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Length Weight Relationship and Condition Factor of Freshwater Snow Trout, *Schizothorax niger* (Heckel 1838) from Dal Lake of Kashmir Himalayas

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Abstract: *Typically, growth can be defined as the change in size (length, weight) over time. The length-weight relationship (LWR) and annual condition factor of an economically important snow trout, Schizothorax niger, from Dal lake of Kashmir was studied and reported in this communication. A total of 120 specimens were collected with the help of traditional fishing gear during 2012-2013. The coefficient 'b' value of the LWR suggested allometric growth throughout the year except in April, July and September 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 in this study will be useful for fishery managers to impose adequate regulations for fishery and sustainable management.*

Key words: Condition Factor; Dal Lake, Length-Weight Relationship; *S. niger*

Introduction

One of the major problems being faced by the developing countries including India is to provide adequate quantum of protein rich balanced diet for its ever increasing population. Major component of the protein requirement in our daily diet comes from animal sources. Fish is considered as rich source of cheap protein (Agusa *et al.*, 2007). Protein content of raw fish flesh is 18-22%. Fish does the duel functions of food, as well as requirement of basic nutrition and plays a vital role in fulfilling the vitamin and mineral deficiencies.

The growth rate is an important parameter that influences population dynamics in fishes (Seshappa (1999), Shamsan and Ansari (2010). It is a good indicator of the health of individuals and populations. Although most of fish continue to grow throughout their lives, growth is not constant over the year. For species that can be aged, growth is directly determined from size at age or back calculation from scale reading. Apart from length-weight relationship, the condition factor (K) is equally important in fisheries. Study of the length-weight relationship (LWR) of fishes are very important in fisheries, because it allows the estimation of the average weight of the fish of a given length group by establishing a mathematical relation between them (Sarkar *et al.*, (2008), Mir *et al.,* (2012). The growth rate is variable and is influenced by physiological and biotic factors such as age, maturity, ingested food quality and quantity (Edah *et al.*, (2010).

Native fish *Schizothorax niger* (Heckel *et al* (1838) is locally called as snow trout. The genus Schizothorax inhabits the streams, rivers and lakes of the Kashmir valley. The genus is believed to have migrated into the water bodies of Kashmir valley from Central Asiatic waters. The fish got isolated in the Kashmir region by land upheavals and evolved into the large number of species endemic in the valley. Although earlier a number of fishes belong to the genus Schizothorax have

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been reported in Kashmir water. However, presently only five species of this genus are found in the water bodies of Kashmir. The fish population in Dal lake has been declined due to encroachment, urbanization, agricultural activities, eutrophication and overfishing. Among Schizothorax spp. *Schizothorax niger* being a truely lacustrine fish does not show any spawning migration. It inhabits lentic water bodies of valley, found mostly in Dal lake.

The knowledge of age and growth of a fish is essential for understanding the age composition of the stock and the role of various class years in the fisheries. Although information on length weight relationship of *Schizothorax niger* has been reported in the past by some workers (Khan and Sabah (2013), Mir (2014), Bashir *et al.*, (2016). However, no detail information is available on the length-weight relationship and condition factor of this species. Therefore, in the present study the length weight relationship and condition factor of *S. niger* in Dal lake was studied. It forms the first base line information on the LWRs and condition factor of S*. niger* from Dal lake.

Material and Methods

Samples of *S. niger* were collected from Dal lake of Kashmir Himalayas by using different types of fishing gears with the help of fisherman during 2012-2014. After collection, the samples were brought to wet laboratory and measurement of length and weight of each individual were taken by using digital vernier caliper and digital top loading balance (Sartorus CPA- 224S 0.1 mg sensitivity, Goettingen, Germany), respectively. The total length of fish was measured to its nearest 0.01cm and total body weight was measured to its nearest 0.01g as per standard procedure. The total length of fish was taken from the tip of snout to the extended tip of the caudal fin.

The relationship between length and weight of fish was analyzed by measuring length and weight of fish specimen collected from study area. The statistical relationship between these parameters of fishes worked out by using algometric equation as per 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:

$$LogW= Loga +bLogL$$

Condition Factor (K)

The 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. Differences in the condition factor have been interpreted as a measure of physiological events such as fat reservation, adaptation to the environment and gonadal development Le Cren (1951). The coefficient of condition K was calculated by using Fulton (1904), equation.

$$K = W/L^3x100$$

Where, W = weight in grams, L = length in cm, and 100 is a factor to bring the value of K near unity Froese (2006).

Result and Discussion

Length Weight Relationship

A total of 120 specimen were utilized for this purpose, significance of difference between the regression coefficient was tested statistically. The length range of fish was 24.4–35.0 cm and total weight 200–460 g. The regression equation for length weight relationship (LWR), coefficient of determination (r^2), growth coefficient (b) is given in Table 1. In the present study, the LWR and condition

Table 1. Descriptive Statistics and Estimated Parameters of Length-Weight Relationships and Condition Factor (K) for *S. niger* from Dal Lake Kashmir Himalayas

		Total length (cm)		Weight (gm)		Regression parameters $W= aL^b$			
Months	**N**	**Min.**	**Max.**	**Min.**	**Max.**	**a**	**b**	**r**	**K**
January	10	26.2	28.5	215	260	1.73	2.70	0.97	1.12
February	10	24.4	30	205	267	1.64	2.31	0.85	1.14
March	10	27	31	220	330	1.89	2.86	0.95	1.17
April	10	26.3	30.5	235	325	1.83	3.00	0.75	1.19
May	10	27.2	31.5	275	380	1.40	2.49	0.98	1.27
June	10	26	30	220	310	1.73	2.79	0.81	1.18
July	10	26.5	30.4	200	430	2.32	3.00	0.97	1.21
August	10	29.4	33	260	420	1.63	2.71	0.95	1.13
September	10	25.5	34.5	210	460	1.56	3.00	0.97	1.15
October	10	26	35	220	410	2.54	2.48	0.98	1.13
November	10	29.4	33.5	280	395	2.13	2.95	0.89	1.14
December	10	28	31.5	210	410	2.16	2.72	0.99	1.16

factor of *S. niger* showed significant variation among these parameters. The regression graph of *S. niger* is depicted in Figure 1. The combined regression was expressed as $Y= 2.4564X–1.701$ with R^2 value highly significant. The value of 'b' showed deviation from cube law throughout the year except in the months of April, July and September, where 'b' was recorded to as equal to 3 and which indicate that the growth of the fish assumed isometric. Whereas, for the rest of the months a negative allometric growth was observed as 'b' was estimated less than 3. The growth coefficient was minimum in the month of February (b= 2.31) and maximum values of growth coefficient were obtained in the months of April, July and September (b= 3.0).

Condition Factor (K)

Condition of fish in general is an expression of relative fatness of fish. The monthly variation of condition factor of *S. niger* was calculated and result are presented in Table 1 and Figure 2. The monthly variation and fluctuation in K factor was in the range of 1.12-1.27. The highest value of 'K' was reported in the month of May followed by July, April and June, respectively. While lowest value of condition factor was recorded in the month of January.

It has been widely accepted that growth of fish or any other animal increases with increase in body length and is inter related to each other. The length-weight relationship can be obtained from length and weight measurement of the same fish throughout its life or from a sample of fish taken at a particular time Wootton (1990). It has been reported in the past that study of LWR could serve as a tool for providing insight into growth strategies of fishes from Kashmir valley Carlander (1969). The b-values obtained in the present study (Figure 1) also are in conformity of Carlander (1969), who suggested that 'b' normally falls between 2.5 and 3.5. In terms of growth type, a value close to three indicates

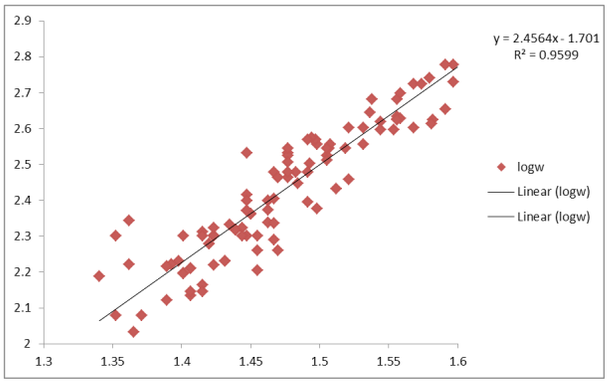

Fig. 1 Showing Combined Regression Graph of Length-Weight Relationship of *S. niger*

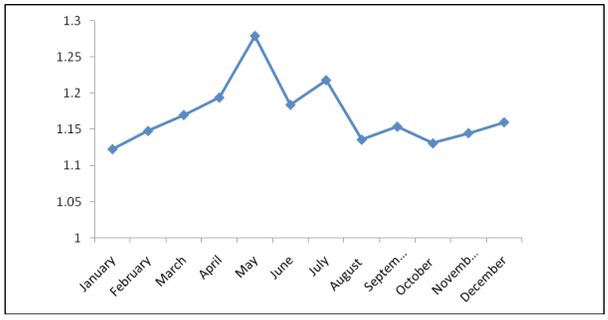

Fig. 2 Month-Wise Variation in Condition Factor of *S. Niger* Collected from Dal Lake of Kashmir Himalayas

that the fish grows isometrically and other values indicate allometric growth. In this study, isometric growth was observed in the months of March, July and September and for rest of the months growth was allometric (b<3). Such changes in 'b' value may be attributed to certain environmental factors such as food competition, overfishing and trophic potential of the rivers Kleanthids *et al.,* (1999). 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 presumably favouring the swimming speed. Similar observations were also made by Goel *et al.,* (2011) in *S. richardsoni* from hill streams of Uttarakhand, and Dar *et al.,* (2012) in *S. esocinus* from river Jhelum in Kashmir. 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. niger* 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 such as temperature, food supply, spawning conditions and other factors such as sex, age, fishing time and area Ricker (1973). Allen (1938) also 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 condition factor of *S. niger* showed variation in different months. During the months of April, May, June and July, 'K' was higher when fish entered into the maturation phase and for rest of the months 'K' showed slightly lower values (Figure 2). Le Cren (1951) reported that environmental factors, parasitism and food supply have great influence on the health of the fish. The seasonal difference in condition factors 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. Besides that during winters, the high values of 'K' could also be attributed to high deposition of fats as preparation for the coming breeding season. From a nutritional point of view, increase in K value indicates the accumulation of fat and sometimes gonadal development. Figueiredo-Garutin and Garuti (1991) stated that the lowest K value occurs in the beginning of the reproductive period and the highest at its end.

The present study is the first attempt to provide information about the growth condition of *S. niger* 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 of this fish species.

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References

Allen K. R. (1938) Some Observation on the Biology of the Trout (*Salmo truta*) in Windermere. *J. Anim. Ecol.,* **7,** 333-349.

Agusa T., Kunito T., Sudaryanto A., Monirith I., Kan-Atireklap S., Iwata H., Ismail, A., Sanguansin J., Muchtar M., Tana T.S. and Tanabe S. (2007) Exposure Assessment for Trace Elements from Consumption of Marine Fish in Southeast Asia. *Environ. Poll.,* **145,** 766-777.

Bashir A., Sharma N. K., Bisht B. S., Singh R., Mir J. I. and Akhtar M. S. (2016) Length-Weight Relationship of Five Commercially Important Freshwater Fish Species in the Kashmir Valley, India, *J. Appl. Ichthyol.,* **32**, 740-741.

Carlander K. (1969) Handbookof Freshwater Fishery Biology. (eds, IA Iowa Ames). State University Press, pp: 557.

Dar S. A., Najar, A. M., Balkhi M. H., Rather M. A. and Sharma R. (2012) Length Weight Relationship and Relative Condition Factor of *Schizopyge esocinus* (Heckel, 1838) from Jhelum River, Kashmir. *Inter. J. Aquat. Sci.,* **3**, 29-36.

Edah B. A., Akande A. O., Ayo-Olalusi C. and Olusola A. (2010) Computed The Wet Weight-Dry Weight Relationship of *Oreochromis niloticus*, Tilapia. *Inter. J. Food Saf.*, **12**, 109-116.

Figueiredo-Garuti M.L. and Garuti V. (1991) Total Condition Factor and Somatic Condition Factor for Females Astyanax Bimaculatus (Pisces, Characidae), Coming from the Northwest Region of Sao Paulo, Parana River Basin. *IX Brazilian Meeting of Ichthyology* pp: 62.

Froese R. (2006) Cube law, Condition factor and Weight-Length Relationship: History, Meta-analysis and Recommendations. *J. Appl. Ichthyol.,* **22**, 241-253.

Fulton T. W. (1904) The Rate of Growth of Fishes. Twenty Second Annual Report Part III. *Fish. Board Scot. Edinb.*, 141-241.

Goel C. Barat A., Pande V., Ali S. and Kumar R. (2011) Length-Weight Relationship of Snow Trout (*Schizothorax richardsonii*) Based on Linear and Nonlinear Models from Hill Stream Uttarakhand, India. *World. J. Fish Mar. Sci.,* **3**, 485-488.

Heckel J.J. (1838) Fische aus Cashmir. Carl Freiherrn V. Hugel, Wien.

Khan M. A. and Sabah (2013) Length–Weight and Length–Length Relationships for Five Fish Species from Kashmir Valley. *J. Appl. Ichthyol.* **29**, 283–284.

Kleanthids P. K., Sinis A. I. and Stergiou K. I. (1999) Length-Weight Relationships of Freshwater Fishes in Greece. Naga, *ICLARM Q.*, **22**, 37-41

LeCren E. D. (1951) The Length-Weight Relationship and Seasonal Cycle in Gonad Weight and Condition in the Perch (*Perca fluviatilis*). *J. Anim. Ecol.,* **20,** 201-219.

Mir J. I., Sarkar U. K., Dwivedi A. K., Gusain O. P., Pal A. and Jena J. K. (2012) Pattern of Intra Basin Variation in Condition Factor, Relative Condition Factor and Form Factor of an Indian Major Carp, *Labeo Rohita* (Hamilton-Buchanan, 1822) in the Ganges Basin, India. *Europ. J. Biol. Sci.* **4**, 126-135.

Mir F. A., Mir J.I., Patiyal R.S. and Kumar P. (2014) Length-Weight Relationships of Four Snow Trout Species from the Kashmir Valley in India. *J. Appl. Ichthyol*., **30,** 1103-1104.

Ricker W. E. (1973) Linear Regressions in Fishery Research. *Fish. Res Board Canada* **30,** 409-439.

Shamsan, E.F. and Ansari, Z.A. (2010) Study of Age and Growth of Indian Sand Whiting, Sillago Sihama (Forsskal) from Zuari Estuary, Goa. *Indian J. Mar. Sci*., **39**, 1-5

Sarkar U. K., Deepak P. K. and Negi R. S. (2008) Length–Weight Relationship of Clown Knife Fish *Chitala chitala* (Hamilton 1822) from the Ganga Basin, India. *J. Appl. Ichthyol.,* **25**, 232-233.

Sarkar U. K., Deepak P. K. and Negi R. S. (2009) Length–Weight Relationship of Clown Knife Fish *Chitala Chitala* (Hamilton 1822) from the River Ganga Basin India. *J. Appl. Ichthyol.,* **25**, 232-233.

Seshappa, G. (1999). Recent Studies on Age Determination of Indian Fishes, using Scale, Otolith and other Hard Parts. Indian J. Fish, **46**, 1-11.

Wootton, R. J. (1990). Ecology of Teleost Fishes. Chapman and Hall, London.