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Length-weight relationship, morphometric and meristic controlling elements of three freshwater fish species inhabiting North Western Himalaya

Shahid Mehmood[1], Imtiaz Ahmed[1]* and Md. Niamat Ali[2]

[1]Fish Nutrition Research Laboratory, Department of Zoology, University of Kashmir, Hazratbal, Srinagar
[2]Centre of Research for Development, University of Kashmir, Hazratbal, Srinagar, India 190006
***Corresponding author: imtiazamu1@yahoo.com**

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ABSTRACT

Length-weight relationship (LWRs) is a propondral index used to understand the general health of the fish through various growth-related indices, besides being helpful to compare different fish populations. In the present study, LWRs, morphometric and meristic elements of three food fish species, including *Tor putitora* (Chirak), *Labeo dero* (Karah)and *Schizothorax richardsonii* (Lass) and inhabiting the Rajouri River of North-Western Himalayan region were investigated. From June 2019 till May 2020, Specimens of *T. putitora*, *L. dero,* and *S. richardsonii* (45, 40, 40 individual/species, respectively)were collected by using gill and cast nets. Results showed that 'b' value for *L. dero* was 3.187 and for *T. putitora* was 3.102, indicating a positive allometric growth (b > 3). While, in the case of *S. richardsonii*, the 'b' value was recorded 1.915 with negative allometric growth (b < 3). The regression coefficient (r^2) value was noted as 0.95, 0.94, and 0.91 for *T. putitora, L. dero,* and *S. richardsonii*, respectively. Moreover, the condition factor of all the three species was near to '1', indicating the suitability of environmental conditions for better growth of these fish species. In addition, a total of 23 morphometric characters and 6 meristic counts were also analyzed, where morphometric characters showed a gradual increase with respect to body length, while the meristic counts remained constant with respect to the increase of body length. Data obtained can give a deep insight into the welfare of fish upon which a proper strategy can be affordable to manage and conserve fish population and their biomass.

INTRODUCTION

In freshwater habitats, a decline in fish population has been witnessed day-by-day due to some factors, including habitat degradation, overfishing, pollution and inadequate strategies for proper management and conservation of fish and its resources **(Odo *et al.*, 2009)**. To conserve the fishery resources, there is a dire need to determine a strategy that will provide an insight about the well-being of fish. It is considered as a keystone tool for the investigation of fish healthto conserve and manage their stock population and biomass. The LWR is applied for estimating the standing stock biomass and comparing the ontogeny of fish populations in different regions **(Ayoade & Ikulala, 2007)**. Now-a-days, studying the LWR of fish is also considered an important biological marker to generate information about the growth condition of

fish species living in both natural and culture environment. In addition, it plays a significant role in the biological study of fish, which gives the degree of the well-being of the fish in its habitat along with its physiological and biological conditions. Besides, it provides information about fish population growth rates and their dynamics **(AL Nahdi *et al*., 2006)**. Moreover, the LWR affords data concerning fisheries' management throughsetting yield equations for estimating and relating the population, and thereby base line data on stock condition can be generated both spatially and temporally **(Kumary & Raj, 2016).** Moreover, it can also be applied to study the feeding rate, development of gonads and maturation stages of fish **(Beyer, 1987)**. However, LWRs data differ among species depending on inherited body shape and physiological factors such as maturity and spawning **(Schneider *et al*., 2000)**. The sustainable exploitation of freshwater fish species for commercial purposes is inevitable, which emphasized that fishery continuously plays an important role in the social and economic growth of the world. The LWRs study is an approach that is widely applied in fisheries management as it provides information on stock density, biomass, breeding grounds, seasons, health status and availability of the fish **(Froese, 2006; Sharma *et al*., 2016)**. Nowadays, the study of LWRs of some threatened fish species contains the most important biological parameters that provide information about the growth and condition of fish species as well as the entire fish community. Additionally, it is highly significant for fishery research, management and conservation of fish populations.

Apart from LWR, the condition factor (K) indicates the well-being of fish with respect to habitat and season as well. The 'K' is also an important quantitative parameter used to analyze the well-being of fish and the degree of feeding activity, reflecting recent feeding habits, reproductive status, and physiological state of fish in relation to its fitness. Besides, it is a useful indicator to understand the accumulation of fat in fish body and comprehend their gonad development as well.

Morphometric and meristic characters provide quantitative description for the identification of fish and are considered as dynamic elements commonly used to measure the differences between populations of same fish species **(Cardin, 2000; Doherty & McCarthy, 2004)**. Morphological variations between fish populations are actually controlled by a combination of ecological factors that include temperature, radiation, dissolved oxygen, water depth and water flow **(Turan, 1999)**. Environmental variability has been widely used by ichthyologists to differentiate between populations within a specific species **(Murta, 2000)**. Morphometric characters and meristic counts are not only essential to understand the taxonomy, but the differences in its features are probably related to the habitat among the variants in different species **(Turan *et al*., 2004; Randall & Pyle, 2008)**.

The River Rajouri originates from Rattan ridge of Pir Panjal Himalayan range after passing a stretch of more than 100 km and enters into the Chenab River. The water bodies of the River Rajouri are considered as a dwelling for diverse fish species and other aquatic organisms. Several fish species have been reported form the river like *Labeo boga, Labeo bata, Labeo dero, Crossochelius latius, Tor putitora, Puntius conchonius, Schizothorax richardsonii* etc. **(Gandotra & Sharma, 2015)**. Among these, *T. putitora*, *L. dero* and *S. richardsonii* are

dominant fish species of the river and are considered as important food fish species of the region. *T. putitora*, the golden Mahseer is the most important cyprinid fish that provides a significant contribution towards the overall fish production of the river. However, the population of Mahseer has been drastically declined and is on the verge of extension **(Khajuria & Langer, 2014)**. While, genus Labeo is a very important fish and is largely consumed throughout the country due to its great nutritive value and easy availability, but the population of this fish species has also been affected recently. Remarkably, ray-finned fish, *S. richardsonii*, was also found in the river because it preferesto live in cold water mountainous rocks and mainly feeds on aquatic plants and detritus **(Krishan & Tarana, 2010)**. It fetches high marketability due to its taste and nutritional quality. The overall fish production from the river has been decreased due to some reasons and needs serious concern to understand the well-being of fish species habituating in the river.

Although, works have been concerned with the LWRs, morphometric characters and meristic counts of different fish species have been reported in the past and the details have been reviewed **(Sheikh & Ahmed, 2019; Awas *et al*., 2020)**. Despite all that, fisheries are still collapsing in some parts of the world, especially in freshwater ecosystem, and efforts to sustain the strategy for the conservation of fish biodiversity are imperative. As per existing literature, the LWRs, morphometric and meristic characters of three important fish species inhabiting the Rajouri River has not yet been reported. Therefore, in the present study, an attempt has been made to investigate LWR, morphometric and meristic characters of these fish species.

MATERIALS AND METHODS

The present study was carried out to estimate the LWR, morphometric and meristic controlling elements of three freshwater food fish species inhabiting the River Rajouri in the North Western Indian Himalayan range. During the study period from June 2019 to May 2020, a total of 125 fish specimens were collected from four sites of the river viz. Thannamandi ($33^0 31' 50.7'' N$; $74^0 21' 45.6'' E$) followed by Maradupur ($33^0 19' 14.6'' N$; $74^0 19' 40.6'' E$), Narian ($33^0 10' 30.0'' N$; $74^0 15' 44.5'' E$) and Baripatan ($33^0 04' 06.3'' N$; $74^0 21' 58.9'' E$) with the help of a local fisherman using cast and gill nets. The species collected included *T. putitora* (45), *L. dero* (40) *and S. richardsonii* (40). After collection, the specimens were identified with the help of the standard keys given by **Talwar and Jhingran (1991)** and **Kullander *et al*. (1999)**. The samples were brought in icebox to the Research laboratory, Department of Zoology, University of Kashmir, and the required measurement of length and weight were taken. In the present study, a total of 23 morphometric characters and 6 meristic counts were taken into consideration. The total length of fish was measured to its nearest 0.01 cm using Vernier caliper, and body weight was taken using digital electronic balance (Shimadzu UX320G) having 0.01 gm sensitivity, respectively. The total length of fish was taken from the tip of snout to the extended tip of the caudal fin, and the relationship was analyzed by measuring length and weight of fish specimen collected from study

area. The statistical relationship between length and weight of these fishes were estimated by using the algometric equation of **Froese (2006)** as follows:

$W= aL^b$

Where, W = Total body weight (g)
L = Total length of fish (cm)
a = Initial growth coefficient
B = Slope or the growth coefficient

The parameters 'a' (intercept) and 'b' (regression coefficient slope) were derived by using the following formula of **Le Cren (1951):**

LogW = Loga + bLog L

Condition factor (k)

The coefficient of condition 'K' was calculated using the equation of **Fulton (1904)**:

$K = W/ L^3 \times 100$

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

RESULTS

Length weigh relationship (LWR) and Condition factor (K)

In the present study, the LWR, condition factor (K), morphological characters and meristic counts of three fish species inhabiting the River Rajouri of the North Western Himalayan region have been evaluated. Significant differences with respect to their regression co-efficient values were recognized. The total length (TL) and body weight (BW) of three different fish species were reported in the range from 17.4 - 36.5cm; 45.3 - 504g for *T. putitora,* 22.8 - 42cm; 118.6 - 850g for *L. dero* and 15.7- 32.5cm; 58.9 - 212.7g for *S. richarsdsonii.* The LWRs were obtained as Log W = -2.2067 + 3.102 Log L for *T. putitora*, Log W = -2.2299 + 3.1874 Log L for *L. dero* and Log W = -0.6024 + 1.9514 Log L for *S. richarsdsonii,* while the co-efficient determination of the three species was recorded to be 0.955, 0.940 and 0.915, respectively. The 'b' value of the three species as follows:3.102 for *T. putitora,* 3.187 for *L. dero* and 1.954 for *S. richardsonii* with recorded regression coefficients (r^2) of 0.955 for *T. putitora*, 0.945 for *L. dero* and 0.915 for *S. richardsonii*, respectively. The highest 'b' value (3.187) was found in *L. dero,* followed by *T. putitora* (3.102), whereas the lowest 'b' value (1.953) was found in *S. richardsonii.* The condition factor (K) value was recorded to be 0.87 for *T. putitora,* 1.122 for *L. dero and* 1.00 for *S. richardsonii* (Table 1).

Table 1. Descriptive statistics and estimated parameters of length-weight relationship (LWRs) and their regression parameters, (95%CI) and condition factor (K) of three food fish species inhabiting the river Rajouri of North Western Himalayan, range

Species	No.	Total length (cm)		Weight (g)		b	95% CI of b	a	95% CI of a	r^2	K
		Min.	Max.	Min.	Max.						
Tor putitora	45	17.4	36.5	45.3	504	3.10	2.893 - 3.309	0.110	0.082- 0.147	0.955	0.87
Labeo dero	40	22.8	42	118.6	850	3.18	2.924 - 3.450	0.107	0.072- 0.158	0.940	1.12
Schizothorax richardsonii	40	15.7	32.6	58.9	212.7	1.95	1.765- 2.140	0.544	0.423–0.700	0.915	1.00

Controlling elements

A total of 23 morphometric characters and 6 meristic counts were studied during the present work. Correlation coefficient and regression equations were applied on all characters except for pre-orbital length, inter-orbital length and snout length in relation to the total length of fish. While, pre-orbital length, inter-orbital length and snout length were correlated with the head length of fish. Different morphometric characters and meristic counts were studied with respect to the three different fish species, and were then analysed statistically to determine mean, standard deviation, range, range difference, co-relation coefficient and regression equation. Total length and total weight were found highly significant with an 'r' value of 0.955 for *T. putitora.* The parameters that showed highest correlation in relation to total length were standard length (SL) and fork length (FL), which showed a correlation of 0.976 and 0.977 (Table 2). While, the meristic counts, such as number of lateral line scales, pectoral fin rays, pelvic fin rays, dorsal fin rays, anal fin rays and caudal fin rays in *T. putitora* also showed some vital differences (Table 3). In the case of *L. dero*, the total length and total weight varied between each other with 'r' value of 0.940. The parameters that showed the highest correlation in relation to the total length were standard length (SL) and fork length (FL), which showed co-relation values of 0.946 and 0.931, respectively (Table 4). Meristic counts included the number of lateral line scales, pectoral fin rays, pelvic fin rays, dorsal fin rays, anal fin rays and caudal fin rays and also showed some correlation differences with respect to length and weight (Table 5). For *S. richardsonii*, the total length and total weight showed some significant variations with 'r' value of 0.915. The parameters that showed the highest correlation in relation to the total length were fork length (FL) and standard length (SL) with co-relation values of 0.917 and 0.88, respectively (Table 6). The number of lateral line scales, pectoral fin rays, pelvic fin rays, dorsal fin rays, anal fin rays and caudal fin rays in *S. richardsonii* were also studied and correlated (Table 7). During the study, the highest correlation among all the morphometric characters was standard length and

fork length in all the three different fish species. The correlation analysis indicates that all morphometric characteristics showed a proportional change as the total length increased. However, all the meristic characters of *T. putitora*, *L. dero* and *S. richardsonii* showed significant differences among each other. Thus, giving an idea that meristic counts are independent on the body size of fishes.

Table 2. Range, mean, range difference, SD, correlation coefficient (r) and regression equation between different morphometric characters of *T. putitora,* inhabiting the River Rajouri of North Western Himalayan, range

S.no.	In the percentage of total fish length	Range	Mean	Range difference	SD	Correlation co-efficient	Regression equation
1.	Standard length(SL)	14-32	21.5	18	4.832	0.9765	Y=1.0832x- 0.2063
2.	Fork length(FL)	15.2-34	23.7	18.8	5.299	0.9777	Y = 1.0743x- 0.1506
3.	Pre pectoral length	3-9	5.4	6	1.496	0.9022	Y = 1.2717x- 1.0721
4.	Pre pelvic length	7-15	10.7	8	2.307	0.9587	Y = 1.0438x- 0.4505
5.	Pre dorsal length	6.5-14.8	10.4	8.3	2.196	0.9485	Y = 1.0094x- 0.4164
6.	Pre anal length	10-22	15.7	12	3.251	0.9381	Y = 0.9725x- 0.184
7.	Pectoral fin length	0.8-8.2	1.6	7.4	1.464	0.0118	Y = 0.2389x- 0.2007
8.	Pectoral fin height	1-5.4	3.6	4.4	0.977	0.6	Y = 1.1922x- 1.1436
9.	Pelvic fin length	0.6-2.6	1.1	2	0.353	0.472	Y = 0.9091x- 1.2289
10.	Pelvic fin height	1-5	3.1	4	0.842	0.2176	Y = 1.8112x- 2.0334
11.	Dorsal fin length	2-4.9	2.9	2.9	0.665	0.7753	Y = 0.9354x- 0.8605
12.	Dorsal fin height	2.1-5.8	4.2	3.7	0.900	0.5433	Y= 0.8404x- 0.5727
13.	Anal fin length	1-3	1.78	2	0.548	0.6903	Y = 1.2949x- 1.5969
14.	Anal fin height	1.3-6	3.3	4.7	0.854	0.5909	Y = 1.0091x- 0.9146
15.	Caudal fin length	1.8-5	2.9	3.2	0.849	0.7321	Y = 1.1939x- 1.2264
16.	Caudal fin height	2.4-8	5.1	5.6	1.367	0.6615	Y= 1.1624x- 0.9497
17.	Maximum body depth	3.8-8.2	5.6	4.4	1.290	0.8541	Y = 1.0022x- 0.6724
18.	Minimum body depth	1.3-4	2.5	2.7	0.582	0.7793	Y = 0.9985x- 1.0225
	In the percentage of Head length						
19.	Pre-orbital	1-3	1.85	2	0.468	0.746	y = 0.8867x - 0.372
20.	Inter-orbital	1.5- 4	2.32	2.5	0.582	0.487	y = 0.7017x - 0.1426
21.	Snout length	1-5	2.2	4	0.902	0.655	y = 1.2254x - 0.5531

Table 3. Meristic characters of *T. putitora*, inhabiting the River Rajouri of North Western Himalayan, range

Meristic Characters	Range
No. of lateral line scale	22-34
Pectoral fin rays	10 -15
Pelvic fin rays	7-10
Dorsal fin rays	9-13
Anal fin rays	5- 8
Caudal fin rays	15-22

Table 4. Range, mean, range difference, SD, correlation coefficient (r) and regression equation between different morphometric characters of *L. dero,* inhabiting the River Rajouri of North Western Himalayan, range

S.no.	In the percentage of total fish length	Range	Mean	Range difference	SD	Correlation co-efficient	Regression equation
1.	Standard length(SL)	19.9 -36	24.90	16.1	4.072	0.9464	Y=1.087x- 0.2163
2.	Fork length(FL)	21.8- 39	27.62	17.2	4.130	0.9319	Y = 0.99 x- 0.0269
3.	Pre pectoral length	3.2- 9	5.15	9	1.269	0.6837	Y =1.272 x- 1.1804
4.	Pre pelvic length	8.6-18	12.07	18	2.091	0.8525	Y = 1.1017 x- 0.5531
5.	Pre dorsal length	8-17	10.92	17	2.276	0.8386	Y = 1.2569 x- 0.8282
6.	Pre anal length	14-27	17.97	27	2.877	0.896	Y = 1.0152 x- 0.2514
7.	Pectoral fin length	1-2.8	1.617	1.8	0.411	0.6858	Y = 1.4368 x- 1.9284
8.	Pectoral fin height	2.3-6.5	4.442	4.2	0.909	0.819	Y = 1.3692 x- 1.386
9.	Pelvic fin length	1-3.5	1.495	2.5	0.427	0.4937	Y = 1.2036 x- 1.6184
10.	Pelvic fin height	2.3- 6	4.265	3.7	0.849	0.6777	Y = 1.2129 x- 1.1722
11.	Dorsal fin length	2.3-12.6	5.275	12.6	2.206	0.5312	Y = 1.6888 x- 1.8007
12.	Dorsal fin height	3-7.8	5.01	4.8	0.958	0.2691	Y = 0.6823 x- 0.3163
13.	Anal fin length	1-3.5	2.195	2.5	0.636	0.7222	Y = 1.8281 x- 2.38
14.	Anal fin height	1.2-5.3	3.88	4.1	0.987	0.6583	Y = 1.7247 x- 1.9778
15.	Caudal fin length	2-6.8	4.012	4.8	1.375	0.763	Y = 2.2076 x- 2.6863
16.	Caudal fin height	2.5- 9	6.147	6.5	1.576	0.6444	Y = 1.7374 x- 1.7973
17.	Maximum body depth	4.6-14	7.45	9.4	1.768	0.8549	Y = 1.3969 x- 1.2032
18.	Minimum body depth	2.2-5	3.34	2.8	0.657	0.8949	Y = 1.2749 x- 1.369
In the percentage of Head length							
19.	Pre-orbital	1.3-3.8	2.46	2.5	0.641	0.559	y = 0.7579x - 0.1545
20.	Inter-orbital	1.5-5	2.88	3.5	0.699	0.286	y= 0.481x + 0.1106
21.	Snout length	1.2-4.2	2.52	3	0.797	0.578	y = 0.9529x - 0.2888

Table 5. Meristic characters of *L. dero*, inhabiting the River Rajouri of North Western Indian Himalayan, range

Meristic Characters	Range
No of lateral line scale	23-45
Pectoral fin rays	12-17
Pelvic fin rays	8-10
Dorsal fin rays	10-22
Anal fin rays	6-8
Caudal fin rays	17 -23

Table 6. Range, mean, range difference, SD, correlation coefficient (r) and regression equation between different morphometric characters of *S. richardsonii*, inhabiting River Rajouri of North Western Himalayan, range

S.no	In the percentage of total fish length	Range	Mean	Range difference	SD	Correlation co-efficient	Regression equation
1.	Standard length(SL)	13-26.3	18.06	13.3	3.290	0.885	Y = 0.9436x- 0.0152
2.	Fork length(FL)	14-27	19.72	13	3.705	0.9175	Y = 1.0028x- 0.057
3.	Pre pectoral length	1.8-7	4.013	5.2	1.402	0.851	Y = 1.8905x- 1.9589
4.	Pre pelvic length	6.7-14	9.168	7.3	1.744	0.8884	Y = 0.9514x- 0.3205
5.	Pre dorsal length	6.8-13	8.897	6.2	1.580	0.8816	Y = 0.8833x- 0.2413
6.	Pre anal length	9.7-20	13.29	10.3	2.824	0.8137	Y = 1.026x- 0.2611
7.	Pectoral fin length	1-1.9	1.276	0.9	0.239	0.0014	Y = 0.0374x+ 0.0486
8.	Pectoral fin height	2-4.2	2.968	2.2	0.691	0.6332	Y = 1.0176x- 0.9032
9.	Pelvic fin length	0.7-1.7	0.994	1.0	0.254	0.5378	Y = 0.9949x- 1.3493
10.	Pelvic fin height	1.3-4	2.555	2.7	0.680	0.8253	Y = 1.3349x- 1.3972
11.	Dorsal fin length	1.2-4	2.281	2.8	0.594	0.7957	Y = 1.2945x- 1.3918
12.	Dorsal fin height	1.7-5	3.115	3.3	1.070	0.8234	Y = 1.6507x- 1.7431
13.	Anal fin length	1-2	1.452	1.0	0.348	0.8758	Y = 1.2382x- 1.51
14.	Anal fin height	2.1-4	2.884	1.9	0.644	0.501	Y = 0.501x- 0.6902
15.	Caudal fin length	2-3.7	2.713	1.7	0.537	0.7443	Y = 0.9509x- 0.8497
16.	Caudal fin height	3-6	4.086	3	1.098	0.7383	Y = 1.2224x- 1.042
17.	Maximum body depth	3.4-6.2	4.815	2.8	0.779	0.6518	Y = 0.7554x- 0.3361
18.	Minimum body depth	2-3.7	2.451	1.7	0.474	0.2808	Y = 0.52x- 0.316
In the percentage of Head length							
19.	Pre-orbital	1-1.9	1.36	0.9	0.254	0.704	y = 0.5034x - 0.1437
20.	Inter-orbital	1-3	1.77	2	0.254	0.725	y = 0.8319x - 0.2216
21.	Snout length	1-3	1.59	1.9	0.402	0.818	y = 0.6646x - 0.1689

Table 7. Meristic characters of *S. richardsonii*, inhabiting from the River Rajouri of North Western Himalayan, range

Meristic Characters	Range
No. of lateral line scale	60-85
Pectoral fin rays	12-15
Pelvic fin rays	7-10
Dorsal fin rays	7-12
Anal fin rays	6-10
Caudal fin rays	16-22

DISCUSSION

The LWRs of fishes are affected by intrinsic and extrinsic factors including the length range of sampled specimens, number, habitat, seasonality, sex, feeding, stomach fullness, etc. **(Froese, 2006; Sharma *et al*., 2015; Abbasi *et al*., 2019)**. In the present study, LWR, condition factor, morphometric characters, meristic counts, values of 'a' and 'b' for the three important food fish species were reported within the normal range but showed significant variations among each other. The LWRs and condition factor of the three fishes were reported first time from the River Rajouri. The value of 'b' less than 3 represents that the fish becomes slenderer as the length of fish increases. However, the value of 'b' remains constant at 3 for the ideal fish, lesser or greater value of 'b' indicates the negative allometric and positive allometric growth **(Kuriakose *et al*., 2017)**. The 'b' value of all the three species were recorded in the range from 1.951 to 3.187 with the highest 'b' value of 3.1874 estimated for *L. dero,* followed by *T. putitora* (3.102), while the lowest 'b' value (1.951) was recorded for *S. richardsonii* (Fig. 1, 2& 3). The values of 'b' for *T. putitora* and *L. dero* were greater than 3, signifying positive allometric growth. Similar pattern of growth has also been detected in different fish species **(Abdurchiman *et al*., 2004; Chatta & Ayub, 2010; Ujjania *et al*., 2012)**. Interestingly, almost similar 'b' value (2.982) was reported for the fish collected from another adjoining tributary of the River Chenab at the same region **(Awas *et al*., 2020)**. The 'b' value obtained in the present study for *T. putitora* seems slightly lower than that (3.38) assessed in the study of **Johal and Tandon (1981)** and the 'b' value (3.68) of **Gupta *et al*. (2005)**. Contrarily, the value of 'b' was noted less than '3' (about 1.915) in the case of *S. richardsonii* thriving in the same habitat, thus showing a negative allometric growth.

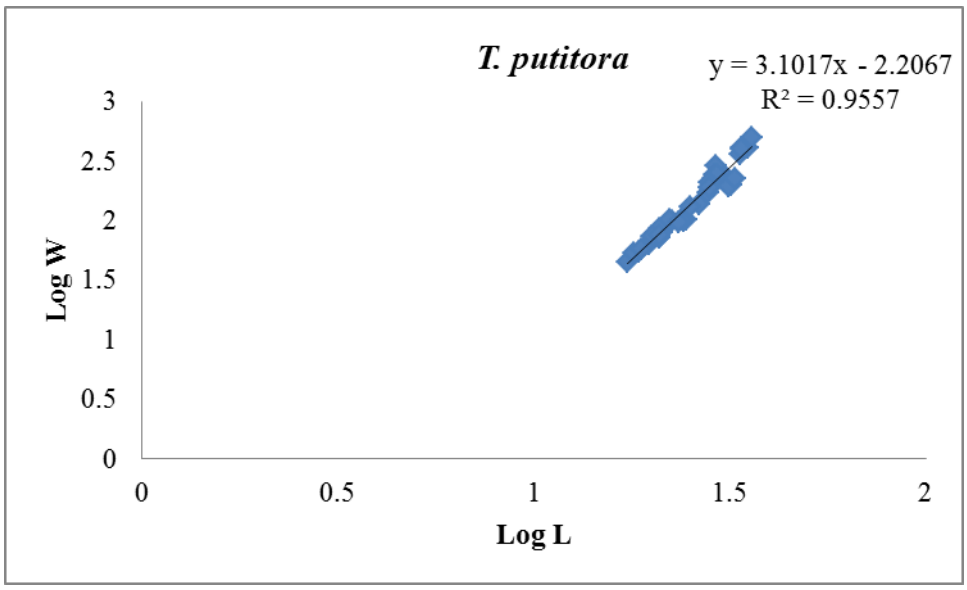

Fig. 1. Logarithmic relationship between length and weight of *T. putitora*

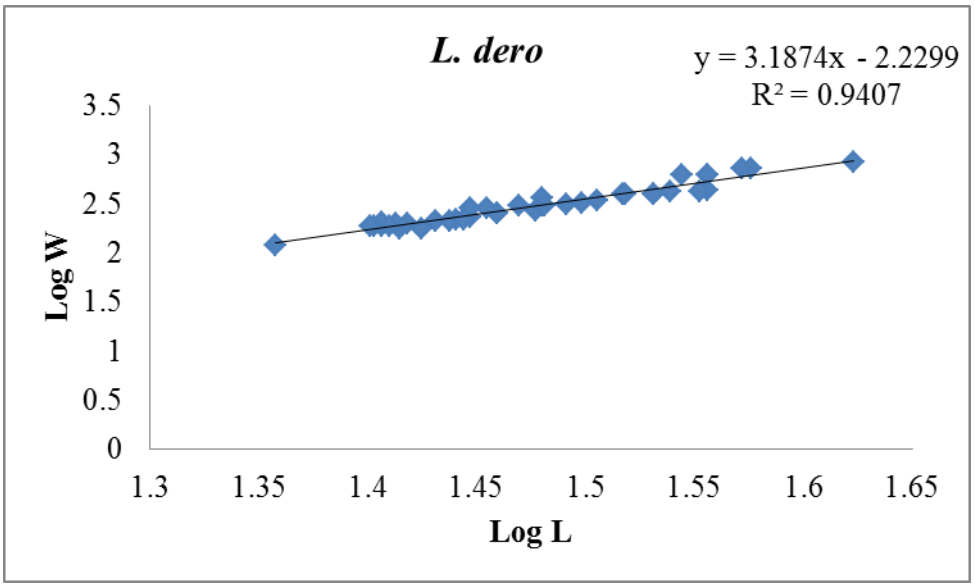

Fig. 2. Logarithmic relationships between length and weight of *L. dero*

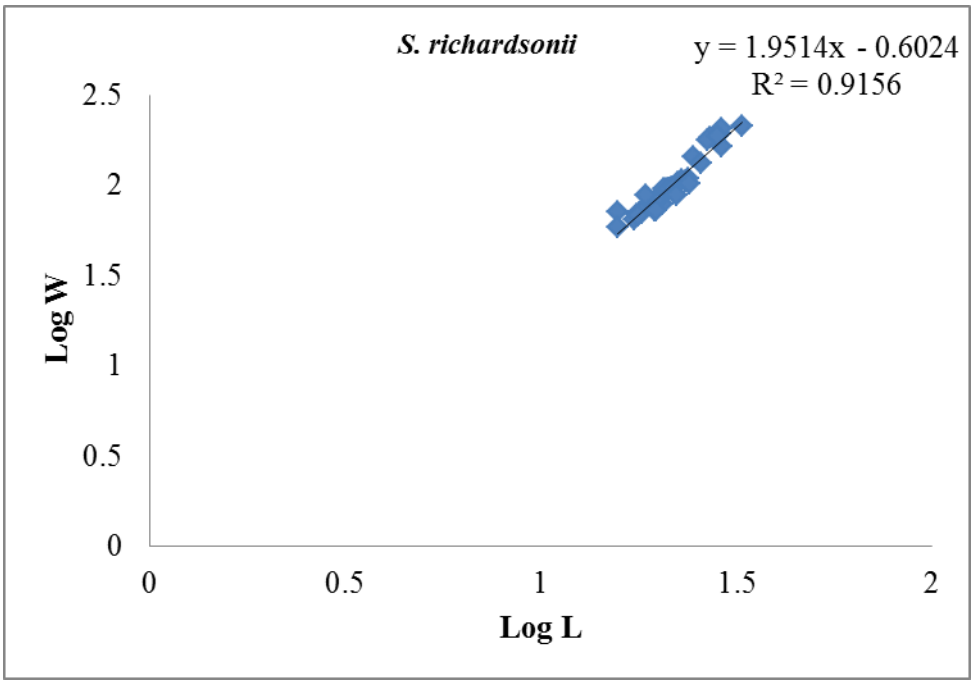

Fig. 3. Logarithmic relationships between length and weight of *S. richardsonii*

Condition Factor (K)

Population dynamics studies have shown that high condition factor values indicate favourable environmental conditions, and that low values indicate less favourable environmental conditions **(Blackwel *et al*., 2000)**. In the present study, the average recorded values of 'K' were as follows: 0.872 for *T. putitora*, 1.122 for *L. dero* and 1.00 for *S. richardsonii*. Differences in condition factor have been considered as the indication of various biological features such as fitness or suitability of the environment **(Le Cren, 1951)**. The decrease in 'K' value in one of the species *S. richardsonii* in the present study could be considered as the degradation in feeding habits **(Kırankaya *et al*., 2014)**. The nearness of 'K' value to '1' clearly indicates the suitability of the environment conditions for the fish growth. An overall fitness for fish species is assumed when 'K' value is equal or close to 1. Therefore, the present findings are in the conformity with the findings of **Gandotra *et al*. (2008)** and **Awas *et al*. (2020)**.

Controlling elements (Morphometric & Meristic characters)

Notably, the variations among morphological characters may be attributed to several ecological conditions such as food abundance due to fluctuations in climatic conditions **(Swain *et al*., 1991; Wimberger *et al*., 1992; Sidiq *et al*., 2021)**. During the present study, it was found that all morphometric characters changed proportionally with the increase of the total fish length. The morphometric characters that showed the highest correlation with the total length were standard length and fork length in all the three fish species. Different morphometric characters such as snout length, pre- orbital length and inter-orbital length were correlated with the head length. It was also observed that the highest correlation was detected with the head length having 'r' value of 0.746 for pre-orbital length and 0.655 for snout length in *T. pitutora*. In case of *L.*

dero, snout length and pre-orbital length showed the highest correlation with head length having 'r' value of 0.578 and 0.559, respectively. In case of *S. richardsonii*, the snout length and the pre-orbital length showed the highest correlation with head length having 'r' value of 0.818 and 0.725, respectively. Meristic counts remained constant despite the size differences among the , which clearly indicate that meristic counts are not dependent on the body size of the fish. Our results coincide with the findings of other researchers who also observed similar pattern of growth in different fish species **(Bashir *et al*., 2015; Ahmad & Ahmed, 2019)**.

CONCLUSION

The present study is the first attempt to provide baseline data on LWRs, condition factor, morphometric characters and meristic counts of three freshwater food fish species, including *T. putitora, L. dero and S. richardsonii* inhabiting the River Rajouri. The 'b' value obtained for *S. richardsonii*, during the study was < 2 which indicates that the fish is under serious threat, and thus needs an immediate effective effort for its sustainable growth in its natural habitat. The study will help the biologists in evaluating the growth conditions, phenotypic variations and health status of fishes inhabiting the River Rajouri which may, in turn, help to impose suitable regulations for sustainable fishery management and conservation of the region.

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