



Length-Weight Relationship and Condition Factor of *Schizothorax plagiostomus* found in River Jhelum from Kashmir Valley

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Abstract

Length weight relationship is important in describing several biological aspects of fish species found under cultured and natural condition. Length weight relationship provides information about whether somatic growth was isometric or allometric. While condition factor provide information about the well being fish. In the present study the individuals of *Schizothorax plagiostomus* were collected from river Jhelum from different locations for the determination of length weight relationship and condition factor during the period of 2014–2016. Length weight relationship was computed using the equation $W = aL^b$, which was further transformed into $\text{Log}W = \text{Log}a + b\text{Log}L$. Results showed that the value of b in length weight relationship of male *S. plagiostomus* ranged from 2.316–2.965, while in female fishes the value of b ranged from 2.01–3.66. The results clearly show allometric type of growth in male and isometric type of growth in females. The regression coefficient between males and female did not shows any significant difference, ($p > 0.05$) whereas significant difference ($P < 0.01$) could be noticed between males and between females ($p < 0.01$). However, condition factor (K) of *S. plagiostomus* fluctuates between 0.82–1.58 in male and between 0.870–1.31in female, indicating the robustness of the fish inhabiting in river Jhelum.

Keywords: Condition Factor, Jhelum, Length Weight, *Schizothorax plagiostomus*

1. Introduction

Length-weight Relationship (LWR) studies of fishes is considered as an important tool for understanding of fish health status. Length-weight Relationship of fishes is also important in fisheries and fish biology as its allow the estimation of the average weight of the fish of a given length group by establishing a mathematical relation between them⁶. Length-weight Relationships have broadly been used for the conversion of growth-in-length equations to growth-in-weight for use in stock assessment models in order to estimate the stock assessment, relate the life histories of certain species and other changing aspects of fish population^{2,32,48,31,51} Nile *et al.*, 2013;. Like any other morphometric characters, the LWR can be used as a character for the differentiation of taxonomic units and the relationship changes with the various developmental events. In addition, the Length-weight Relationship indicates the degrees of stabilization of taxonomic characters in fish species and very useful in the management and exploitation of fish populations³⁹. Growth of fish, usually indicated

through increase in length and weight which is considered as the most appropriate characteristic to determine the population analysis at a particular time²¹. Now a days study of Length-weight Relationships (LWRs) of threatened fish species are the most important biological parameters to provide information about the growth and condition of fish species as well as entire fish community and are highly significant for management and conservation of natural populations^{43,33}. Fulton's condition factor (k) is extensively used in fisheries and fish biology studies. This factor refers to the well-being of a certain species and its degree of fatness which depends on the weight of the fish^{38,13}. Condition factor reflects the variations by interaction among feeding conditions, parasitic infection and physiological factors and recent physical and biological circumstances^{24,5,49,28}. The study of condition assumes that heavier organisms of a given length are in better physical state, therefore, condition indices are used in fishery sciences as indicators of the length-weight-relationship of a population. Condition factor also helps to reflect the feeding conditions of the species.

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2. Material and Method

Our study estimates LWRs of indigenous cold water species *Schizothorax plagiostomus* belonging to family Cyprinidae and order Cypriniformes. The samples of *S. plagiostomus* were collected from 2014–2016 from locations of river Jhelum of Kashmir valley with the help of fisherman. After collection, the samples were brought into wet laboratory Department of Zoology, University of Kashmir and the required measurement of length and weight were taken by using digital caliper and digital weighing balance, respectively. The total length of fish was measured to its nearest 0.01 cm and total body weight was measured to its near 0.01 g. The total length of fish was taken from the tip of snout to the extended tip of the caudal fin and the relationship was analyzed by measuring length and weight of fish specimen collected from study area. The statistical relationship between these parameters of fishes was analyzed with the help of allometric equation by Forese (2006).

$$W = aL^b$$

Where W = Total weight (g).

L = length of fish (cm).

a = Initial growth coefficient.

B = Slope or the growth coefficient.

The value of constants 'a' and 'b' was estimated by linear regression after logarithmic transformation of weight and length data by using formula:

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

2.1 Determination of Condition Factor

Condition factor is used for comparing the condition, fatness or well-being of fish, based on the assumption that heavier fish of a given length are in better condition. The coefficient of condition 'K' was calculated using¹⁵ equation:

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

Where, W = weight (g), L = length (cm) and 100 is a factor to bring the value of K near unity.

3. Results

The Length-weight Relationship of *S. plagiostomus* representing male, female and pooled (both sexes) are presented in Figure 1, Figure 2 and Figure 3, respectively. The equations thus derived in respect of Length-weight Relationship are as follows:

Females: $\log W = 1.764 + 2.895 \log L$

Males: $\log W = 1.690 + 2.736 \log L$

Combined: $\text{Log}W = 1.656 + 2.7145 \log L$

In the present study increase in 'b' value in male fish showed deviation from cube law throughout the annual period as negative allometric growth was observed throughout the annual period i.e $b < 3$. The growth coefficient was minimum in March (2.315) and maximum was observed in July (2.965). The

coefficient of determination 'r²' fluctuates from 0.90 (January) to 0.990 in (June) as shown in Table 1. In case of females the value of 'b' also indicated deviation from cube law throughout annual period except, May, July and August were value of $b > 3$. However, this was to be attributed to the fact that during these months presence of high food availability and favorable environmental temperature, as compared to rest of months. This has led to almost ideal growth pattern of the fish. During annual period the female *S. plagiostomus*, shows coefficient of determination oscillates between (July) 0.901 to 0.975 in October (Table 2). The month wise Fulton's condition factor, of male, *S. plagiostomus* ranged from 0.82 to 1.583 and it was observed highest in the month of June followed in the month of July and December, respectively while lowest value was recorded in the month of September followed by January. Whereas in case of female, *S. plagiostomus* the condition factor values are in the range of 0.870–1.31 with highest condition factor was recorded in the month of June followed by July, October and lowest value was recorded in the month of April followed March and January, respectively (Table 3). The variation of condition factor in both male and female *Schizothorax plagiostomus* is depicted in Figure 4.

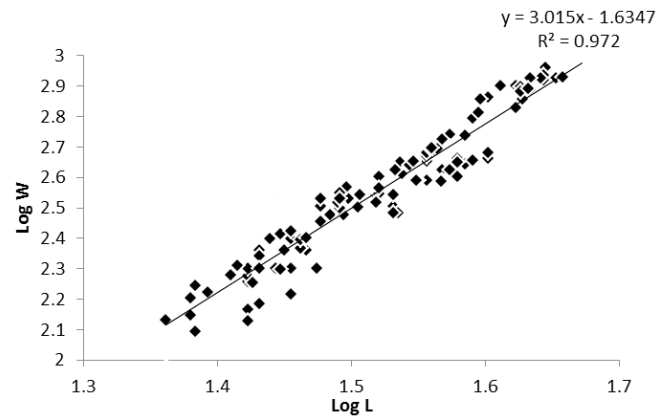


Figure 1. Depicts Length-Weight Relationship of *Schizothorax plagiostomus* (Male).

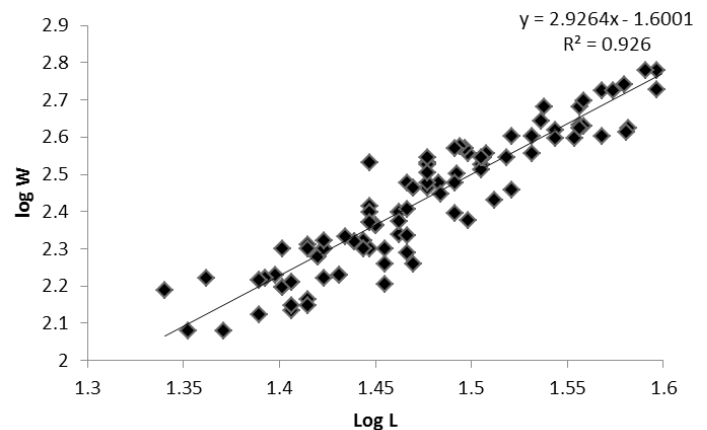


Figure 2. Depicts Length-Weight Relationship of *Schizothorax plagiostomus* (Female).

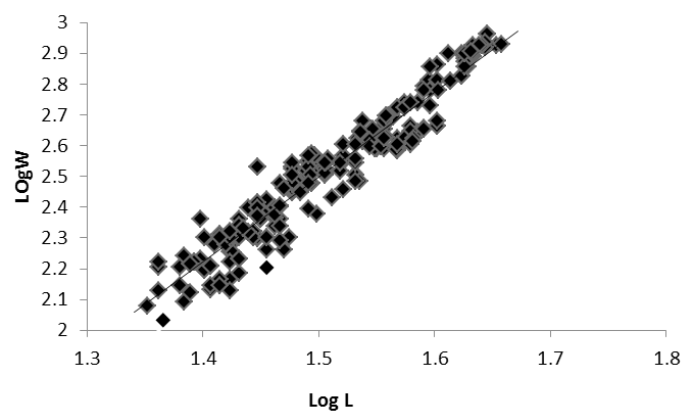


Figure 3. Depicts Length-Weight Relationship of *S. plagiostomus* Combined.

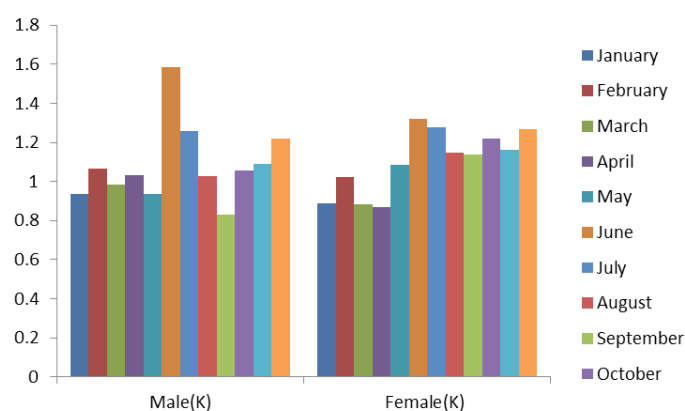


Figure 4. Depicts month wise condition factor of both male and female *S. plagiostomus*

Table 1. Month wise Length-Weight Relationships of *S. plagiostomus* (Males) in river Jhelum from Kashmir valley

Months	N	Total Length (cm)		Total Weight (gm)		Regression Parameters $W = aL^b$		r^2
		Min.	Max.	Min.	Max.	a	b	
January	12	30	37	295	323	1.789	2.564	0.905
February	12	26	31	210	310	1.876	2.435	0.935
March	12	28	36	290	360	1.764	2.315	0.956
April	12	24	32	230	310	1.564	2.316	0.946
May	12	30	38	300	375	1.734	2.356	0.976
June	12	23	29	240	280	1.489	2.563	0.990
July	12	27	39	290	370	2.670	2.965	0.908
August	12	29	34	280	340	1.785	2.435	0.911
September	12	31	36	285	325	1.297	2.927	0.959
October	12	29	37	295	310	1.786	2.433	0.921
November	12	31	35	295	335	1.234	2.315	0.901
December	12	30	35	288	310	1.456	2.198	0.965
Mean ± SD		28.16 ± 2.65	34.91 ± 2.96	274.83 ± 30.21	329 ± 28.30	1.70 ± 0.36	2.48 ± 0.23	0.93 ± 0.03

Table 2. Month wise of length-Weight relation of *S. plagiostomus* (Female) in river Jhelum from Kashmir valley

Months	N	Total Length cm		Total Weight (gm)		Regression Parameters $W = aL^b$		r^2
		Min.	Max.	Min.	Max	a	b	
January	12	32	37	326	360	1.573	2.897	0.936
February	12	28	35	272	415	1.786	2.887	0.949

Months	N	Total Length cm		Total Weight (gm)		Regression Parameters $W = aL^b$		r^2
		Min.	Max.	Min.	Max	a	b	
March	12	31	38	310	345	1.674	2.967	0.917
April	12	32	36	320	365	1.789	2.980	0.938
May	12	31	37	312	390	1.897	3.665	0.917
June	12	26	30	240	295	1.906	2.762	0.926
July	12	28	35	245	340	2.098	3.016	0.975
August	12	29	38	285	370	2.790	3.013	0.921
September	12	28	34	225	290	1.798	2.091	0.911
October	12	29	36	320	335	2.765	2.011	0.901
November	12	28	34	295	345	1.980	2.754	0.913
December	12	27	35	210	310	1.786	2.781	0.933
Mean ± SD		29.08 ± 1.97	3541 ± 2.19	280 ± 40.79	346.66 ± 3694	0.39 ± 1.98	2.81 ± 043	0.92 ± 0.01

Table 3. Month wise condition factor of male and female *S. plagiostomus* in river Jhelum from Kashmir valley

Months	Male (K)	Female (K)
January	0.935 ± 0.263	0.890 ± 0.156
February	1.067 ± 0.084	1.021 ± 0.160
March	0.984 ± 0.307	0.882 ± 0.229
April	1.034 ± 0.484	0.870 ± 0.143
May	0.937 ± 0.248	1.086 ± 0.360
June	1.583 ± 0.381	1.318 ± 0.151
July	1.257 ± 0.173	1.277 ± 0.269
August	1.026 ± 0.186	1.149 ± 0.106
September	0.829 ± 0.123	1.139 ± 0.261
October	1.054 ± 0.087	1.221 ± 0.018
November	1.088 ± 0.234	1.164 ± 0.176
December	1.218 ± 0.208	1.216 ± 0.271

4. Discussion

The Length Weight Relationship of fish has significant importance in studying the growth, gonadal development, general well being of fish population and for comparing life history of fishes^{24,38,40}. Fisheries management and research often requires the use of biometric relationships in order to transform data collecting from the field into appropriate indices³⁷. Studies on the Length Weight Relation of fishes constitutes an important tool in fishery biology and helps to understand whether variations from the expected weight for the known groups are the indicators of fatness, well-being and gonadal development in relation to the environment^{4,24,50}. In the present study, the 'b' value was found higher in females as compared to males. The highest 'b' value in females of *S. plagiostomus* implies that the females gain weight at a faster rate in relation to its length. The b value of males indicates negative allometric, which indicates that, the increase in length is not in accordance with increase in weight. Similar results were observed by Dar et al. (2012) in *Schizopyge esocinus*. Le Cren (1951) had reported that females are heavier than males of the same length probably because of difference in fatness and gonadal development. The slope value of regression line less than '3' has been reported in Tortor (Malhotra, 1982), *Labeo dero* (Malhotra and Chauhan, 1984), *Labeo dyocheilus* (Malhotra, 1985), *Cyprinus communis* and *Ctenopharyngodon idella* (Dhanze and Dhanze, 1997) and *Rasbora daniconius* (Sunil, 2000). According to Ruz Campos, 2010, the b value ranged from a minimum of 2.863 for reef fin spot (*Paraclinus integripinnis*) to 3.404 for the fluffy sculpin (*Oligocottus snyderi*). All the earlier reports are in compliance with the present study in which the b value was very close to isometric value of 3 and this indicates that *S. plagiostomus* in the present study showed an isometric growth. Also it is well known that the functional regression b value represents the body form and is directly related to the weight affected by ecological factors habitat, area, seasonal effects, degree stomach fullness, gonad maturity, sex, health, preservation techniques and differences in the observed length ranges of the captured specimens^{29,17,18} (Ricker, 1973). Several workers reported positive allometric growth in freshwater fish; notable among them are^{20,34,23,9,19,45,30,42,35} in *Cirrhina mrigala*, *Catla catla*, *Labeo bata*, *Labeo rohita*, *Pristolepis fasciata*, *Pangasius pangsius*, *Pseudorasbora parva* and *Macragnathus aculeatus* respectively. The greater value of 'b' mainly depends on shape and fatness of individuals of fish. Isometric growth was also reported by (Haniffa et al., 2006; Serajuddin et al., 2013; Kashyap et al., 2015) in *Channa punctatus* collected from lentic and lotic water bodies. According to Copp et al. (2013), the isometric body growth of *Barbatula barbatula* changes to allometric type when it reaches a certain standard length in order to become an adult. This indicates that body growth type sometimes changes accordingly to their physiology needs. Allen, (1938) have reported that the cube law is applicable only for those species which maintain the form and specific gravity throughout their life, but the shape and

the form of fish may change with time, so the Length-weight relationship of most of fish species may deviate the cube law. The value of 'b' reported by Bhat et al. (2010) for *S. labiatus* differs from the present study, which is possibly due to several factors such as habitat, number of specimens examined and length ranges and length types used. Qadri and Mir (1980) reported the value of 'b' as 2.4487 for *S. plagiostomus* from the peripheral water bodies of Dal Lake, where as⁷ have reported the 'b' value of *S. plagiostomus* (2.928) for the same fish from Jammu water bodies. Our results are in conformity with the earlier reports of Bhagat and Sunder (1983); Qadri and Mir (1980); Bhat (2010). In general it has been observed that the 'b' values reported of snow trout species from this part of the world are within the range of 2.5 to 3.5 which are considered as normal 'b' value as reported by¹⁴. The b values observed in this study were significantly below 3 which mean that the *S. plagiostomus* in river Jhelum exhibited negative allometric growth pattern except few months in case of females. Finally, the Length-weight relationships and condition factor presented here will provide useful information for fisheries management and fish population dynamic studies. Therefore, the results of the present study can serve as baseline data for these species and for comparisons with future studies.

5. Acknowledgements

The author is grateful to the Head, Department of Zoology, University of Kashmir, Hazratbal, Srinagar, India for providing the laboratory facilities and gratefully acknowledge the financial support from the Department of Biotechnology (DBT), Govt of India, New Delhi on Fish Nutrition and Diet development program. Thanks are also due to Mr. Mufti Buhran, University Chief Executive Engineer for helping the construction of new Feed Technology Laboratory (Wet-Lab.) in the Department of Zoology.

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