*Indian J. Fish.*, 65(3): 105-109, 2018
DOI: 10.21077/ijf.2018.65.3.69549-14

## Note

# Morphometric relationships of length-weight and length-length in snow trout *Schizopyge niger* (Heckel, 1838) from Dal Lake, Kashmir

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## ABSTRACT

The present study elucidates the length-weight (LWR) and length-length (LLRs) relationships in Alghad snowtrout *Schizopyge niger* (Heckel, 1938), an economically and commercially important fish species of Kashmir. In total, 238 *S. niger* samples ranging in total length from 62-367 mm and 10-491 g in body weight were studied over a period of one year (November 2015 to October 2016). The results showed that the allometric coefficient 'b' in males (2.8391) was close to isometric value (≈ 3.0) than in case of females (2.6). The L-W equations were log W = - 4.5996 + 2.8391 log L for males and log W = - 4.0507 + 2.6073 log L for females. The results further inferred a strong length-length correlation (r = 0.728-0.988; $p<0.05$).

Keywords: Dal Lake, Length-length relationship, Length-weight relationship, Morphometric characters, *Schizopyge niger*

*Schizopyge niger* (Heckel, 1838), an indigenous lacustrine fish belonging to family Cyprinidae is one of the most important fish species of Kashmir Valley. Commonly known as Alghad snowtrout, the fish primarily inhabits the lakes, wetlands and ponds of the valley, while it is also been found in the slow flowing zones of river Jhelum. On account of its high nutritive value, it is one of the most commercially important and preferred fish in the valley. Although being dominant in most of the lakes of Kashmir (Yousuf, 1996, Bhat *et al*., 2010), very little is known about the morphometric characters, especially the length-length relationships (LLRs), taxonomic units, population dynamics and developmental biology of *S. niger*. Morphometric characteristics like length-weight relationships helps in comparing the life histories of fishes from different locations (Petrakis and Stergion, 1995) and play an important role in fisheries management (Moutopoulos and Stergiou, 2002). Besides, parameters like growth, gonadal development and overall wellbeing, these relationships are pre-requisites for studying the dynamics of any fish population (Le Cren, 1951; Pauly, 1993; Nagesh *et al.,* 2004). Even though various studies have been conducted on length-weight relationship of *S. niger,* there is hardly any report on the length-length relationship of the fish, especially in Dal Lake. Therefore, the study was undertaken to carry out a comprehensive description of the length-weight (LWRs) and length-length relationships (LLRs) of *S. niger* from the Dal Lake, Kashmir. Dal Lake is a sub-Himalayan urban lake and is the second largest in the state of Jammu and Kashmir. The lake comprises five basins and a myriad of inter-connecting channels covering an area of 11.4 $km^2$ with an average maximum depth of 5.4 m. The lake lies 34º 07' north and 74º 52' east at an altitude of 1584 m above mean sea level and has a catchment area of 316 $km^2$ (Qadri *et al*., 2008). The lake sometimes referred to as "liquid heart" of Srinagar city or "jewel of kashmir" has been an important source of fishery and commercial fishing operations, especially to the people of Srinagar city.

A total of 238 specimens of *Schizopyge niger* (Fig. 1) ranging from 62-367 mm in total length and 10-491 g body weight were procured from the fishermen operational in five basins (Fig. 2) over a period of one year (November 2015 to October 2016). Fresh fish specimens used for the study were properly wiped with blotting paper to ensure removal of moisture. Different morphometric lengths of the fish were measured to the nearest millimeter using digital vernier caliper and the weight was recorded using an electronic digital balance, measured to the nearest gram. Morphometric measurements like total length (TL), standard length (SL), headlength (HL), pre-dorsal length (PDL), pre-pectoral length (PPL), pre-pelvic length (PPeL), pre-anal length (PAL) and maximum body depth (MBD) were studied following the standard procedures described by Apparao (1966) and Dwivedi and Menezes (1974).

Fig. 1. *Schizopyge niger* (Heckel, 1838)

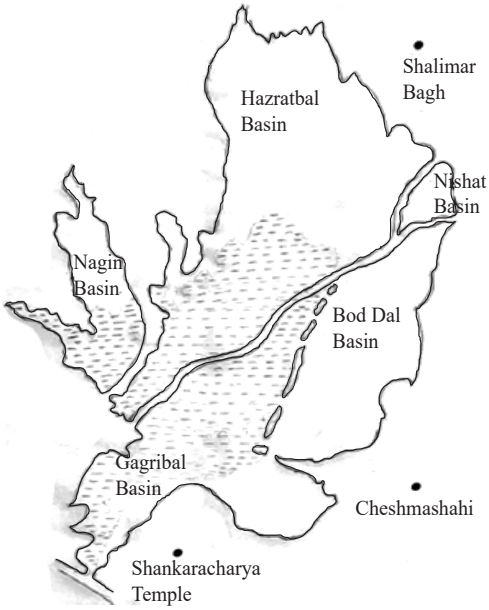


Fig. 2. Map of Dal Lake showing five sampling basins

LWR was calculated and statistically treated by the method of least squares using the equation of Le Cren (1951) given as:

$$\log W = \log a + b \log L$$

where, a and b are constants estimated by linear regression of the log-transformed values, 'a' is the intercept of the regression and 'b' is the regression coefficient (slope).

The growth rate of different body regions in comparison to TL was studied by regression analysis, employing the formula Y = a + bX and correlation coefficient (r) between TL with rest of the body parameters using SPSS (ver. 20). The determination coefficient ($r^2$) was used as an indicator of the quality of the linear regressions (Scherrer, 1984). All the statistical analyses were considered at the significance level of 5% ($p \leq 0.05$).

The present study showed that *S. niger* has an elongate fusiform body with short snout. Mouth is sub-terminal and slightly prognathous. Lips are thick and not expanded into folds. There is a slight increase in dorsum immediately after the head. In the current study, the smallest fish caught was 62 mm in total length with the corresponding weight being 10 g, while the maximum length of captured fish was 367 mm with corresponding weight being 491g. Descriptive statistics of various morphometric characteristics are given in Table 1.

Table 1. Statistical estimates of various morphometric characteristics

| Characteristics | Range (mm) | | Mean (mm) | SEM |
|---|---|---|---|---|
| | Min | Max | | |
| TL | 62 | 367 | 238.29 | 2.59 |
| SL | 44 | 332 | 204 | 2.31 |
| HL | 17 | 72 | 45 | 0.54 |
| MBD | 23 | 77 | 47 | 0.57 |
| PDL | 31 | 162 | 102 | 1.18 |
| PPL | 18 | 99 | 44 | 0.57 |
| PPeL | 33 | 163 | 105 | 1.19 |
| PAL | 53 | 262 | 159 | 1.81 |

TL = Total length; SL = Standard length; HL = Head length; MBD = Maximum body depth; PDL = Pre-dorsal length; PPL = Pre-pectoral length; PPeL = Pre-pelvic length; PAL = Pre-anal length

Maximum growth with respect to TL was shown by SL (85.56%) followed by PAL (66.65%), PPeL (43.98%), PDL (42.59%), MBD (19.67%), HL (18.88%) and PPL (18.64%). All these parameters recorded significant positive relationship (r=0.728-0.988) with the total length which was significant at $p \leq 0.05$ (Table 2). The functional relationships among TL, SL, HL, PDL, PPL, PPeL, PAL and MBD along with the estimated parameters of the LLRs and the coefficient of determination ($r^2$) are presented in Table 3 and diagrammatically shown in Fig. 3(a-g). The calculated values of $r^2$ in LLRs of TL with SL, PDL, PPL, PPeL, PAL, HL and MBD were recorded as 0.9763, 0.6910, 0.8524, 0.6614, 0.8770, 0.9106 and 0.6379 respectively.

The calculated 'b' value of LWRs was found as 2.8391 for male and 2.6073 for female. The value of 'b' of LWRs for both male and female were found to be less than

Table 2. Pearson correlation coefficient (r) for various morphometric characters of *Schizopyge niger*

| | TL | SL | PDL | PPL | PPeL | PAL | HL | MBD |
|---|---|---|---|---|---|---|---|---|
| TL | 1 | 0.988* | 0.831* | 0.799* | 0.923* | 0.813* | 0.937* | 0.954* |
| SL | | 1 | 0.840* | 0.821* | 0.935* | 0.822* | 0.948* | 0.962* |
| PDL | | | 1 | 0.772* | 0.849* | 0.871* | 0.857* | 0.838* |
| PPL | | | | 1 | 0.804* | 0.728* | 0.806* | 0.797* |
| PPEL | | | | | 1 | 0.841* | 0.965* | 0.942* |
| PAL | | | | | | 1 | 0.841* | 0.818* |
| HL | | | | | | | 1 | 0.943* |
| MBD | | | | | | | | 1 |

*Significant at p<0.05)

Table 3. Regression parameters 'a' and 'b', correlation coefficient 'r' and coefficient of determination '$r^2$' of various morphometric parameters (dependent variables) with total length (independent variable) of *Schizopyge niger*

| Dependent variable | Equation | a | b | r | $r^2$ |
|---|---|---|---|---|---|
| SL | SL= - 0.5537+0.8788 TL | - 0.5537 | 0.8788* | 0.9881 | 0.9763 |
| HL | HL = 0.4133+0.1715 TL | 0.4133 | 0.1715* | 0.8313 | 0.6911 |
| PDL | PDL = 0.1764+0.4185 TL | 0.1764 | 0.4185* | 0.9233 | 0.8525 |
| PPL | PPEC = 0.2222+0.1772 TL | 0.2222 | 0.1772* | 0.8133 | 0.6615 |
| PPeL | PPEL = 0.2066+0.4312 TL | 0.2066 | 0.4312* | 0.9365 | 0.8770 |
| PAL | PAL = - 0.0086+0.6669 TL | - 0.0086 | 0.6669* | 0.9543 | 0.9107 |
| MBD | MBD = 0.5021+0.1757 TL | 0.5021 | 0.1757* | 0.7987 | 0.6379 |

*Significant at p<0.05)

3 indicating negative allometric growth. Males showed higher values of 'b' as compared to females showing better growth. LWR of the fish was represented by the equation: log W = - 4.3831 + 2.7472 log L, indicating the allometric coefficient 'b' as 2.74 (Fig. 3h).

The morphometric measurements have been extensively used in the identification of fish (Kullander *et al*., 1999). In order to determine possible differences between separate unit stocks of the same species, morphometric relationships between length and weight are used (King, 2007). In *S. niger,* maximum growth with respect to TL was shown by SL (85.56%) followed by PAL (66.65%), PPeL (43.98%), PDL (42.59%), MBD (19.67%), HL (18.88%), PPL (18.64%) and fin length (7.31%). The SL showed a maximum value of correlation with TL (r = 0.9881) as compared to other parameters. However, there was a significant positive correlation between the growth of all other parameters with TL (p<0.05).

The length-weight relationship plays an important role in fishery management and is also used in estimating the average weight at a given length group (Beyer, 1987). Length-weight relationships are useful in fisheries research because they allow the conversion of growth-in-length equations to growth-in-weight, biomass estimation, the condition of the fish, differences of life histories of fish species and are useful in fish stock and population assessments (Moutopoulos and Stergiou, 2002). Ideally, the value of 'b' usually varies between 2 and 4 (Tesch, 1971) and in majority of cases under natural conditions it is hardly found equal to 3 (Hile, 1936). Allen (1938) found that true cases of strong allometric growth (cube law) apply only to those species, which show little or no change in their form and specific gravity during their growth. Lagler (1956) also reported that the cube law does not hold well throughout the life period and the weight gain in a fish may not be always be cube of its length gain. Antony (1967) recorded the value of 'b' within a range of 2 to 5 (Fig. 3h).

Qadri and Mir (1983) calculated the value of 'b' to be equal to 2.448 in *Schizothorax richardsonii* of Sindh Nallah while Mir *et al.* (2012) reported different values of 'b' (<3) in different months in case of *Schizothorax curvifrons* from river Jhelum. Khan *et al.* (2013) reported 'b' values of 2.69, 2.66, 3.08, 2.64 and 2.86 for *S. curvifrons*, *S. niger*, *Schizothorax esocinus*, *Schizothorax labiatus* and *Schizothorax plagiostomus,* respectively. Bhat *et al.* (2010) reported on the values of 'b' for *S. labiatus* (3.0997), *S. esocinus* (3.0034) and *S. plagiostomus* (2.9467) in the Lidder River of Kashmir. Yousuf *et al.* (1992, 2001) reported 'b' value for *S. niger* of Manasbal Lake, Dal Lake and Anchar Lake as 3.014, 2.977 and 2.974 respectively.

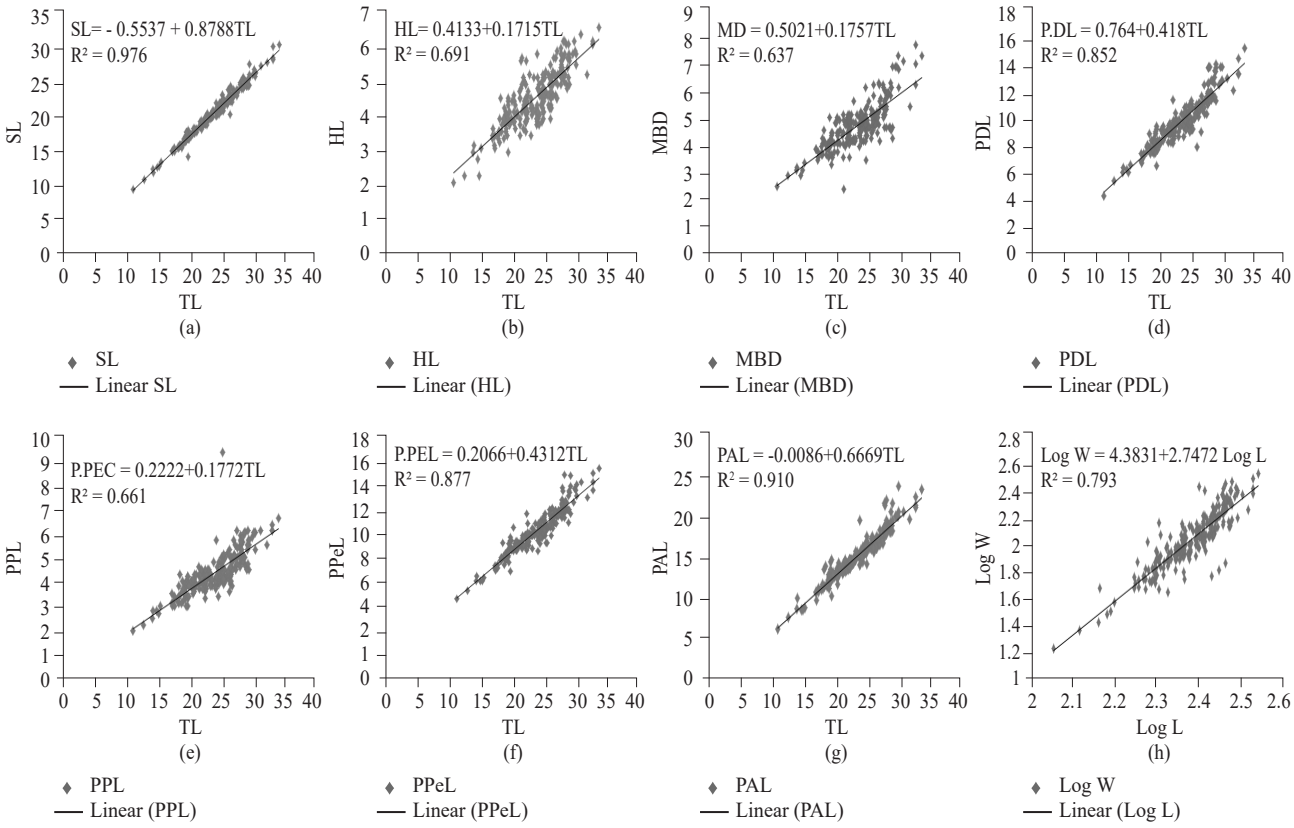


Fig. 3. Scatter diagram showing morphometric relation between TL and (a) SL, (b) HL, (c) MBD, (d) PDL, (e) PPL, (f) PPeL, (g) PAL and (h) LWRs in *Schizopyge niger*

The estimated allometric coefficient 'b' was recorded as 2.74 with males (b=2.8391) showing higher value as compared to females (b=2.6073). These values are well within the limits (2 and 4) reported by Tesch (1971) for most fishes. Thus, the LLRs established for *S. niger* suggested negative allometric growth of the cube law thus indicating that the fish is growing more in length as compared to weight. Khan and Sabah (2013) also reported the exponential value of 'b' equal to 2.66 in *S. niger*. While Yousuf *et al.* (1992, 2001) reported 'b' value of 2.977 for *S. niger* from Dal Lake.

Comparing the present values of 'b' in *S. niger* with previous studies, it is evident that the value of 'b' is less. Thus, the LWRs established for *S. niger* suggested negative allometric growth. However, the value of 'b' observed was higher in males (2.839) than in females (2.607) which was significant at $p<0.05$, indicating that males show ideal growth as compared to females. Zargar *et al*. (2012) also reported higher values of 'b' in case of males of *Carassius carassius* in Dal Lake (b = 2.8). The present low value of 'b' as compared to previously reported values ndicates that the lake is not healthy. Deteriorating water quality as well as high load of pollution may be responsible for the non-ideal growth of the fish particularly of females. Same has been recorded by earlier workers from this region as well as from other areas of the world (Sunder and Subla, 1984; Weatherley and Gill, 1987; Bhat *et al.,* 2010; Zargar *et al*., 2012). Le Cren (1951) also specified that the variation in 'b' value is because of the environmental factors, nutrient load, food availability, sex, life stage, season and other physiological factors.

## Acknowledgements

The authors are immensely thankful to the Dean, Faculty of Fisheries, SKUAST-K for providing the necessary facilities for carrying out the research work. Sincere acknowledgement is also due to the fishermen of Hazratbal Srinagar for their cooperation during sampling.

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Date of Receipt : 14.04.2017
Date of Acceptance : 31.08.2018