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Length-weight relationship of six freshwater fish species from Wular Lake - A Ramsar site in Kashmir Himalaya, India

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Abstract

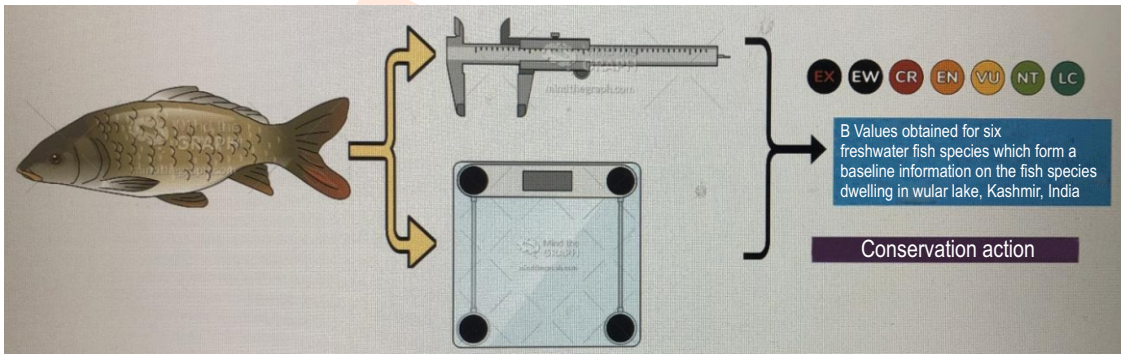
Aim: This study was undertaken to understand the length weight relation of six freshwater fish species from Wular Lake.

Methodology: A total of 303 specimen belonging to two families (Cyprinidae and Nemacheilidae) and four genera (*Schizothorax, Triplophysa, Crossocheilus, Puntius*) from Wular Lake were collected from five different sites with the help of local skilled fishermen using cast nets and traditional nets. Total length and weight were measured to the closest 0.1 mm and 0.01 g employing a digital caliper and weighing balance, respectively.

Results: The values of the exponent b in length-weight relationship was recorded as 2.05 for *Triplophysa marmorata*, 0.31 for *Crossocheilus diplochilus*, 0.12 for *Pethia conchonius*, 4.14 for *Schizothorax niger*, 2.58 for *Schizothorax esocinus* and 4.93 for *Schizothorax curvifrons* respectively. These results provide the primary basic information on length-weight parameters of these commercially important fish species from Wular Lake.

Interpretation: Length-weight relationship can form a baseline data that can be further employed to study the growth pattern of fish species in the lake. This would help in the development of a strategy for conservation of natural stocks of these endemic fish species in Wular Lake.

Key words: Ecological, Freshwater, Ramsar, *Schizothorax*, Wular Lake



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Introduction

Wular Lake, located in district Bandipora (Jammu and Kashmir) is one of the largest freshwater lakes of India. Owing to its diversified habitats, it was designated as a wetland (Ramsar site) of International importance under the Ramsar Convention in 1990. The lake harbour indigenous and exotic fishes, macrophytes and migratory birds. The lake is known for being an important fish habitat for Schizothoracids, carps of commercial importance and other small fish species of ecological importance. Many fishers who inhabit various villages around the periphery of lake are entirely dependent on the lake for their livelihood. While some earn their livelihood entirely from fishing, others are engaged in harvesting of water chestnut (Trapa) and floating heart (Nymphoides). Inspite of being an important natural habitat to a wide range of aquatic flora and fauna and also a vital source of livelihood for local community, the lake continues to face numerous challenges including pollution, siltation and encroachment. Wular with its extensive surrounding marshes is the natural habitat for wild life. It is also an important fish resource accounting for about 60% of the total fish production in the state (Rumysa *et al.,* 2012). It is the source of sustenance for a huge chunk of human population living along its fringes.

Length-weight relationship is a commonly used tool in fisheries science to estimate the weight of fish based on their length. It is important in fisheries management as it can be used to calculate the biomass of a fish population and determine the growth and condition of individual fish. Length-weight relationship can be regarded as a keystone tool for investigating and managing of fish stock. This relation can also be helpful to compare the morphometric parameters among various species or among same species from geographically isolated water bodies (Goncalves *et al.,* 1997, Moutopoulos and Stergiou, 2002). Many studies have emphasized on the importance of determining length-weight relationship of fish as it provides information about the growth pattern, habitat, life history, health and morphological characteristics of fish (Schneider *et al.,* 2000; Froese, 2006). These values vary among fish species depending on the inherited body shape and other factors like stage of maturity and spawning (Schenider *et al.,* 2000). Thus this relation can change over a period of time extending between seasons/days/months (De Giosa *et al.,* 2014).

These relationships are also used for comparison of life history studies, population dynamics, biomass estimation, ecosystem modelling, and stock assessment (Erzini, 1994; Jisr, *et al.,* 2018; King, 1995; Lteif *et al.,* 2016; Santos, *et al.,* 2002). A lot of research works have been carried out to study the length-weight relationships of indigenous freshwater fish species from Kashmir waters (Qayoom *et al.,* 2015; Mushtaq *et al.,* 2016; Mushtaq *et al.,* 2018). Khan and Sabah (2013) while studying the length-weight and length–length relationships for five fish species from Kashmir Valley found that three species of *Schizothorax* (*S. esocinus, S. labiatus* and *S. plagiostomus*) showed negative allometric growth indicating that the allocation of energy is more toward axial growth rather than to isometric growth. However, limited information is available on the length weight relationships of fishes from Wular Lake. Hence, this study was under taken up with an objective to study the length weight relation of these fishes present in this freshwater lake.

Materials and Methods

A total of 303 fish samples were collected on a monthly basis from five different sites of Wular Lake (Watlab Ghat, Vintage park, Sopore Ghat, Central site and Ashtung). Sampling was carried out for a period of one year. The samples were collected during the day time by local skilled fishers using cast nets (mesh size of 15–20 mm), and traditional nets/traps made locally. Freshly caught fish specimens were preserved in ice and delivered to the laboratory of Fisheries Resource Management, Faculty of Fisheries, SKUAST-K. Species were identified using standard literatures of Talwar and Jhingran (1991) and Jayaram (1999). Total length (TL) and body weight (W) were measured to the nearest 0.1 cm and 0.01 g with a digital calliper and electronic weighing balance, respectively. The length-weight relationship, W = a*Lb i.e., log W = log a + b log L were estimated by linear regression analysis where "a" is the intercept and "b" is the slope of linear regression on the log-transformed data variables (length and weight) (Froese, 2006).

Results and Discussion

Fish were evaluated for their International Union for Conservation of Nature (IUCN) status (Table 1). While two species (*Triplophysa marmorata* and *Pethia conchonius)* were listed under the "Least Concern" category and three (*Schizothorax niger, Schizothorax curvifrons* and *Crossocheilus diplochilus*) were listed under "Not Evaluated" category, the commercially important *Schizothorax esocinus* found its place in the vulnerable status (IUCN, 2022), thus suggesting that conservation measures should be taken up in order to save this fish species from further exploitation. The results are further presented in Table 1 as descriptive statistics and estimated parameters of length- weight relationship, "a and b" and coefficient of determination (R2) for six indigenous fish species from Wular Lake, Kashmir, India.

For *Pethia conchonius* and *Crossochelius diplochilus*, the maximum values of total length used for estimation of length weight relationship were 9.8 cm and 15.0 cm, while earlier reported maximum values for the same were 25.7 cm for *Pethia conchonius* from lakes of Kumaon Himalaya, Uttarakhand (Negi and Negi, 2009) and 18.1 cm for *Crossocheilus diplochilus* from two tributaries of Indus river basin, Jammu and Kashmir (Bashir *et al.,* 2015). Similarly, for *Triplophysa marmorata*, the maximum total length range of 14.4 cm was used as against previous report of 14.5 cm from two tributaries of Indus river basin, Jammu and Kashmir (Bashir *et al.,* 2015). For *Schizothorax niger, S. esocinus* and *S. curvifrons*, the maximum values of total length were 34.7, 30.9, 32.3, respectively against the maximum values of total

Table 1: Descriptive statistics and estimated parameters of length-weight relationship for six freshwater Cyprinid and Balitorid fish species collected from Wular Lake, Kashmir.

Family	Species	N	Total length (cm)		Total weight (g)		Regression parameters			IUCN status
			Min	Max	Min	Max	a^a	b	r^2	
Cyprinidae	*Pethia conchonius* (Hamilton, 1822)	38	5.00	9.80	6.30	13.00	0.97	0.12	0.82	LC
	Crossocheilus diplochilus (Heckel, 1838)	48	1.50	15.0	6.20	39.20	1.46	0.31	0.85	NE
	Schizothorax niger (Heckel, 1838)	80	16.1	34.7	63	410	2.69	4.14	0.69	NE
	Schizothorax esocinus (Heckel, 1838)	47	14.7	30.9	94	360	2.04	2.58	0.53	VU
	Schizothorax curvifrons (Heckel, 1838)	16	17.9	32.3	76	405	3.01	4.93	0.77	NE
Nemacheilidae	*Triplophysa marmorata* (Heckel, 1838)	74	6.60	14.4	17.0	21.50	2.96	2.05	0.97	LC

Note: Species in bold, N: Sample size, a: Intercept, b: Slope of the linear regression, r^2: Coefficient of determination IUCN Status: LC: Least Concern, NE: Not Evaluated, VU: Vulnerable

length reported for *Schizothorax niger* as 35.9 (Shafi and Yousuf, 2012), *S. esocinus* as 42.00 (Bhat *et al.,* 2010) and *S. curvifrons* as 44.6 (Qadri *et al.,* 2017). The recorded values were different from the previous studies which can be due to sample size and length range or difference in the thermal regimes of water which influences fish growth (Jobling, 1997). In addition, the growth process can differ in the same species living at diverse locations with a marked difference in topography, terrain and also influenced by numerous other biotic and abiotic factors. Enin (1994) stated that when b value is equal to three, growth is isometric (increasing in all dimensions at the same rate) and when it is less than or more than 3, it is allometric (fish grows faster in length than in weight). However, Wootton (1992) specifically stated that growth is positively allometric when the weight of the organism increases more than length (b>3) and negatively allometric when length increases more than weight (b<3). In case of isometric growth (b= 3), the a (intercept) can be considered to be an indicator of good physiological condition in a certain environment; if it is allometric, however, 'a' cannot be interpreted in this manner (Pauly, 1984).

A number of intrinsic (gonadal development, age, sex, genetic makeup) and extrinsic factors (e.g., food availability, season, habitat characteristics, etc.) are known to affect the b value of fishes. In the present study, the b value of test species ranged from 0.12 to 4.93. Considering the b values, it was observed that large specimens have a body shape that becomes more elongated or small specimens were in better nutritional condition at the time of sampling. Similar kind of observation was recorded by Goel *et al.* (2011) in *S. richardsonii* from hill streams of Uttarakhand (Shafi and Yousuf, 2012) in *S. niger* from world famous Dal Lake of Kashmir. These changes were attributed to size, sex, feeding intensity and gonadal development of fish. It is expected that b may change during different time periods illustrating the fullness of stomach, general condition of appetite and gonads stages (Flura *et al.,* 2015). As far as b value of *Pethia conchonius* is concerned, it followed a negatively allometric growth (b<3). A similar value has been reported by Mir and Mir (2012) for the same fish species. The b value for *Triplophysa marmorata* (2.05) is somewhat similar and in agreement with the values of a previous study (2.96) by Mushtaq *et al.* (2018). The b values for *Schizopyge esocinus* were recorded as 2.58 which is in accordance with the findings of Rather (2002) as 2.9270 from the Jhelum. The results however are not in agreement with the findings of Bhagat and Sunder (1984) who reported a b value of 3.0180 from the Dal Lake.

The deviation of values can be attributed to the difference in environmental factors like pH, temperature, dissolved oxygen, ammonia and heavy metal concentration. Yousuf and Firdous (1992) and Yousuf *et al.* (2001) observed that difference in the environmental factors can have a marked influence on the b values. Similarily for *Schizothorax niger*, the b values in the present study were recorded as 4.14 which is not in accordance to the previous findings of Shafi and Yousuf (2012) and Rani *et al.,* 2018 who reported it as 3.07 and 2.57 respectively for fishes from Dal Lake. The b values for *Schizothorax esocinus* recorded as 2.58 are in agreement with those reported by Qadri *et al.* (2017) while working on the same species from River Jhelum. It can be inferred that the 'b' value is influenced by the geographical and ecological differences which lead to variations in water quality parameters and food availability thereby affecting the fish growth (Mommsen, 1998). This study provides the first length weight relationship reports for these endemic fish species from Wular Lake, Kashmir, India. Considering the importance of these fish species both in terms of commercial importance, decorative value and biodiversity, all the presented values on length weight relationships of those species which can be used as basic biological parameters for future management and conservation of these fishes. Mir *et al.* (2012) reported different 'b' values (<3) in different months in *S.*

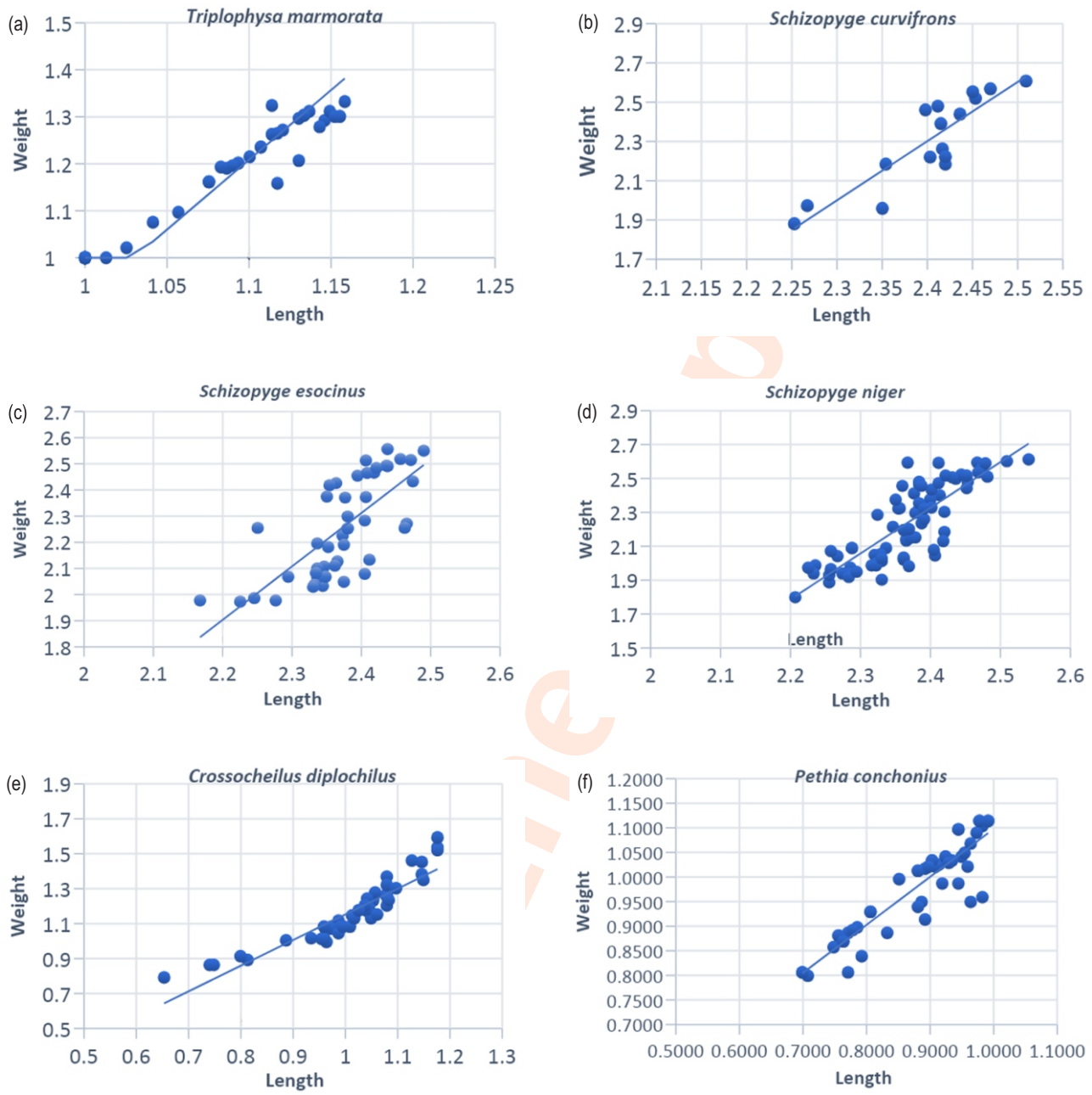

Fig. 1 (a - f): Scatter diagram representing length-weight relationship of fishes found in Wular Lake, Kashmir (Length is measured in mm and weight in g)

curvifrons from River Jhelum. Khan and Sabah (2013) reported the exponential value of 'b' equal to 2.69 for *S. curvifrons*. Similar observations were mentioned by earlier workers from this region as well as other areas of the world (Bhat *et al*., 2010; Zarger *et al*., 2012; Tah *et al*. 2012; Zhu *et al*. 2021).

The significance of fisheries management, conservation efforts, and comprehending the general health and expansion of fish populations has been highlighted in this study paper's examination of the relationship between length and weight in fish species. The link between length and weight differs among fish species, reflecting their distinct life histories, habitats, and feeding behaviors, as we have seen through the examination of length-weight data. This study emphasizes the significance of gathering precise and current length-weight data for various fish species in order to guide sustainable management strategies and

guarantee the long-term viability of fish populations. We can help to preserve aquatic habitats and maintain a healthy fish resource for future generations by improving our knowledge of the length-weight relationship in fish.

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