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Morphometry and length-weight relationship of *Schizopyge niger* from Kashmir

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Abstract
Schizopyge niger locally called as "Ale gad", is a prized commercial fish of Kashmir found abundantly in the valley lakes. The present investigation was carried out to study the morphometry of the fish using conventional methods and to establish the length-weight relationship. High correlation coefficient (R^2) values were obtained in the study (0.4497-0.8264) indicating high degree of relationship between the different morphometric characters compared. The length-weight relationship was established logarithmically as LogW= -3.4361+2.3827 LogL. The correlation coefficient (R^2) was obtained at 0.6568, indicating strong correlation between the two parameters. The growth coefficient (b) value was estimated at 2.3827 indicating negative allometric growth pattern for *S. niger*.

Keywords: *Schizopyge niger*, morphometry, length, weight, snow trout, Kashmir.

Introduction
Jammu and Kashmir is rich in aquatic resources ranging from ponds, water flows, wetlands, springs, rivers to voluminous lake in the plains and the high altitudes. These water bodies play a great role in the socio-economic status of the people and are home to a variety of flora and fauna. The ichthyofauna of Kashmir is quite different from the rest of the country and is mainly represented by the cold-water schizothoracine group. Yousuf (1996) [31] documented 42 fish species from Kashmir waters, while Balkhi (2007) [3] recorded 40 species. However, not more than 22 species were documented by Kullander *et al.* (1999) [14]. Schizothoracines, the indigenous cyprinids (also called snow trouts), inhabit both lentic as well as lotic water bodies of Kashmir. The fish belongs to the family Cyprinidae and order Cypriniformes. Schizothoracines are highly valued fish, preferred to most other fish species. They feed on detritus, attached plants (including algae) coating of stones and rocks, and the associated invertebrate fauna. The fish population has declined to a large extent due to encroachment, urbanization, agricultural activities, eutrophication, and overfishing (Balkhi *et al.*, 2007) [3]. Most fish species inhabiting the Himalayan region are small in size. Their distribution depends on environmental conditions such as the velocity of water current, nature of substratum, and the availability of food. *Schizopyge niger*, locally known as Ale gad is a prized fish of Kashmir. The fish belongs to the family Cyprinidae, *S. niger* being a lacustrine fish occurs in lakes of Kashmir in good numbers, including Dal Lake. The mouth of *S. niger* is inferior with upper jaw little projecting beyond the lower and is horse-shoe shaped. Barbells are shorter than eyes, the origin of dorsal fin a little nearer to the root of the caudal fin than to the end of the snout. The anal fin is small, shorter than pectoral fin. The length of the snout is much more than the diameter of the eye, which is 1/5th of the head length and sides with small blackish dots (Jhingran, 1991) [13]. *S. niger* feeds on detritus, attached plants (including algal) coating of stones and rocks, and the associated invertebrate fauna. It has been found to be herbivorous fish, feeding mainly on green algae, plant fragments, diatoms, detritus, unrecognizable matter (sand/silt, fish scales, ropes). (Sabha *et al.*, 2017) [29].

The study of morphometric characters in fishes is very important from a taxonomic point of view (Balli *et al.*, 2007) [4] as they can be used for the differentiation of taxonomic units. The length-weight relationship provides basic information on fish biology and thus is useful to estimate the weight from the length of individual fish (Froese, 1998) [9]. This relation can be used to obtain information on the somatic growth of the fish to determine whether it was isometric or allometric (LeCren, 1951) [15]. Length-weight relationship of any fish species is a prerequisite for the study of its population and has significant importance in studying the growth, gonadal development, and general well-being of the population (LeCren, 1951; Pauly, 1993; and Nagesh *et. al.*, 2004) [15, 21]. It also helps in comparing the life histories of fishes from different locations (Petrakis and Stergion, 1995) [23].

Material and methods

Collection of fish sample

A total of 20 specimens of *S. niger* were collected from Dal lake. Simple random sampling, representative of all length groups, was collected. The samples collected were transported in iceboxes to the laboratory for biological analysis.

Morphometry

Morphometric characters were measured by using fish measuring board and Vernier Calipers for accuracy to the nearest millimeter as described by Lagler *et al*. (1962) [16], Laevastu (1965) [17], Lowe-McConnel (1971) [18], Dwivedi and Menezes (1974) [6] and Grant and Spain (1977) [10].

The following eleven morphometric characters were measured:

1. **Total Length (TL):** The distance from the tip of the snout to the tip of the caudal fin.
2. **Standard Length (SL):** The distance from the tip of snout to the base of the caudal fin.
3. **Pre-Dorsal Length (PDL):** Distance from the tip of snout to the anterior margin of the base of the dorsal fin.
4. **Pre-Pectoral Length (PPL):** Distance from the tip of the snout to the anterior margin of the base of the pectoral fin.
5. **Pre-Pelvic Length (PPCL):** Distance from the tip of the snout to the origin of the pelvic fin.
6. **Pre-Anal Length (PAL):** Distance from the tip of snout to the origin of the anal fin.
7. **Snout Length (SL):** The distance from the snout to the anterior margin of the orbit.
8. **Body Depth (BD):** Maximum vertical length of the body (deepest part of the body).
9. **Eye Diameter (ED):** The distance from the anterior margin to the posterior margin of the eye.
10. **Caudal Fin Length (CFL):** Distance from the origin of the caudal fin to its maximum length.
11. **Head Length (HL):** The distance from the tip of the snout to the posterior margin of the operculum.

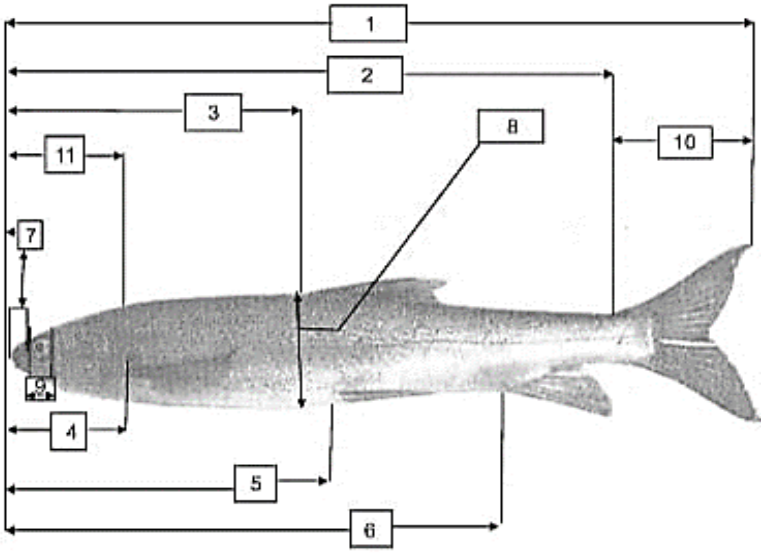

Fig 1: Morphometric characters of *S. niger*

Length-weight relationship

The study on length-weight relationship was based on 20 specimens of *S. niger* collected from Dal Lake. Immediately after bringing the specimen to the laboratory, the total length (TL) was measured to nearest mm using measuring board and weight was noted to the nearest 0.01g accuracy in an electronic balance. The length-weight relationship was estimated using the allometric formula proposed by Le-Cren (1951) [15] separately for both sexes and significant differences, if any, in the slopes of the regression lines for males and females were ascertained.

$$W = aL^b \quad \text{or}$$

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

Where, 'W' is weight of the fish (g), 'L' is length of fish (mm), 'a' is the intercept and 'b' is the slope.

Results and discussion

Morphometry

The maximum total length recorded was 260.69 mm while the minimum total length recorded was 200.17 mm. The relationship between various characters i.e., total length v/s standard length, total length v/s pre dorsal length, total length v/s pre pectoral length, total length v/s pre pelvic length, total length v/s pre anal length, total length v/s body depth, total length v/s head length, head length v/s snout length and head length v/s eye diameter are shown in the Table 1 Figs 1-9. The correlation coefficient (r) value was noted highest between total length and pre anal length (0.8264) and least between head length and snout length (0.4497) indicating high degree of relationship between the characters compared.

Table 1: Relationship between various morphometric characters of *S. niger*

Morphometric characters	Intercept (a)	Slope (b)	Y=a+ b X	Correlation (r^2)
TL and SL	17.224	0.7848	Y= 17.224+ 0.784X	0.7341
TL and PDL	33.134	0.2913	Y=33.14+0.2913X	0.6533
TL and PPL	25.107	0.3369	Y=25.107+0.3369X	0.6868
TL and PPCL	19.695	0.0998	Y=19.695+0.0998X	0.5637
TL and PAL	11.604	0.6287	Y=11.604+0.6287X	0.8264
TL and BD	12.025	0.1425	Y=12.025+0.1425X	0.5270
TL and HL	14.463	0.1233	Y=14.463+0.1233X	0.5294
HL and SL	-14.928	0.7563	Y=-14.928+0.7563X	0.4497
HL and ED	-4.3816	0.2472	Y=-4.3816+0.2472X	0.5602

In the present study, among all the morphometric characters compared with total length, standard length (b=0.784) and pre anal length (b=0.628) indicated high growth rate, while for the pre pectoral length (b=0.3369), pre dorsal length (b=0.2913), body depth (b=0.1425), head length (b=0.1233) and pre pelvic length (b=0.0998) growth was very slow. Among the two characters compared with head length, snout length (b=0.7563) showed faster growth as compared to eye diameter (b=0.2472).

The morphometric analysis of fish is an important key in the study of biology of fish (Hussain *et al*., 2012) [12] and have been used extensively in identification of fish (Kullander *et al*., 1999; Yousuf *et al*., 2003) [14, 32]. Bhat *et al*., 2010 [5] studied the morphometric characteristics of Schizothorax spp. in the River Lidder of Kashmir and reported maximum growth in standard length (0.9080) and least in maximum body depth (0.1730) with respect to the total length of the fish. Shah *et al.*, 2011 reported high level of interdependence (0.8262 - 0.9979) between fourteen morphometric characters of *Oncorhynchus mykiss* from Kashmir. Sharma *et al*., 2014 studied the relationship of total length and external body parts while analysing the morphometric and meristic characteristics of *Botia birdi* in the Indus basin, Jammu and Kashmir and reported a positive correlation in all the parameters with total length. The highly correlated body parameter in relation to total length was fork length (r=0.999) while as least correlation was observed for Post orbital length (r=0.776).

Length weight relationship

A total of 20 specimens of *S. niger* in length range 200.17 – 260.69 mm and weight range of 87.72 – 200.40g were analysed for length weight relationship

The length weight relationship was established logarithmically as

LogW = - 3.4361 + 2.3827 LogL (r = 0.6568)

The scatter diagram of this logarithmic relation of length weight is presented in Figure 1.

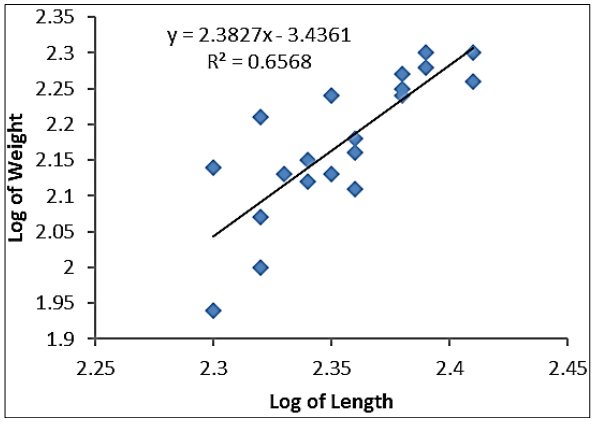

Fig 1: Logarithmic relation between length and weight of *S. niger*

It is a universal fact that the growth of fishes or any other animal increases with an increase in body length. Thus, it can be inferred that the growth and length are interrelated. Shah *et al.*, 2013 [26] has also reported strong positive correlation between length and weight of rainbow trout from Kashmir. The length-weight relationship can be obtained from the length and weight measurements of the same fish throughout their lives or from a sample of fish taken at a particular time (Wootton, 1990) [30]. According to Wootton (1990) [30], if the fish retains the same shape, and their specific gravity remains unchanged, it shows isometric growth, and the value of exponent 'b' will be exactly 3.0. A value less than 3.0 shows that fish becomes lighter and greater than 3.0 indicates heavier for a particular length as it increases in size. Hile (1936) [11], Martin (1949) [19], and Le Cren (1951) [15] pointed out the value of constant 'b' varies from 2.5 to 4, and for an ideal fish, it is 3. In the present study, the b value was recorded at 2.3827, indicating negative allometric growth pattern in the fish. In other words, *S. niger* becomes less rotund (slender) as length increases. Similar results were observed by Dar *et al*. (2012) in *Schizopyge esocinus*. The slope value of the regression line less than 3 has been reported in *Labeo dyocheilus* (Malhotra, 1985) [20]; *Cyprinus carpio communis* and *Ctenophyryngodon idella* (Dhanze and Dhanze 1997) [7]; *Rasbora daniconius* (Sunil, 2000) [24] and *Sardinella longiceps* (Shah *et al*., 2014). These reports corroborate with the present findings on the length-weight relationship in *S. niger* in which a significant departure of 'b' value from the isometric value of 3 was noticed. Bhagat and Sunder (1984) [2] have reported the value of 'b' parameter for *S. esocinus* as 3.0034. The value of 'b' reported by Bhat *et al*. (2010) [5] for *S. labiatus* differs from the present study, which may be possibly due to several factors such as habitat, the number of specimens examined, and length ranges, and length types used. Allen (1938) [1] 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 form may change with time, so the length-weight relationship of most fish species may deviate from the cube law.

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