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Length-Weight Relationship and Condition Factor of *Schizopyge curvifrons* (Heckel, 1838) from River Jhelum, Kashmir, India

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Abstract: This study is the first attempt to describe the length-weight relationship (LWR) as well as annual condition of an economically important snowtrout, *Schizopyge curvifrons* from River Jhelum in Kashmir Valley, India. A total of 296 specimens used in this study were caught with traditional fishing gear from January to December 2011. Overall, the allometric coefficient *b* of the LWR was found to be negatively allometric (b<3) throughout the year except March, July and October where the growth was isometric (b=3). A trend line graph was applied to compare condition of fish in different months as per the relationship, which indicated declining growth condition. The condition factor showed an overt variation with highest value during the breeding season. The result obtained through this study will be useful for fishery managers to impose adequate regulations for sustainable fishery management.

Key words: Wild Population % Month-Wise Variation % *Schizopyge curvifrons* Jhelum % Kashmir

INTRODUCTION

Length-weight relationship (LWR) of fishes are important in fisheries and fish biology because they allow the estimation of the average weight of the fish of a given length group by establishing a mathematical relation between them [1]. 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 life such as metamorphosis, growth and onset of maturity [2]. Besides this, LWR can also be used in setting yield equations for estimating the number of fish landed and comparing the population in space and time [3]. LWR parameters (*a* and *b*) are useful in fisheries science in many ways: to estimate weight of individual fish from its length, to calculate condition indices, to compare life history and morphology of populations belonging to different regions [4] and to study ontogenetic allometric changes [5]. Furthermore the empirical relationship between the length and weight of the fish enhances the knowledge of the natural history of commercially important fish species, thus making the conservation possible. Fulton's condition factor (K) is widely used in fisheries and fish biology studies. This factor is calculated from the relationship between the weight of a fish and its length, with the intention of describing the "condition" of that individual fish [6]. Different values in K of a fish indicate the state of sexual maturity, the degree of food sources availability, age and sex of some species [7] and the system of environment [8].

The subfamily Schizothoracinae is a group of specialized fishes, dominant of the torrential mountain streams of the Himalaya and Central Asia. They are confined to cold regions and to localities possessing snow fed rivers and thus commonly called as snowtrouts. *Schizothorax curvifrons* locally called as Satter Gad is a good prized indigenous herbivorous cold freshwater teleost of Kashmir Valley. The fish belonging to family Cyprinidae proves to be morphometrically, meristically and economically most variable and valuable promising food fish of the paradise dale. It can always be recognized by the combination of large high scale count, high gill raker number and thin lips [9, 10]. The reported maximum size of this fish is 40 cm [11] and 1,250 g in weight [12].

LWR have been extensively studied across the world [13-16]. The literature available on the LWR and condition factor of the snowtrouts is scarce; some of the recent contributions available are on *Schizopyge richardsoni* from the Garhwal Hills [17-19]. Dar *et al*. [20] reported the LWR and relative condition factor of *Schizopyge esocinus*

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from River Jhelum in Kashmir and Shafi and Yousuf [21] investigated the LWR and condition factor of *Schizopyge niger* from world famous Dal Lake in Kashmir. However, no information is available so far on the length-weight relationship and condition factor of *Schizopyge curvifrons* and therefore, the present study was under taken to establish the pattern of growth and general condition of this fish species from the natural habitat for conservation and assessment.

MATERIALS AND METHODS

Sample Collection: 296 Samples of *S. curvifrons* were collected monthly from January 2011 to December 2011 from River Jhelum in District Baramulla (74.36° east and 34.20° north) of Kashmir by using different types of fishing gears. The required measurement of length and weight were taken at the site by using digital caliper (Mitutiya) and digital weighing machine (ACCULAB Sartorius Group) respectively. The length of the fish was taken from the tip of snout (mouth closed) to the extended tip of the caudal fin nearest 0.01mm and weighed to the nearest 0.01 g (total weight).

Length-Weight Relationship: The relationship between length and weight of fish was analyzed by measuring length and weight of fish specimens collected from study area. The statistical relationship between these parameters of fishes were established by using the parabolic equation by LeCren [22] $W = aL^b$

Where, W = weight of fish in grams, L =length of fish in mm, a = constant and b = an exponential expressing relationship between length-weight.

The relationship ($W = aL^b$) when converted into the logarithmic form gives a straight line relationship graphically Log W = Log a + b Log L

Where b represents the slope of the line, Log a is a constant.

Condition Factor (K): The coefficient of condition, K was calculated using Fulton [23] $K = W*100/L^3$

Where, W = weight in grams, L = Length in cm and 100 is a factor to bring the value of K near unity. The significance of the LWR and K were assessed by analysis of variance (ANOVA) and the values for each river were tested by t-test to verify its significance level in different months of a year. All the statistical analysis was done in Excel 2007.

RESULTS

Length-Weight Relationship: The length range of fish, regression equation for LWR, coefficient of determination (r^2), growth coefficient (b), 95% confidence interval of b and condition factor (K±SD) is given in table 1. In our study we calculated LWR and condition factor of *S. curvifrons* throughout the year and noticed the kind of variation in these parameters. The value of b showed deviation from cube law throughout the year except March, July and October, where b was observed to be equal to 3 and growth of fish was isometric. Whereas for rest of the months negative allometric growth was observed as b was less than 3. The growth coefficient was minimum in February (b=2.29) and maximum in March, July and October (b=3.0) (Table 1).

Table 1: Descriptive statistics and estimated parameters of length-weight relationships and condition factor for *S. curvifrons* from River Jhelum in Kashmir, India

Month	Sample size (g)	Length range (mm)	R^2	b	95% CL of b	K±SD
January	18	80-230	0.93	2.73	2.53-2.87	1.08±0.13
February	25	112-248	0.98	2.29	2.12-2.38	1.27±0.21
March	17	93-250	0.96	3.00	2.89-3.11	1.87±0.12
April	29	132-322	0.96	2.98	2.78-3.10	1.95±0.10
May	32	105-294	0.97	2.49	2.33-2.64	1.45±0.20
June	28	112-328	0.94	2.88	2.65-2.95	1.33±0.15
July	22	109-295	0.97	3.00	2.97-3.14	1.24±0.16
August	28	97-260	0.98	2.74	2.57-2.89	1.27±0.12
September	31	120-289	0.97	2.82	2.69-2.94	1.22±0.14
October	30	110-320	0.97	3.00	2.87-3.06	1.11±0.23
November	17	136-312	0.97	2.99	2.86-3.08	1.10±0.25
December	19	99-288	0.95	2.68	2.48-2.84	1.00±0.30

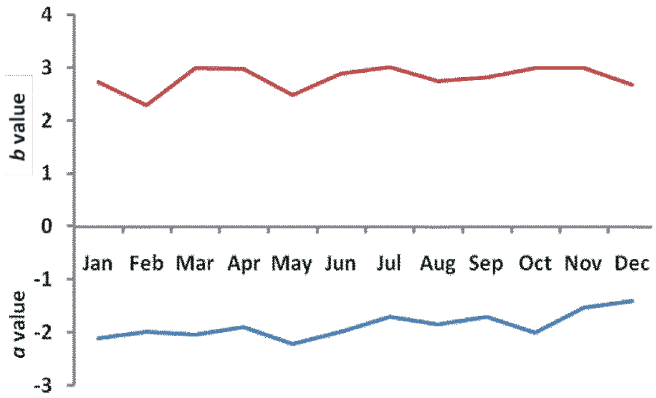

Fig. 1: Growth equation changes in *a* and *b* values for *S. curvifrons* from River Jhelum as indicated by trend lines during January-December 2011.

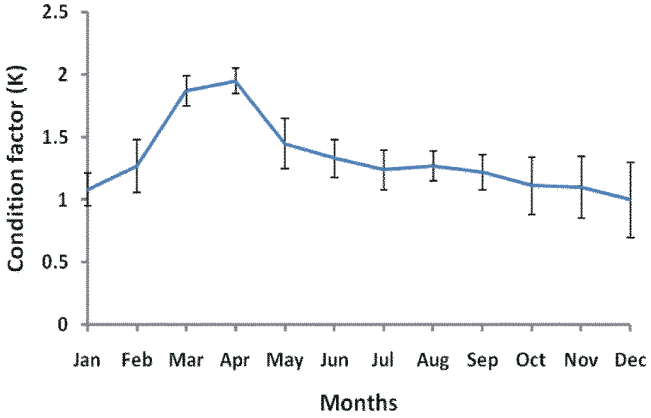

Fig. 2: Month-wise variation in condition factor of *S. curvifrons* collected from River Jhelum, Kashmir during January-December 2011.

Figure 1 depicts the variation in *a* (intercept) and *b* (slope) values of *S. curvifrons* for different months, indicating a clear picture of the average growth condition. The graph plotted to illuminate the of growth of the target fish shows declining trend in the growth pattern in different months from selected river.

Condition Factor: The condition factor of *S. curvifrons* was calculated month-wise and it ranged from 1.0-1.95. K was highest in April followed by March, May, June, February and August, July, September, October, November, January and it was lowest in December (Table 1). The variation of condition factor is depicted in figure 2.

DISCUSSION

The LWR of fish have significant importance in studying the growth, gonadal development and general well-being of fish population [22, 24, 25] and for comparing life history of fish from different [4].

This is the first study for *S. curvifrons* on the parameters of LWR in Jhelum River of Kashmir, which could serve as a tool for providing insight into growth strategies of this species. The *b*-values of the present study conform to the suggestion of Carlander [26] that *b* normally falls between 2.5 and 3.5. In terms of growth type, a value close to three indicates that the fish grows isometrically and other values indicate allometric growth [27]. In this study isometric growth (b=3) was observed in March, July and October and for rest of the months the growth was negatively allometric (b<3). Such changes in *b* value may be attributed to certain environmental factors such as overfishing, food competition and trophic potential of the rivers [28]. Considering the *b* values, large specimens have a body shape that becomes more elongated or the small specimens were in better nutritional condition at the time of sampling [6] An approximate 95% confidence limit for *b*-values showed a significant tendency for the populations to increase in body thickness as they grew by an over-proportional increase in length relative to growth in weight presumably

favouring the swimming speed. Similar kind of observation were noticed by Goel *et al.* [19] in *S. richardsoni* from hill streams of Uttarakhand, Dar *et al*. [20] in *S. esocinus* from River Jhelum in Kashmir and Shafi and Yousuf [21] in *S. niger* from world famous Dal Lake of Kashmir and they attributed these inferences to size, sex, feeding intensity and gonadal development of fish.

According to Le Cren [22], ecological conditions of the habitats or variation in the physiology of the animals, or both, are responsible for growth rate variations in the same species in different months of a year (Fig. 1). On the contrary, it can be seen that the growth condition is towards a declining trend in different months. Similar kind of growth pattern was observed by Haniffa *et al.* [29] in *Channa punctatus* and attributed it to habitat degradation.

The condition factor of *S. curvifrons* showed variation in different months, it was noticed that the K was higher when fish entered into the maturation phase during the months of March and April, for rest of the months K showed slightly lower values. Le Cren [22] reported that environmental factors, food supply and parasitism have great influence on the health of the fish. The differences in condition factors seasonally could be attributed to low feeding intensity and degeneration of ovaries during winter and high feeding intensity and full development of gonads during summer months. Comparatively higher values of K during winters could be attributed to high deposition of fats as preparation for the coming breeding season.

The present study is the first attempt to provide information about the growth condition of *S. curvifrons* from wild habitat. This study will enlighten biologists about the status and growth condition of this fish in natural waters and will be useful for the fishery biologists and conservation agencies, for successful development, management, production and ultimate conservation.

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