11.84 ± 1.03 mm (August) (Table 6).

Table 6: Various Analysis Regarding Pectoral Length (mm) of *Botia lohachata* During Study Months

Month	Sex	n	Min	Max	Total Length (mm)	
					Mean±SD	95% CI
July	Male	24	10	12	11.71±0.62	11.44 to 11.97
	Female	26	11	15	12.38±0.94	12.00 to 12.76
	Combined	50	10	15	12.06±0.87	11.81 to 12.31
August	Male	25	10	13	11.76±0.60	11.51 to 12.01
	Female	25	10	15	11.84±1.03	11.42 to 12.26
	Combined	50	10	15	11.80±0.83	11.56 to 12.04
September	Male	23	11	12	11.65±0.49	11.44 to 11.86
	Female	27	11	15	12.52±0.85	12.18 to 12.85
	Combined	50	11	15	12.12±0.82	11.89 to 12.35
October	Male	20	10	12	11.48±0.75	11.13 to 11.82
	Female	30	11	14	12.30±0.84	11.99 to 12.61
	Combined	50	10	14	11.96±0.90	11.70 to 12.22

Pelvic Length: Details analysis of the length of *Botia lohachata* are presented in table 7. In case of combined sexes, the highest pelvic length was found in the month of September and the mean (\pm SD) value was 25.38 ± 1.69 mm. The lowest mean pelvic length 24.90 ± 1.87 mm was recorded in month July (Table 7). The highest PvL for male was recorded highest 24.52 ± 0.99 mm in the month September and lowest 23.83 ± 1.46 mm in the month July. On the other hand the highest PvL for female was found as 26.13 ± 1.36 mm October and lowest 25.88 ± 1.66 mm July and August (Table 7).

Table 7: Various Analysis Regarding Pelvic Length (mm) of *Botia lohachata* During Study Months

Month	Sex	n	Min	Max	Total Length (mm)	
					Mean±SD	95% CI
July	Male	24	19	26	23.83±1.46	23.21 to 24.45
	Female	26	24	29	25.88±1.66	25.22 to 26.55
	Combined	50	19	29	24.90±1.87	24.37 to 25.43
August	Male	25	19	27	24.24±1.54	23.61 to 24.87
	Female	25	21	29	25.88±1.48	25.27 to 26.49
	Combined	50	19	29	25.06±1.71	24.57 to 25.55
September	Male	23	23	26	24.52±0.99	24.09 to 24.95
	Female	27	20	29	26.11±1.83	25.39 to 26.83
	Combined	50	20	29	25.38±1.69	24.90 to 25.86
October	Male	20	21	26	24.00±1.22	23.44 to 24.56
	Female	30	24	29	26.13±1.36	25.63 to 26.64
	Combined	50	21	29	25.24±1.68	24.76 to 25.72

Anal length: Details analyses of the length of *Botialohachata* are presented in table 8. In case of combined sexes, the highest anal length was found in the month of September and the mean (\pm SD) value was 37.10 ± 3.17 mm. The lowest mean anal length 36.12 ± 2.95 mm was recorded in month July (Table 8). The highest AL for male was recorded highest 35.74 ± 1.45 mm in the month September and lowest 34.25 ± 2.03 mm in the month July. On the other hand the highest AL for female was found as 38.33 ± 2.70 mm October and 37.64 ± 1.98 mm in the month of August (Table 8).

Table 8: Various analysis regarding anal length (mm) of *Botia lohachata* during study months

Month	Sex	n	Min	Max	Total Length (mm)	
					Mean±SD	95% CI
July	Male	24	28	24	34.25±2.03	33.39 to 35.11
	Female	26	34	43	37.85±2.62	36.79 to 38.90
	Combined	50	43	43	36.12±2.95	35.28 to 36.96
August	Male	25	28	41	34.68±2.36	33.71 to 35.65
	Female	25	35	42	37.64±1.98	36.82 to 38.46
	Combined	50	28	42	36.16±2.62	35.42 to 36.90
September	Male	23	31	38	35.74±1.45	35.11 to 36.37
	Female	27	25	43	38.26±3.76	36.77 to 39.75
	Combined	50	25	43	37.10±3.17	36.20 to 38.00
October	Male	20	26	37	34.43±2.54	33.27 to 35.59
	Female	30	34	44	38.33±2.70	37.33 to 39.34
	Combined	50	26	44	36.74±3.28	35.81 to 37.67

Length-Length Relationship: The relationship between total length (TL) and fork length (FL), total length (TL) and standard length (SL), total length (TL) and body depth (BD), total length (TL) and dorsal length (DL), total length (TL) and pectoral length (PcL), total length (TL) and pelvic length (PcL), total length (TL) and anal length (AL) were studied in this study. The various results obtained from the study are mentioned here.

The Relationship between Total Length (TL) and Fork Length (FL): Relationship between total length (TL) and fork length (FL) in male, female and both or combined sexes are presented in Figure IV, V, VI, respectively. The values of $R^2=0.9434$ for male specimens, 0.9687 for female specimens and 0.9712 for combined sexes.

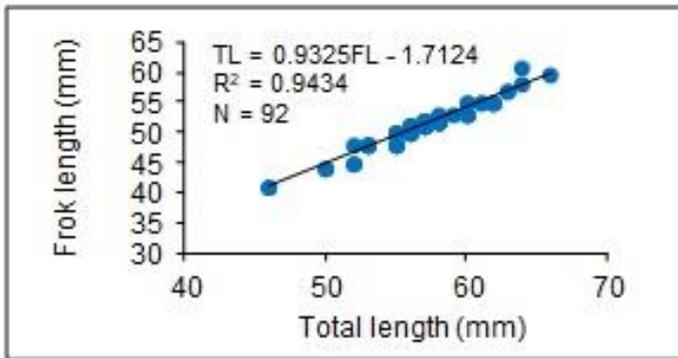


Figure IV: Relationship between total length (TL) and fork length (FL) in male

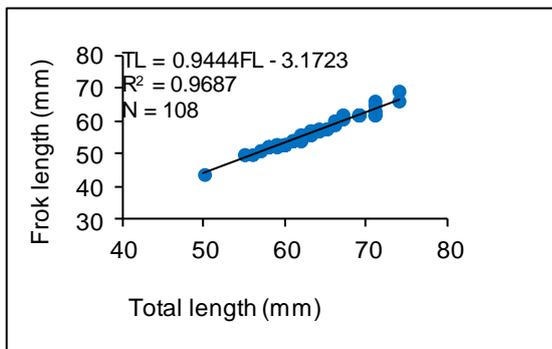


Figure V: Relationship between total length (TL) and fork length (FL) in female

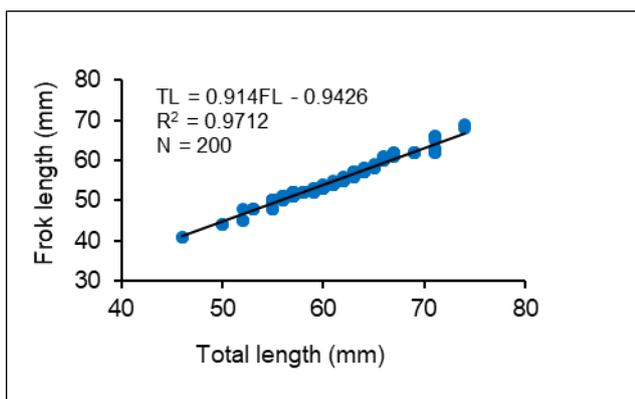


Figure VI: Relationship between total length (TL) and fork length (FL) in combined sexes

The relationship between total length (TL) and standard length (SL): Relationship between total length (TL) and standard length (SL) in male, female and both or combined sexes are presented in fig.VII, VIII, and IX respectively. The values of $R^2=0.9548$ for male specimens, 0.9505 for female specimens and 0.9664 for combined sexes. **The relationship between total length (TL) and body depth (BD):** Relationship between total length (TL) and body depth (BD) in male, female and both or combined sexes are presented in fig.X, XI, and XII respectively. The values of $R^2=0.9348$ for male specimens, 0.924 for female specimens and 0.9318 for combined sexes.

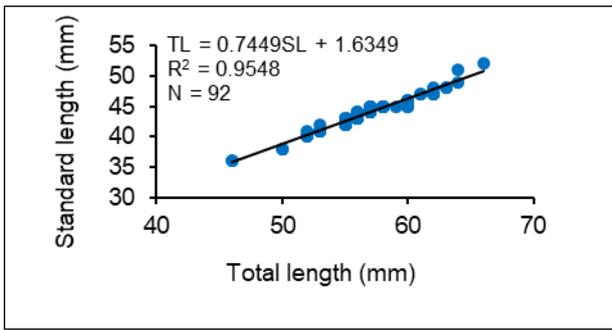


Figure VII: Relationship between total length (TL) and standard length (SL) in male

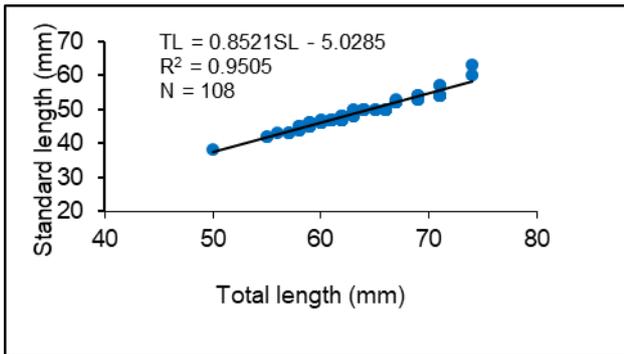


Figure VIII: Relationship between total length (TL) and standard length (SL) in female

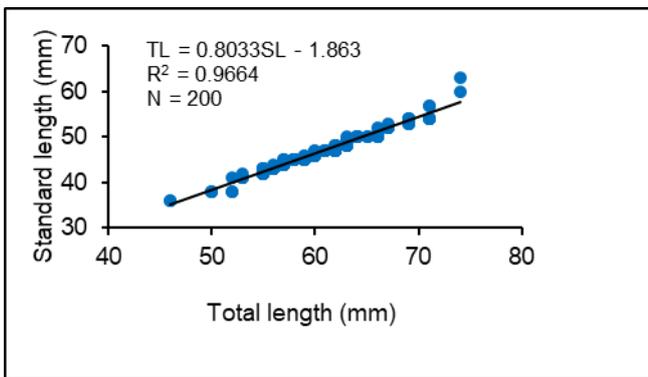


Figure IX: Relationship between total length (TL) and standard length (SL) in combined sexes

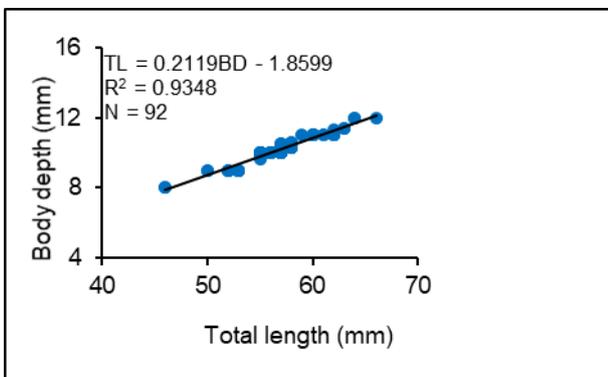


Figure X: Relationship between total length (TL) and body depth (BD) in male

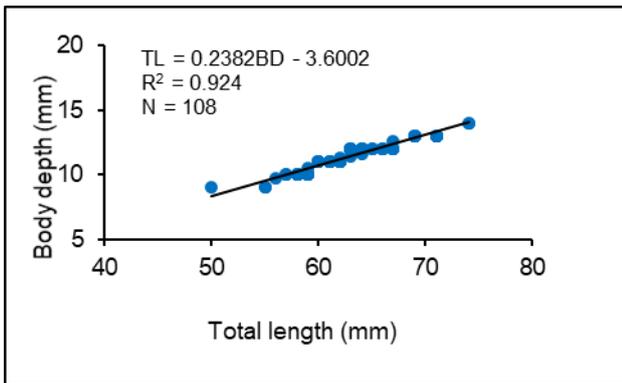


Figure XI: Relationship between total length (TL) and body depth (BD) in female

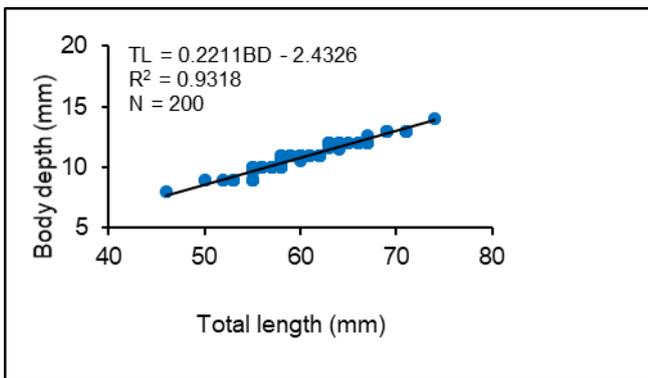


Figure XII: Relationship between total length (TL) and body depth (BD) in combined sexes

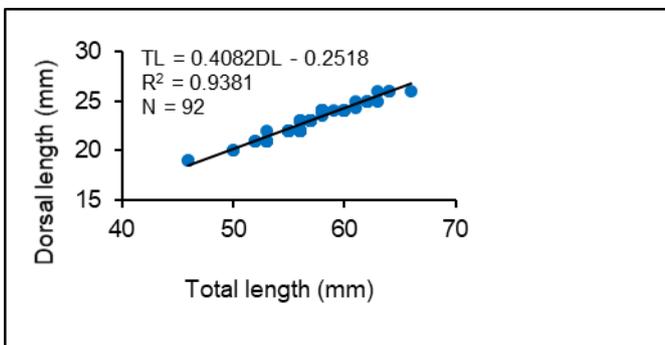


Figure XIII: Relationship between total length (TL) and dorsal length (DL) in male

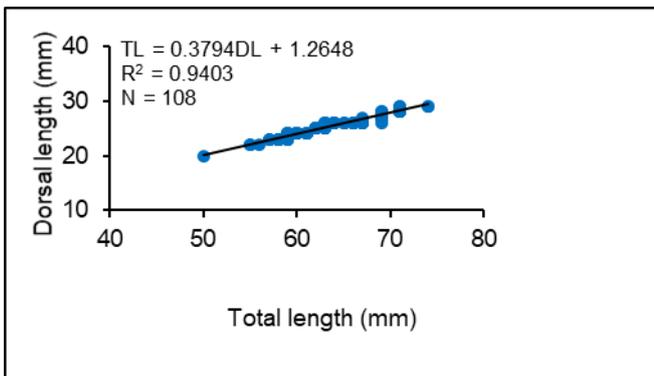


Figure XIV: Relationship between total length (TL) and dorsal length (DL) in female

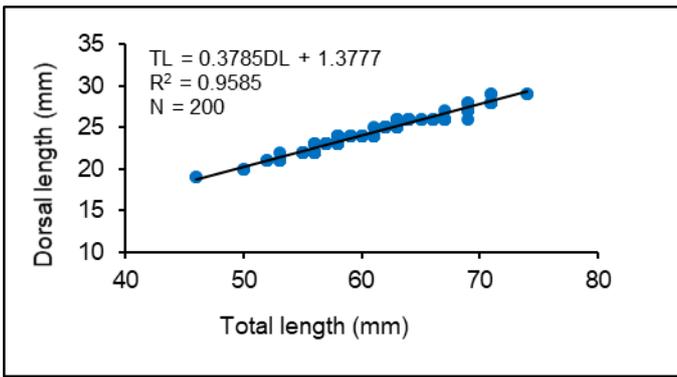


Figure XV: Relationship between total length (TL) and dorsal length (DL) in combined sexes

The relationship between total length (TL) and dorsal length (DL): Relationship between total length (TL) and dorsal length (DL) in male, female and both or combined sexes are presented in fig.XIII, XIV, and XV respectively. The values of $R^2=0.9381$ for male specimens 0.9403 for female specimens and 0.9585 for combined sexes.

The relationship between total length (TL) and pectoral length (PcL): Relationship between total length (TL) and pectoral length (PcL) in male, female and both or combined sexes are presented in fig.XVI, XVII, and XVIII respectively. The values of $R^2=0.9137$ for male specimens 0.921 for female specimens and 0.9147 for combined sexes.

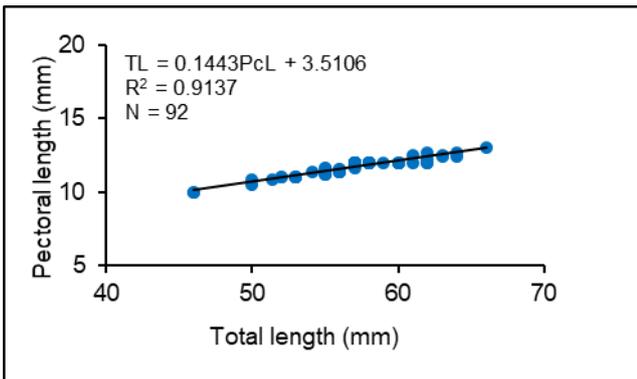


Figure XVI: Relationship between total length (TL) and pectoral length (PcL) in male

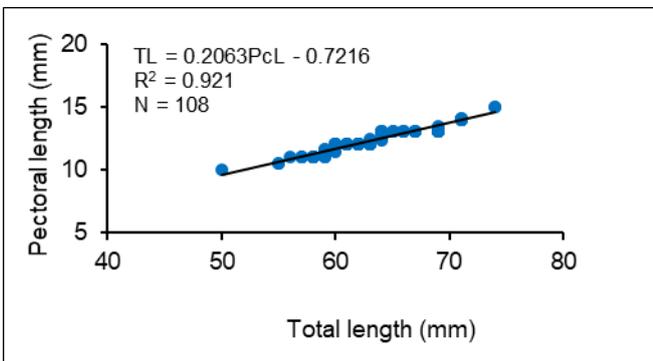


Figure XVII: Relationship between total length (TL) and pectoral length (PcL) in female

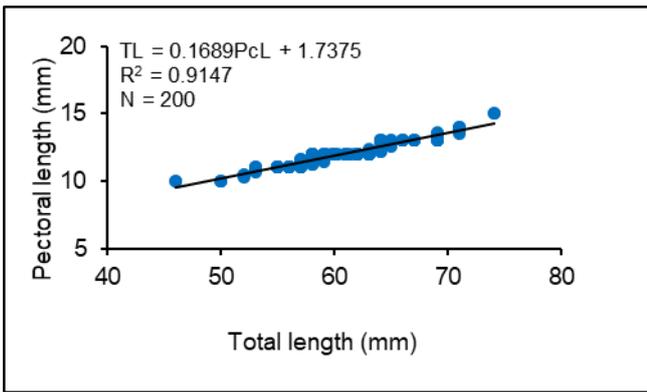


Figure XVIII: Relationship between total length (TL) and pectoral length (PcL) in combined sexes

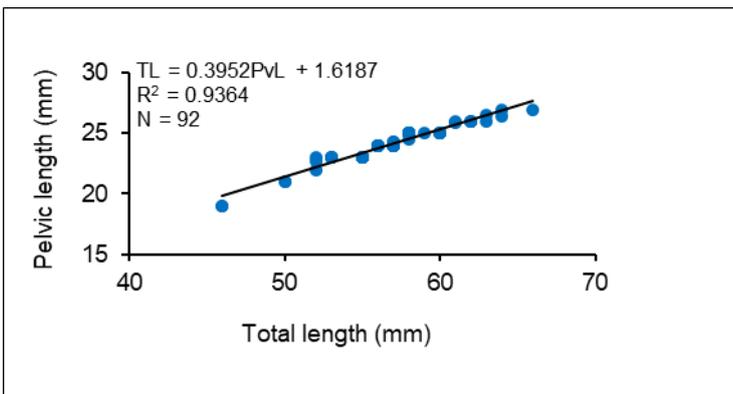


Figure XIX: Relationship between total length (TL) and pelvic length (PvL) in male

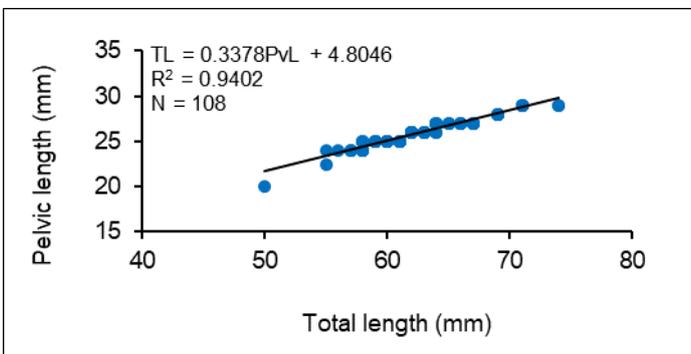


Figure XX: Relationship between total length (TL) and pelvic length (PvL) in female

The Relationship between Total Length (TL) and Pelvic Length (PvL): Relationship between total length (TL) and pelvic length (PvL) in male, female and both or combined sexes are presented in fig.XIX, XX, and XXI respectively. The values of $R^2=0.9364$ for male specimens 0.9402 for female specimens and 0.9442 for combined sexes.

The relationship between total length (TL) and anal length (AL): Relationship between total length (TL) and anal length (AL) in male, female and both or combined sexes are presented in figure XXII, XXIII, XXIV respectively. The values of $R^2=0.9216$ for male specimens 0.9289 for female specimens and 0.9467 for combined sexes.

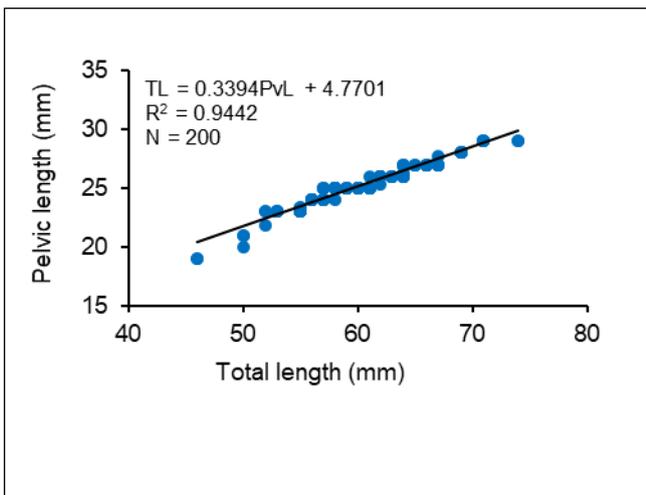


Figure XXI: Relationship between total length (TL) and pelvic length (PvL) in combined sexes

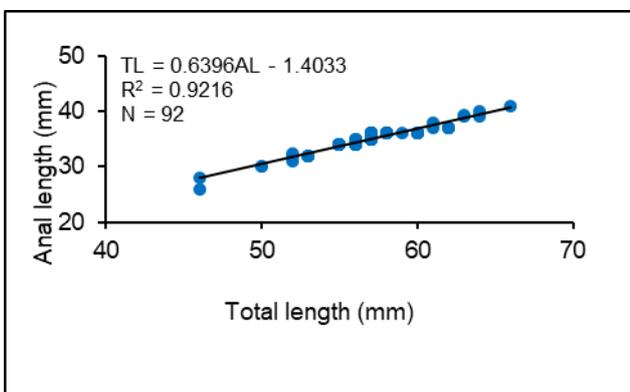


Figure XXII: Relationship between total length (TL) and anal length (AL) in male

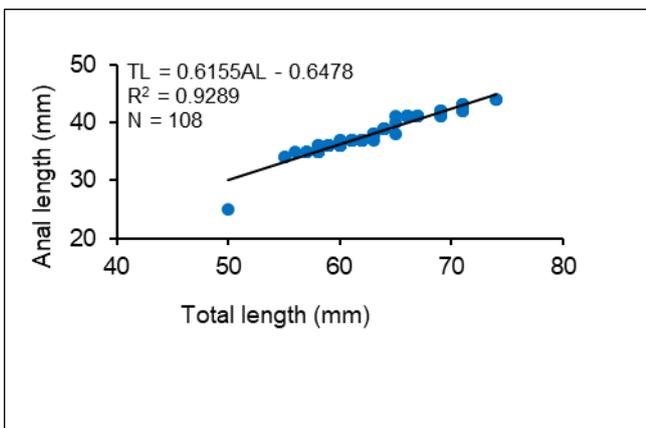


Figure XXIII: Relationship between total length (TL) and anal length (AL) in female

Length-Weight Relationship: The various analysis regarding the body weight of *Botia lohachata* were performed to understand the different variables. These results are presented here under different headings.

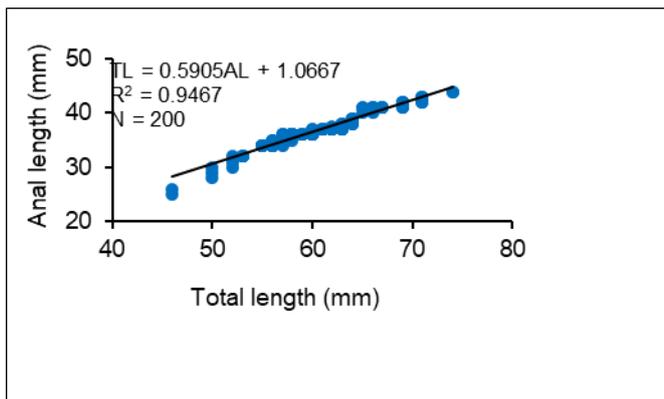


Figure XXIV: Relationship between total length (TL) and anal length (AL) in combined sexes

Table 9: Relationship status among various lengths

Relation type	Sex	n	Regression Parameters		
			a	b	R ²
TL vs. FL	Male	92	-1.7124	0.9225	0.9434
	Female	108	-3.1723	0.9444	0.9687
	Combined	200	-0.9426	0.9140	0.9712
TL vs. SL	Male	92	1.6349	0.7449	0.9548
	Female	108	-5.0285	0.8521	0.9505
	Combined	200	-1.8630	0.8033	0.9664
TL vs. BD	Male	92	-1.8599	0.2119	0.9348
	Female	108	-3.6002	0.2382	0.9240
	Combined	200	-2.4326	0.2211	0.9318
TL vs. DL	Male	92	-0.2518	0.4082	0.9381
	Female	108	1.2648	0.3794	0.9403
	Combined	200	1.3777	0.3785	0.9585
TL vs. PcL	Male	92	3.5106	0.1443	0.9137
	Female	108	-0.7216	0.2063	0.921
	Combined	200	1.7375	0.1689	0.9147
TL vs. PvL	Male	92	1.6187	0.3952	0.9364
	Female	108	4.8046	0.3378	0.9402
	Combined	200	4.7701	0.3394	0.9442
TL vs. AL	Male	92	-1.4033	0.6396	0.9216
	Female	108	-0.6478	0.6155	0.9289
	Combined	200	1.0667	0.5905	0.9467

Body weight (BW) estimation: The various analysis regarding the body weight of *Botia lohachata* is table 10. In case of combined sexes, the highest mean(\pm SD) body weight 2.67 ± 0.71 g was recorded in the month of October. The lowest body weight was recorded in the month of August which was 2.26 ± 0.61 g (Table 10).

Table 10: Various Analyses Regarding the Body Weight of *Botia lohachata* of Study Months

Month	Sex	n	Min	Max	Total Length (mm)	
					Mean \pm SD	95% CI
July	Male	24	1.09	2.21	1.90 \pm 0.30	1.77-2.02
	Female	26	1.74	3.67	2.72 \pm 0.55	2.49-2.94

	Combined	50	1.09	3.67	2.32±0.61	2.15-2.50
August	Male	25	1.09	3.24	1.88±0.51	1.67-2.09
	Female	25	1.27	3.45	2.64±0.45	2.46-2.83
	Combined	50	1.09	3.45	2.26±0.61	2.09-2.44
September	Male	23	1.34	2.98	2.25±0.38	2.08-2.41
	Female	27	2.22	3.78	3.01±0.52	2.81-3.22
	Combined	50	1.34	3.78	2.66±0.60	2.49-2.83
October	Male	20	1.27	2.62	2.08±3.20	1.93-2.22
	Female	30	2.43	4.65	3.10±0.59	2.88-3.31
	Combined	50	1.27	4.65	2.67±0.71	2.47-2.88

In case of female, the highest mean (±SD) body weight 3.10±0.59 g was recorded in the month of September. The lowest body weight was recorded in the month of August which was 2.64±0.45g (Table 10). On the other hand, in case of male, the highest mean (±SD) body weight 2.25±0.38g was recorded in the month of September. The lowest body weight was recorded in the month of August which was 1.88±0.51 g (Table 10).

Relationship between total length (TL) and body weight (BD): The relationship between total length (TL) and body weight (BD) among male, female and combined sexes are shown in figures XXV, XXVI and XXVII. In cases, the value of R2 was found high indicating strong correlation between total length and body weight (Fig. XXV, XXVI and XXVII).

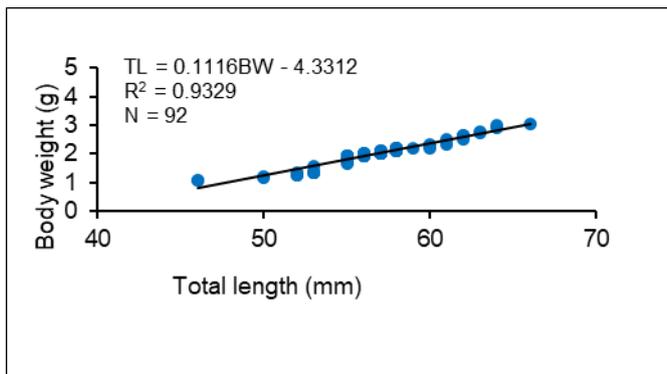


Figure XXV: Relationship between total length (TL) and body weight (BD) in male

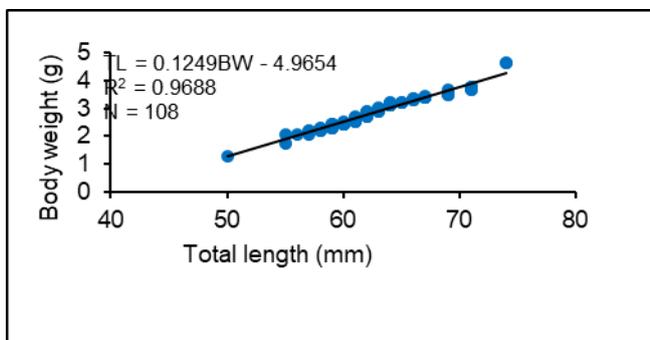


Figure XXVI: Relationship between total length (TL) and body weight (BD) in female

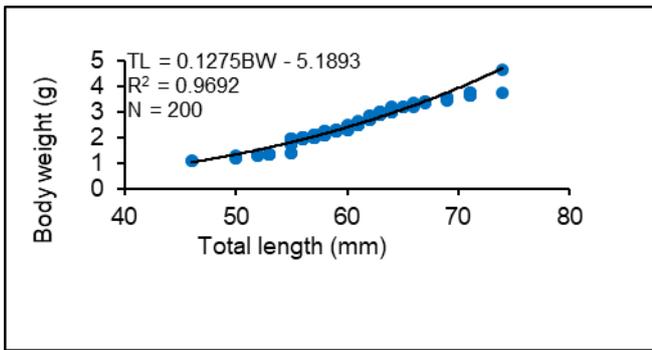


Figure XXVII: Relationship between total length (TL) and body weight (BD) in combined sex

Sex-ratio: A total of 200 specimens were examined and studied during the period of study. Fifty specimens were collected each month from the Kompo River and selected in each month for study. 54% specimens were female and remaining 46% specimens were male (Fig. XXVIII).

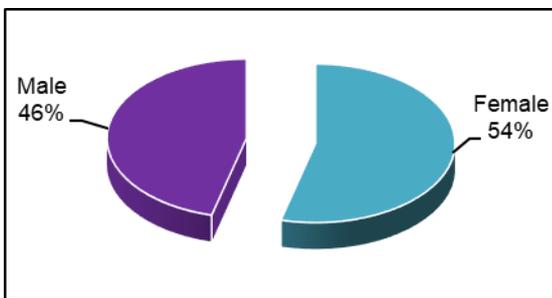


Figure XXVIII: Sex ratio of studied fish specimens

From the results of chi-square test, it was revealed that the overall sex ratio (Female=108, male=92; male:female =1: 1.17) of *Botia lohachata* in the Kompo river during the study period was not significantly differed from the expected value 1:1. The value of chi-square (χ^2) was found 2.4 at 1 degree of freedom (df) ($p < 0.05$) which strongly indicates that the observed sex ratio not significantly differs from the expected ratio (Table 11). Month wise results of chi-square test regarding sex ratio are in table 11. The results have shown that there were no significantly different in sex ratio from the expected ratio in all months (Table 11).

Table 11: Results of chi-square test in order to determine the sex ratio

Month	Male	Female	Total	Ratio (M:F)	χ^2 , df=1	P value	Significance
July	24	26	50	1:1.08	0.08	5.063	ns
August	25	25	50	1:1.00	0	9.660	ns
September	23	27	50	1:1.17	0.32	4.381	ns
October	20	30	50	1:1.50	2.0	2.902	ns
Total	92	108	200	1:1.17	2.4	5.045	ns

ns=not significantly different

Condition factor: Month and sex wise Fulton's condition factors are shown in table 12. In case of combined sexes, the highest condition factor 1.156 ± 0.126 was recorded in month of October and lowest condition factor 1.066 ± 0.205 was recorded in month of August (Table 12 and Fig XXIX). In case of female, the highest condition factor 1.190 ± 0.136 was recorded in month of October and lowest condition factor 1.114 ± 0.095 was recorded in month of August (Table 12 and Fig 4.30). In case of male, the highest condition factor 1.135 ± 0.103 was recorded in month of September and lowest condition factor 1.019 ± 0.268 was recorded in month of August (Table 12 and Fig XXXI).

Table 12: Fulton’s condition factors of *Botia lohachata*

Month	Sex	n	Condition factor (K)			
			Min	Max	Mean±SD	95% CL
July	Male	24	0.900	1.166	1.088±0.065	1.060-1.115
	Female	26	0.821	1.399	1.147±0.121	1.098-0.821
	Combined	50	0.821	1.399	1.118±0.101	1.090-1.147
August	Male	25	0.536	1.631	1.019±0.268	0.909-1.130
	Female	25	0.969	1.354	1.114±0.095	1.074-1.153
	Combined	50	0.536	1.631	1.066±0.205	1.008-1.125
September	Male	23	0.900	1.437	1.135±0.103	1.090-1.179
	Female	27	0.975	1.399	1.160±0.103	1.119-1.201
	Combined	50	0.600	1.437	1.148±0.103	1.119-1.178
October	Male	21	0.900	1.231	1.106±0.093	1.064-1.149
	Female	30	1.008	1.647	1.190±0.136	1.139-1.241
	Combined	50	0.900	1.647	1.156±0.126	1.120-1.191

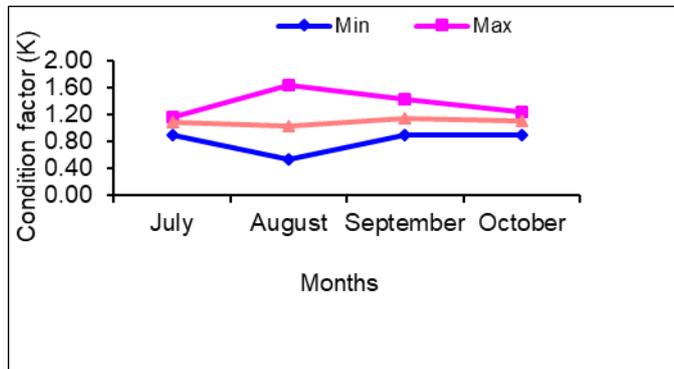


Figure XXIX: Fulton’s condition factor (K) in different month in male

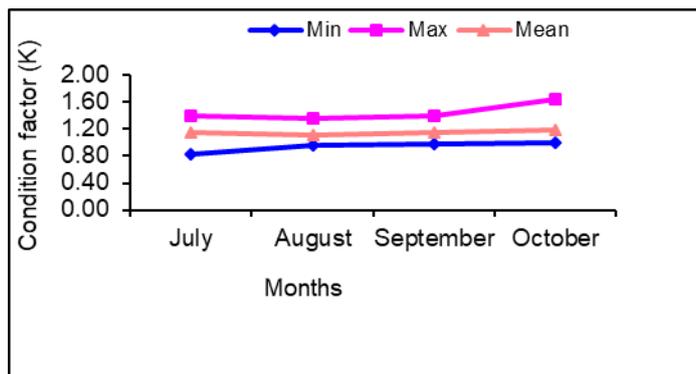


Figure XXX: Fulton’s condition factor (K) in different month in female

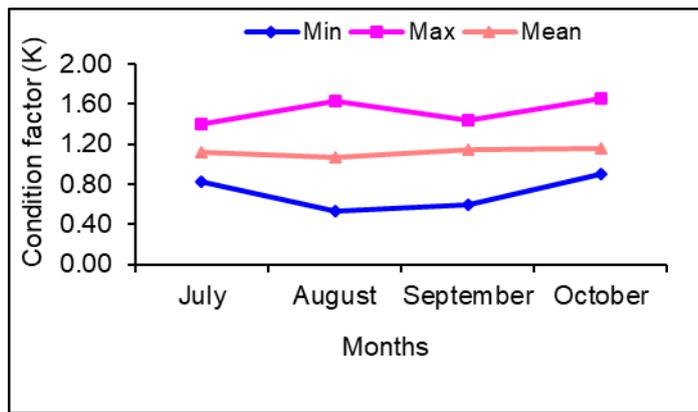


Figure XXXI: Fulton's condition factor (K) in different month in combined sexes

Conclusion

Though the amount of catch of *B. lohachata* is not much in water bodies of Bangladesh but it is important from the point of view of biological conservation. The present research findings would help to update and enhance the existing morphological measurements of *B. lohachata* in both Bangladesh and outside the country. Condition factors would allow biologist to understand its population status and future success. Further in depth research efforts on other aspects of *B. lohachata*, which are not included in present study, are recommended.

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