

Preliminary studies on the length weight relationship and condition factor of *Schizothorax labiatus* (McClelland, 1842) from Vishav stream of South Kashmir, India

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ABSTRACT

Among the Schizothoracine family of class pisces commonly known as snow trouts, the *Schizothorax labiatus* is economically a valuable food fish possessing a wide market demand. The length-weight relationship, morphometrics and condition factor (K) in *S. labiatus* were investigated on the samples collected during late autumn and winter months from Vishav stream at different sites. Analysis of 41 fish specimen which ranged in length from 15.2cm to 36cm and 29g to 364.3g in weight revealed the range in coefficient of variation in morphometric measurements from 14.12% to 24.51%, being maximum (24.51%) in anal fin length (AL) and minimum (14.12%) in case of eye diameter (ED). Correlation coefficient 'r' between different morphometric parameters show significant variation being maximum between total length (TL) and standard length (SL) with value of 'r=1' and the minimum degree of correlation was seen between head length (HL) and inter orbital length (IOL) with minimum value of 'r=0.82'. Regarding the length-weight relationship, the coefficient of correlation 'r' obtained for males, females and pooled were 0.989, 0.938 and 0.948 respectively, indicating a positive correlation between length and weight. The regression coefficient 'b' separately obtained for male, female and for pooled were 3.1701, 2.7867 and 3.0098 respectively, indicating the positive allometric growth pattern in case of males as compared to females during these months. The paper also throws light on condition factor of the fish of both the sexes during these months which showed a significant decrease from late autumn to winter months, which can be attributed to changing water quality parameters, low feeding intensity and spawning stress in the fish.

Key words: Condition factor (K), morphometrics, *Schizothorax*, length weight, condition factor, spawning stress, Vishav stream.

1. INTRODUCTION

The valley of Kashmir which is situated between 33° 01' – 34° 08' N lat. and 74° 47'–74° 49' E longitude at an average altitude of 1550 m above msl in the midst of Himalayas, is drained by the river Jhelum and a number of perennial streams and tributaries on both sides. Among these streams, the Vishav stream forms one of its important perennial tributary having Kounsarnag its main source and bearing a catchment area of 1230 sq kms. This stream is bestowed with different habitat features which facilitate the preferred habitat qualities to different varieties of indigenous as well as some exotic fishes. Among them, the most common fish species include *S.*

plagiostomus, *S. labiatus*, *S. esocinus*, *S. curvifrons*, *Triplophysa* spp, *Glyptothorax* spp, *Crossocheilus diplochilus* and some carp species viz., *Cyprinus carpio communis* and *C. c. specularis*.

Fish like many other animal species are subjected to phenotypic variations of their shape and size due to the prevailing ecological factors of their habitat because morphology is an outcome of ecological feature and ecological factors can induce phenotypic changes [1, 2, 3, 4] that result in various taxonomic categories. Morphometrics i.e. the measurement of continuous characteristics describing the various aspects of such body morphology, is an important tool in fishery biology to measure stock discreteness and relationships among various taxonomic categories [5, 6,7]. Study on length-weight relationship in fishes is of great importance because it reveals an important conclusions on various aspects of fish biology and establishes a mathematical relation to determine average weight of a given fish from length of an individual fish [8, 9] to study growth patterns in a fish population and to convert growth-in-length equations to growth-in-weight for prediction of weight-at-age [10]. A general conclusion can be drawn from the studies of length weight relationship regarding the gonad development, maturity and condition of fish [11, 12]. In order to study the growth patterns in fish, the allometric growth formula follows [13] which describes the relationship between length and weight, but the real observations, however, strictly do not obey the cube law and the equilibrium constant shows certain variability around '3' [12]. When the fish grows isometrically the relationship is valid and in such cases the exponential value is exactly '3'. But due to environmental conditions, the actual relationship between length and weight may depart from the ideal value [12].

The schizothoracine subfamily of pisces are commonly known as snowtrouts because they are confined to snow fed rivers and streams. *S. labiatus* locally called as 'chush', is an indigenous cold freshwater and much prized food fish of Kashmir valley belonging to family cyprinidae. This species first reported by Silas (1960) [14], is recognized by streamlined and elongated body, with rounded lower jaw, 'D' shaped mouth with lips restricted to wide lateral flaps and possessing two pairs of barbels on head region [15]. Studies on the various aspects of fish biology of schizothoracine have been made by a number of researchers across the Indian sub-continent but little information is available on the length-weight relationship of *S. labiatus* from Vishav stream. Therefore the ongoing research study was undertaken in order to establish the growth patterns and general condition of fish from such an important wild habitat for culture, conservation and management assessment and population comparison of the species under study.

2. MATERIALS AND METHODS

2.1. Sample Collection:

During the present five month study, 41 number of fish specimen were collected at different sites of Vishav stream from late October 2017 to February 2018, ranging from 15.2cm to 36cm in length and 29g to 364.3g in weight, by using different types of fishing gears. The samples were identified by their morphological features following [15, 16]. Various morphometric characters (in cm) were measured in laboratory with the help of a Vernier calliper to the nearest 0.1 cm and the body weights were measured with digital balance to the nearest 0.1 g for each fresh individual. Morphometric characters were measured by following standard methods [17, 18,

19]. The morphometric characters measured were total length (TL), standard length (SL), pre-dorsal length (PDL), pre-pectoral length (PPL), pre-pelvic length (PPeL), pre-anal length (PAL), head length (HL), snout length (SnL), body depth (BD), eye diameter (ED) and caudal fin length (CL). Relationships between various body measurements to the total length and head length have been established.

2.2. Length-Weight relationship:

The determination of length weight relationship was made by applying the log transformation of allometric equation, $W=aL^b$ [12] to the data as,

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

Where, W = Total weight of the fish in grams.

L = Total length of the fish in cm.

a = intercept

b = Regression coefficient or slope of the regression curve or slope of the growth

2.3. Condition Factor (K):

The coefficient of condition, 'K' was determined by using the equation $K=W \times 100 / L^3$ [11]

Where, W is the weight of fish in g and L is the total length in cm.

3. RESULTS

3.1. Morphometric parameters:

Morphometric parameters of *S. labiatus* and their range, mean, standard deviation and coefficient of variation is presented in table 1, wherein it was found that the coefficient of variation ranges from 14.12% to 24.51%. Maximum coefficient of variation of 24.51% was shown by anal fin length (AL) and the minimum coefficient of variation of 14.12% was shown by eye diameter (ED). Similarly the standard deviation (SD) values for morphometric parameters ranged from minimum 0.13 for eye diameter (ED) to a maximum value of 5.16 for total length (TL). Table 2 reveals the relationship between various morphometric parameters, wherein the value of correlation coefficient 'r' and also the constants 'a' and 'b' regarding various morphometric relationships are depicted. The table 2 reveals that the degree of correlation varies between different morphometric parameters. Among the characters which were compared, the highest degree of correlation was seen between total length (TL) and standard length (SL) with maximum 'r' value of '1' and the minimum degree of correlation was seen between head length (HL) and inter orbital length (IOL) with minimum 'r' value of 0.82.

3.2. Length-weight relationship:

The regression equations calculated from the data of length and weight for males, females and pooled or combined ones were scatter plotted separately as shown in fig.1 – fig.3 and is represented as:

Male: $\text{Log } W = 3.1701 \text{ Log } L - 2.2991$ ($R^2 = 0.9788$)

Female: $\text{Log } W = 2.7867 \text{ Log } L - 1.7774$ ($R^2 = 0.8801$)

Pooled/Combined: $\text{Log } W = 3.0098 \text{ Log } L - 2.0905$ ($R^2 = 0.9672$)

The above equations clearly indicated that the male and female specimen of *S. labiatus* exhibited difference in the value of exponent “b”, being higher in case of males ($b = 3.1701$) than females ($b = 2.7867$) which clearly indicated that the weight gain is more in case of males than females. The higher value of ‘b’ in case of males revealed the positive allometric growth pattern. The value of coefficient of correlation ‘r’ in case of males, females and combined ones were found to be 0.989, 0.938 and 0.948 indicating the significant positive correlation between the length and weight of the fish.

Condition factor:

The condition factor (K) of *S. labiatus* is represented in table 3, wherein it clearly indicated its variation from October to February. In case of males, the value of “K” is higher in the month of October ($K=0.82$) and lowest in the month of December ($K=0.01$). In case of females, the value of “K” is higher in the month of November ($K=0.86$) and lowest in the month of January ($K=0.01$). In general as indicated by the condition factor (K) of the pooled one, the table revealed that the value of “K” goes on decreasing from October ($K=0.05$) to February ($K=0.01$). The “K” value categorization mentions the “K” values as; 1.60 (excellent), 1.40 (good), 1.20 (fair), 1.00 (poor) and 0.80 (extremely poor) [20]. To apply this classification for the present study, the condition of this very fish from October to February is extremely poor.

4. DISCUSSION

The morphometric analysis of fish is an important parameter to study fish biology and taxonomy [1, 21, 22]. In the present study a significant positive correlation was observed between growth of all parameters with respect to total length wherein the value of “r” ranges from 0.86 to 1. Similar kind of results were during noticed during morphometric studies of Schizothoracines in River Lidder of Kashmir wherein the results revealed a positive correlation coefficient of total length with other parameters under comparison and the correlation coefficient ‘r’ of total length with standard length was observed to be maximum ($r = 0.999$) compared to all other parameters studied [23]. Similar kind positive correlations among all parameters with total length were also observed by other workers [24, 25].

The study of length-weight relationship is of great importance in fish bioecology, as it assists in understanding growth patterns and the general wellbeing in a fish population because length-weight relationship of fish show variation depending upon the condition of life in aquatic environment [26]. Ideally, the regression coefficient “b” of a fish should be very close to 3.0 [27], but the cube law does not hold good throughout the life period of fish and the weight gain may not be always cube of its length gain [28]. The “b” values of the present study conform to the suggestion of researchers [29, 30] that the value of “b” may range between 2.5 and 4.0. As far the growth of fish is concerned, the value of “b” equal to three indicate isometric growth and other values of “b” indicate allometric growth [31]. In this study more positive allometric growth pattern was observed in case of male *S. labiatus* where value of $b=3.170$ and is slightly higher than three and negative allometric growth pattern was followed by female *S. labiatus* wherein value of $b=2.7867$. Higher values of “b” in case of males were also reported by other workers [32, 33]. Therefore the present work revealed that studied fish species did not

followed the cube law completely. Similar kind of departure from cube law has been observed by other ichthyologists also [34, 35, 36, 37 and 38]. The changes in “b” value may be attributed to changing ecological conditions, trophic potential potential of aquatic environment, food availability and sex [12, 39, 40].

In the present study the condition factor shows significant decrease from autumn to winter months being higher in autumn and lesser in winter. The differences in “K” values during different seasons could be attributed to low feeding intensity and degeneration of ovaries during winter and high feeding intensity and development of gonads during other months [38]. Since the environmental factors, food supply and parasitism pose a profound influence on the fish health [12, 41, 42]. Also in Kashmir waters, there is a significant variations in temperature being a freezing condition during winter, so the feeding activity of the fish gets appreciably decreased, which is also supported by the views following [43]

The present study is the first attempt to reveal the information about the morphometrics, length-weight relationship and growth condition of *S. labiatus* from the Vishav stream. This study will particularly add to the baseline data for biologists about the growth condition of this fish in this particular stream and will be useful for conservation biologists for successful production, management and conservation.

Statistical Estimates	Range (cm)		Mean (cm)	Standard deviation	Coefficient of variation (%)
	Min	Max			
TL (cm)	15.2	36	26.04	5.16	19.83
SL (cm)	12.2	30.3	21.91	4.59	20.95
FL (cm)	13.8	33.8	24.15	4.97	20.6
HL (cm)	2.6	7.2	4.73	0.99	20.85
SnL (cm)	0.9	2.6	1.59	0.38	24.15
ED (cm)	0.6	1.1	0.9	0.13	14.12
IOL (cm)	1.7	4.2	3.11	0.64	20.5
PDL (cm)	6.2	15.3	10.95	2.28	20.84
PPL (cm)	2.7	6.9	4.57	0.95	20.83
PPeL (cm)	6.4	16.5	11.37	2.28	20.06
PAL (cm)	9.4	24.2	17	3.61	21.25
AL (cm)	0.7	2.3	1.54	0.38	24.51
BD (cm)	2.5	6	4.39	0.99	22.49
HOD (cm)	2	4.6	3.52	0.59	16.86
CL (cm)	2.9	6.4	4.16	0.71	17.14
CD (cm)	1.1	2.9	2.09	0.47	22.46

Table 1: Morphometrics of *S. labiatus* from Vishav stream.

Table 2: Relationship between various morphometric characters of *S. labiatus* from Vishav stream.

Morphometric character (cm)	Correlation (r)	Intercept (a)	Slope (b)
TL and SL	1	-1.16	0.89
TL and HL	0.93	0.09	0.18
TL and SnL	0.86	-0.07	0.06
TL and PDL	0.99	-0.43	0.44
TL and PPL	0.95	0.03	0.17
TL and PAL	0.99	0.01	0.44
TL and PDL	0.99	-1.09	0.69
TL and HL	0.93	0.09	0.18
TL and BD	0.9	-0.1	0.17
HL and IOL	0.82	0.61	0.53

Table 3: Variation in Condition factor (K) of *S. labiatus* from Vishav stream.

Sex	Month	Condition factor (K) of <i>S. labiatus</i>				
		OCT 2017	NOV 2017	DEC 2017	JAN 2018	FEB 2018
Males		0.82	0.02	0.01	0.06	0.06
Females		0.09	0.86	0.77	0.01	0.02
Combined		0.05	0.02	0.01	0.01	0.01

Fig. 1: Logarithmic relationship between length and weight of *S. labiatus* (males)

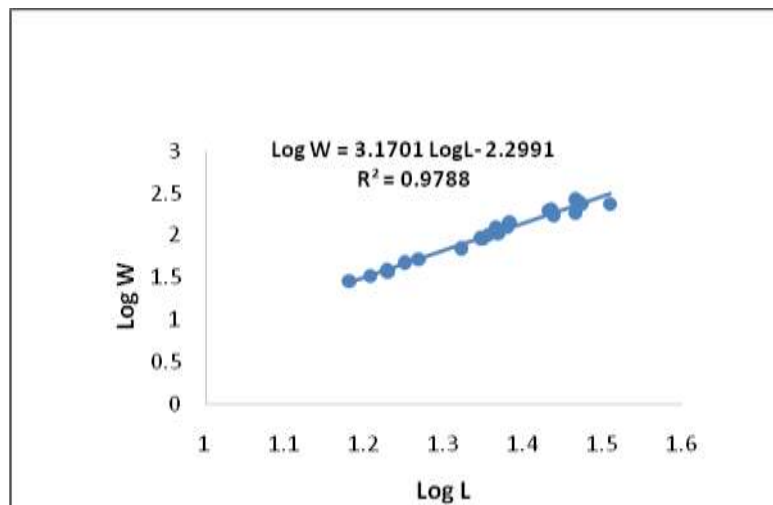


Fig.2: Logarithmic relationship between length and weight of *S. labiatus* (females)

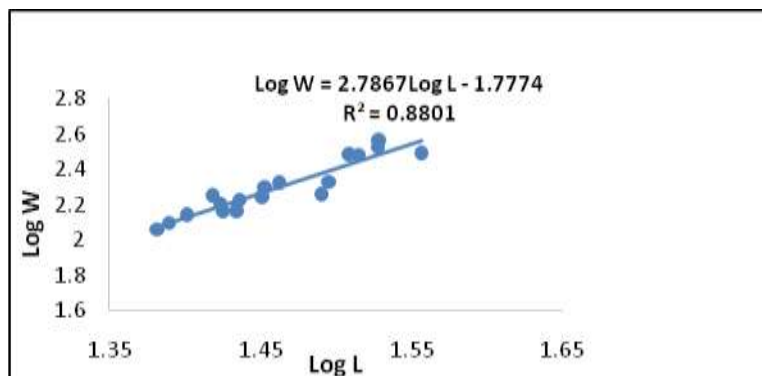
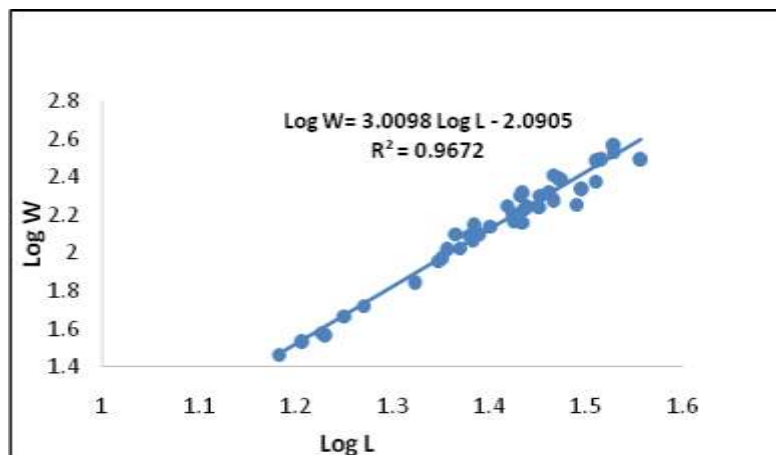


Fig.3: Logarithmic relationship between length and weight for *S. labiatus* (pooled data)



5. CONCLUSION

The length weight relationship including the condition factor helps to determine condition of a fish from a particular waterbody during different stages and during different seasons. The data helps to have an idea about the health of the fish as well as of its habitat. Though it is a short term study but if carried forward could be helpful in conservation and management of this very indigenous snow trout in water bodies of Kashmir and particularly in the Vishav stream, which possesses a great fishery potential.

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