E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2020; 8(2): 108-111

www.fisheriesjournal.com
Received: 11-01-2020
Accepted: 15-02-2020

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Studies on the length-weight variations of an indigenous edible fish *Chela atpar* (Hamilton, 1822) collected from freshwater riverine ecosystem of India

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Abstract
Chela atpar is an indigenous edible freshwater fish having high market demand because of it's nutritive value, palatable taste, easily digestible etc. It has been noticed by several workers as well as fishermen also that the *Chela* fish population is declining rapidly; it may be due to some biological and environmental factors or anthropogenic activities and it has been categorized as lower risk to be threatened (IUCN, 2010). Present study reveals on the length-weight relationship of *Chela atpar* collected from freshwater Kangsabati river in two different seasons; i, e. one in winter (January to March, 2017) and another in monsoon (July to September 2017). Length of experimented fishes ranged from 6.8 cm to 14.47 cm and weight ranged from 2.24 gm to 17.48 gm in winter. In monsoon length ranged from 10.87 cm to 14.85 cm and weight ranged from 5.97 gm to 13.50 gm. To calculate length weight relationship Le Cren formula is used, $W = a + L^b$. 'w'=Weight, 'L' = length, 'a' = constant, 'b' =an exponent. Length, weight data area converted into logarithmic form then graphically plotted. In both cases scattered diagram show linear relationship. In winter correlation coefficient value is significant at 0.01 level (2-tailed) and in monsoon it is at 0.05 level (2-tailed). Correlation result indicates that the relationship in winter is more significant than monsoon. Regression analysis show result or R^2 in winter is 0.872 and in monsoon is 0.0536.

Keywords: Kangsabati River, length weight relationship, different seasons, correlation, regression

Introduction
Chela atpar (Hamilton, 1822) [14] is a genus of small cyprinid freshwater fish from South Asia. Country wise it is distributed in Bangladesh, northern and eastern India and Pakisthan (Talwar and Jhingran, 1991) [22]. It is reported by IUCN, 2010 that this fish is threatened. Fishes inhabit in ponds, ditches, rivers in plain and sub mountain regions (Menon, 1999) [13]. Fishes breed freely in ponds, tanks and small streams (Talwar and Jhingran, 1991) [22]. Length-weight relationship is one of the scientific tool for demonstrating the survival, growth, maturity, reproduction and general well being of fishes (Le Cren, 1951) [11]. It has been widely used in fisheries biology with several purposes to predict weight from known length, to calculate standing crop age structure and function of fish population, growth study, to make seasonal differences etc. It also helps in comparison among regions (Petrakis and Stergiou, 1995; Gonclaves *et al.*, 1997; Haimovici and Velasco, 2000; Ozaydin *et al.*, 2007) [16, 6, 7, 15]. Thus this parameters are of great importance in fisheries assessment, more important to save fishes from exploitation and management of fish population (Haimovici and Velasco, 2000) [7]. The Chakraborty *et al.*, (2019) [4] stated that, the seasonal variations of length–weight relationship of *Mystus vittatus* shows positive correlation in maximum cases but in few cases indicate negative allometric growth pattern due to scarcity of food.

Materials and Methods
A total no. of 58 fish species belonging to all available sizes of both male and female are collected from Kangsabati river of Midnapore Town. Latitude and longitude of Midnapore town is 22.4257^0N and 87.3199^0E respectively.

Experimental layout
Specimens are collected at random basis in two different seasons. Here, two seasons are winter

and monsoon. In case of winter experimental period is January 2017 to March 2017, whereas in case of monsoon it is from July 2017 to September 2017. A total number of 30 specimens are observed in winter and 28 specimens are in summer.

Collection of specimens

Fishes are collected from Kangsabati river with fishing net (Gill net/ cast net) by the help of fisherman and directly kept in ice bag containing ice. The ice acts as preservative which delay the decomposing rate.

Experiment

In the laboratory fishes are blotted and air dried, only to measure actual weight and remove mucus from outer surface. Length is measured by a graduated scale from the tip of the mouth to end of the tail in cm. Weight is measured by an electric balance in gm, results are recorded in an exercise book. Length weight data are analyzed by the proposed formula of Le Cren, 1951 [11]. The equation is $W = a L^b$ where 'W' = total weight of fish in gm, 'L'= total length of fish in cm, 'a'= constant 'b'= co-efficient indicating isometric growth if the value is equal to 3.0 (Wooton, 1990) [23]. If the result of 'b' is greater than 3, it indicates positive allometric growth and if the result of 'b' is less than 3, it indicates negative allometric growth (Levent *et al.*, 2007) [12]. If the equation is expressed in logarithmic form it will be Log w = Log a + b Log L. Calculated length-weight values are graphically plotted, which is shown in scattered diagrams.

Data analysis

To calculate correlation, regression statistics, ANOVA, t-test SPSS software and MS-EXCEL have been used.

Results

The result of statistical analysis are shown in tables-below. Observations are done in two seasons one in winter and another in monsoon. In both cases measured length-weight data are converted into logarithmic form by MS-EXCEL to estimate length-weight relationship. Then the logarithmic results are graphically plotted which is shown in the form of scatted diagram. Fig. 1 represents length-weight data of winter seasons and Fig. 2 is of Monsoon. Both cases Figures are showing that relationship is linear.

Results of correlation are presented in Table No. 1 and 2. Table No. 1 is showing the result of correlation in winter and Table No. 2 in monsoon. In winter correlation is significant at the 0.01 level (2 tailed). In monsoon correlation is significant at the 0.05 level (2-tailed).

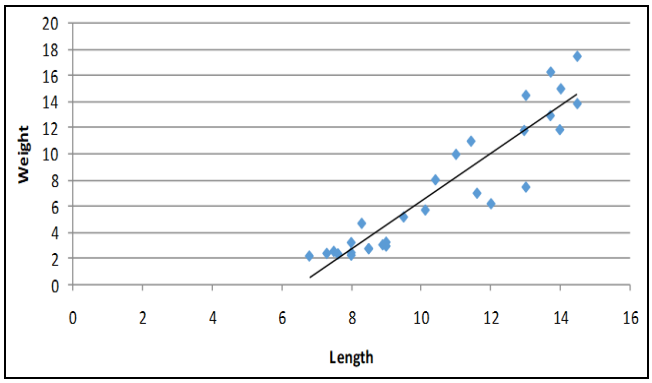

Fig 1: Length weight relationship of experimental fishes in winter season.

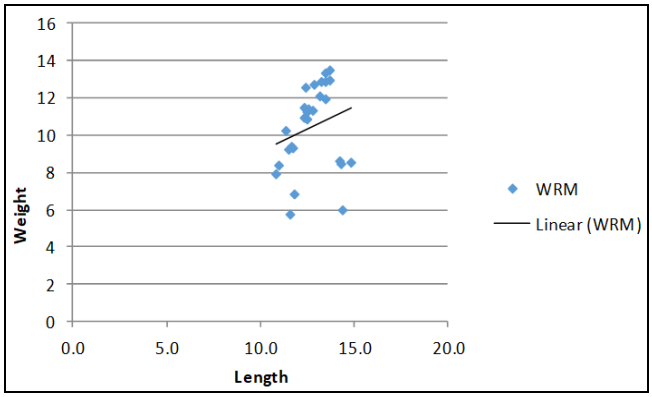

Fig 2: Length weight relationship of experimental fishes in monsoon season.

Table 1: Correlation result of experimental fishes during winter seasons

Correlations		
	LRW	WRW
LRW	1	
WRW	.934**	1
**. Correlation is significant at the 0.01 level (2-tailed).		

Table 2: Correlation result of experimental fishes during monsoon

	Correlations		
		LRW	**WRW**
LRW	Correlation Coefficient	1	.342*
WRW	Correlation Coefficient	.342*	1
*. Correlation is significant at the 0.05 level (2-tailed).			

By the help of MS-EXCEL regression statistics has done both in case of winter and monsoon. Table No. 3 is showing the regression statistics of winter and Table No. 4 is for monsoon. In case of winter the value of R^2 is 0.872. a = - 11.901 and b = 1.829. In case of Monsoon the value of R^2 is 0.053694. a = 11.585, b = 0.1111. Significance of regression is tested through ANOVA.

Table 3: Regression Result of experimental fishes during winter

Summary Output	
Regression Statistics	
Multiple R	0.9338326
R Square	0.8720434
Adjusted R Square	0.8674735
Standard Error	1.8184516
Observations	30

ANOVA					
	df	**SS**	**MS**	**F**	**Significance F**
Regression	1	631.01076	631.010762	190.82412	5.023E-14
Residual	28	92.589454	3.30676622		
Total	29	723.60022			

	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**	**Lower 95.0%**	**Upper 95.0%**
Intercept	-11.90109926	1.418406336	-8.390472434	0.00	-14.80657289	-8.995625633	-14.80657289	-8.99562563
LRW	1.829506604	0.132439443	13.81391047	0.00	1.558216707	2.100796501	1.558216707	2.100796501

Table 4: Regression Result of experimental fishes during monsoon

Summary output	
Regression Statistics	
Multiple R	0.231718959
R Square	0.053693676
Adjusted R Square	0.017297279
Standard Error	1.064581801
Observations	28

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	1.671948	1.671948	1.475247	0.235436
Residual	26	29.46669	1.133334		
Total	27	31.13864			

	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**	**Lower 95.0%**	**Upper 95.0%**
Intercept	11.58564837	0.974336	11.89081	0.0000	9.582871	13.58843	9.582871	13.58843
WRM	0.111113628	0.091482	1.214597	0.2354	-0.07693	0.299157	-0.07693	0.299157

Discussion

The discussion is fully based on the outcome of experimental results. To find out length-weight relationship of fishes we used a formula proposed by Le Cren that is $w = a L^b$. Here two variables are present. One is length and another is 'weight'. It is supposed to that 'Length' is dependent variable and 'weight' is independent variable. 'B' is an exponent. In two observed case result of 'b' is less than 3. It proves negative allometric growth patterns in experimental fishes, neither isometric not positive. These results indicate fishes are favoured to increase in length than in mass in that particular river and its surrounding environment. Earlier study reported on length weight relationship on catfish performed by Paiboon Panase and Kriangsak Mengumpha, 2015 [18] and showed negative growth pattern where 'b' values were 2.63 and 2.03. Awasthi *et al.*, 2015 [3] estimated length weight relationship on *Trichogonter lalius* from different pond ecosystem of eastern and central regions of India. The study showed negative allometric growth pattern. K.C. Nagar and M.S. Sharma observed length-weight relationship on *Chela bacaila* and found 'b' value 2.743 (Female), 2.950 (Male), 2.887 (both sex) all values are lower than 3, shows negative allometric growth. Fig.1 and Fig.2 showing almost linear relationship. Result of correlation prove a significant relationship between length and weight. But in winter, result of correlation is significant at 0.01 level (2-tailed) and in monsoon the result is significant at 0.05 level (2-tailed). By these two correlation results it can be explained that relationship in winter is more significant than in monsoon, because, the result of monsoon is lower (0.05 level) than winter (0.01 level). It may be due to some environmental factors which inhibit growth rate, may be some water parameters which inhibits growth rate or some physiological factors which are responsible for it. In regression statistics the result of R^2 is 0.872 in winter and monsoon is 0.0536. These two values are significant and establish a strong relationship between two parameters. Pal *et al.*, 2013 [14] reported length-weight relationship on *Puntius sphore*, where R^2 value was 0.871 which was significant. Analysis of regression statistics or result of Anova again conclude that almost significant relationship between two parameters. But in winter weight significantly explain length whereas in monsoon length does not explain weight significantly. It may be due to change in water parameters as heavy rainfall occurs, mixing of pesticides from cultivated field through excess rain water when fields are flooded and field washed water flows into river. Thus, it may inhibits the fishes to grow in weight during monsoon.

Conclusion

Based on result of length-weight relationship and seasonal variation of *Chela atpar* in Kangsabati river it is clear that fishes are showing negative growth pattern mainly in monsoon than winter. This phenomenon in useful in fishing management and care should be taken to maintain aquatic ecosystem. Study of length-weight relationship is important to analyze the anatomy and physiology of fishes. This information will helps in assessing variation of different fishes as well as to measure weight from known length and vice-versa, to measure biomass. It is also an indirect way to obtain information of their declining.

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