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LENGTH-WEIGHT RELATIONSHIP OF SCHIZOTHORAX *RICHARDSONII* (GRAY) FROM INDUS (BEAS RIVER SYSTEM, H.P.) INDIA

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INTRODUCTION

The Drainage System of Himachal-Pradesh feeds by the five major rivers, *i.e.* Chenab, Ravi, Beas, Satluj and Yamuna. The Beas River is division of Indus River System. It originates from mighty Dhauladhar range of great Himalaya at an altitude of 4062m asl near Rohtang Pass in District Kullu. The Beas River is a snow fed River and with its perennial tributaries forms major water resources of districts Kangra, Mandi and Kullu of Himachal Pradesh.

The Schizothorax fishes are commonly known as Indian trouts. The fishes have commercial as well as the sport value in the region. These fishes generally inhabit in an elevation above 670m asl all along the Himalayan range. The schizothoracids fishes have shown a sharp decline in catches all along the Himalayas due to indiscriminate fishing and the environmental degradation (Sehgal, 1999).

The length-weight relationship in fishes is influenced by the environmental factors. The relationship is useful in differentiating small taxonomic units, for variation may occur with population of different localities (Lecren, 1951, Chonder, 1972). The length-weight relationship has been used for two different reasons. Firstly, the length- weight relationship is commonly used to describe the mathematical model between weight and length so as to derive one from the other. Secondly, length-weight relationship is used to compute the departure from the expected weight for the length of the individual fish or a group of fishes as indication of well being of the fishes (Wotton, 1990). The length weight relationship has been carried out by several workers for different species in the different localities (Jhingran1952, Nautiyal 1985, Dhanze *et al.*, 2005 and Madan Mohan, 2006).

During the present studies it has been analyzed that the catch of this fish has declined in the Beas River due to over fishing and anthropogenic stresses. Therefore, an attempt has been made to know the length weight relationship and relative condition factor (Kn) which will show the growth pattern and well being of the of the fish in the existing environmental conditions. Further, previously no studies have been carried out on the length-weight relations of the *Schizithorax richardsonii* (Gray) in the Beas water.

MATERIALS AND METHODS

110 examples of *Schizothorax richardsonii* (Gray) were sampled from tributaries of Beas River during the period from 2000 to 2006. Fishes were collected with the help of cast net and preserved in 10% formalin. The length-weight relationship was calculated by the equation Y = A + BX (LeCren, 1951). Length and weight descriptive and statics *viz*. length range, weight of fish, average standard length, average total length, calculated weight, value of log a and value of n were calculated (Table-1& 2).The relative condition factor (Kn) was calculated by the formula $Kn= w/w^1$, where w is the calculated weight and w^1 is the observed weight.

RESULT

The following equation is used in computing the statistics :

$W = aL^n$ or

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

Where W= weight of fish, L = Length of fish, a = constant, b or n = An exponential expressing relationship between length-weight. The values are determined empirically from data.

$\text{Log } W = -4.727 + 2.933 \text{Log SL}$ (r = 0.9838)

$\text{Log } W = -5.123 + 3.000 \text{Log TL}$ (r = 0.9870)

The entire data were pooled into an equation for standard length and total length in relation to weight separately. The value of exponent 'b' is 2.993 and 3.00, when the standard length and total length respectively was taken as the parameter as such the fish is growing isometrically in relation to length and thus followed a cube law. On plotting the observed weight of the species against the observed standard and total length, a curvilinear graph (Fig. 1 & 2) has been obtained. The accuracy of the equations arrived at was confirmed by back calculation of the weight and comparison with the observed weight. It has been found that the calculated weight is less than that of observed weight after attaining a size of 210 mm SL (Table-1). Similar observation has been noticed while plotting the graph between average observed weight and length (SL and TL) (Fig. 1). This is due to gonad development as this fish get maturity after attaining a size of 175 mm and 250mm in male and female respectively in the present climatic conditions (Personal observation). However, the logarithmic values of observed length and corresponding weight revealed a straight-line relationship (Fig. 2). Thus the present findings implied the applicability of the cube law to this species. The regression coefficient 'r' was found as (r = 0.9838) for standard length while (r = 0.9870) for total length.

The value of relative condition factor 'Kn' was calculated for different size groups of fishes, which ranges from 0.87 to 1.10 (Fig. 3). The graph depicts three highest values (1, 1.2, and 1.1) with little variations. The highest value of 'Kn' was found between the length ranges of 200-210 mm of fishes, which reflect that fish is towards maturity. Furhter, the high values are also recorded in the group of lower length range of 50-60 mm and 70-80 mm i.e. 1.10 and 1.02 respectively. The sudden decline of 'Kn' value was noticed at 230-240 mm group which might be due to first maturity of fish.

DISCUSSION

According to Wooton (1990) if the fish retains the same shape and their specific gravity remains unchanged it shows isometric and the value of exponent 'b' will be exactly 3.0. The 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. Similarly, the analysis of the length-weight data for *Schizothorax richardsonii* reveals that the value of 'b' is close to 3 and fish shows the isometric growth. Further, Madan Mohan (2006) reported the value of 'b' 3.0556954 and 2.9695189 for male and female fishes respectively for the same fish in the Kumaon hills, which is almost similar to that of present observation. Though, many fishes do not follow the cube law and may be due to feeding intensity, spawning stresses and the prevailing water chemistry. According to Hile (1936) and Martin (1949) the value of exponent 'n' i.e. 'b" usually ranges between 2.5 and 4 and remain constant at 3 for an ideal fish and coincide with present findings. Further, Tesch (1968) also opined that the exponent 'n' or 'b' values of 3 which indicates the specific gravity of the tissue remains constant throughout its life for an ideal fish and due to this reason, the 'n' value is found very close to 3 in many cases. It is known as cube law. Though the value of 'b' or 'n' varies as per different species but variation with in the species is under the influence of several factors such as seasonal, physiological condition of the fish at the time of collection, sex, gonadal development and nutritive condition of the environment. However, Baloni and Tilak (1985) recorded fist maturity in this fish for the female 175mm and male 140mm in the Garhwal hills though based on present study it is noticed that fish get first maturity after attaining a size of 210mm SL due to which observed weight is more than that of the calculated weight. Further, the correlation coefficient "r" in case of standard length as well as total length was above 0.9 and indicating high correlation coefficient.

Table-1 : Length-weight relationship of *Schizothorax richardsonii* (Gray)

S. N.	Range (mm)	No. of Fish	Av. Obser-ved wt. (g)	Log W	Av. S.L. (mm)	Log SL	(Log SL)^2	Log SLx LogW	Calcula-ted log W	Calcula-ted wt. (g)	Av. T.L. (mm)	(Log TL)	(Log TL)^2	Log TLx Log W	Calcula-ted Log W	Calcula-ted wt. (g)
1.	50-60	3	2.17	0.336	54.67	1.738	3.021	0.584	0.378	2.39	68.0	1.833	3.359	0.616	0.662	4.59
2.	60-70	3	4.67	0.669	68.33	1.835	3.367	1.228	0.668	4.65	85.0	1.929	3.721	1.291	0.935	8.61
3.	70-80	6	6.33	0.801	76.83	1.886	3.557	1.512	0.813	6.50	92.83	1.968	3.873	1.576	1.045	11.09
4.	80-90	7	9.71	0.987	83.86	1.924	3.702	1.899	0.921	8.34	100.14	2.00	4.0	1.974	1.249	17.74
5.	90-100	5	12.4	1.093	96.0	1.982	3.928	2.166	1.086	12.19	121.4	2.084	4.343	2.278	1.375	23.71
6.	100-110	3	19.0	1.278	110.0	2.041	4.166	2.608	1.254	17.95	127.5	2.105	4.431	2.690	1.435	27.23
7.	110-120	10	21.0	1.322	116.0	2.064	4.260	2.729	1.319	20.84	139.93	2.146	4.605	2.837	1.552	35.64
8.	120-130	13	29.95	1.476	127.85	2.107	4.439	3.109	1.441	27.60	155.79	2.193	4.809	3.237	1.685	48.42
9.	130-140	17	32.82	1.516	135.29	2.131	4.541	3.231	1.510	32.36	164.63	2.217	4.915	3.361	1.754	56.75
10.	140-150	8	42.2	1.625	146.67	2.166	4.692	3.519	1.609	40.64	174.0	2.240	5.018	3.64	1.819	65.92
11.	150-160	9	43.8	1.641	156.75	2.195	4.818	3.602	1.692	49.20	188.73	2.276	5.180	3.735	1.921	83.37
12.	160-170	9	57.08	1.756	166.0	2.220	4.928	3.898	1.763	57.94	198.75	2.298	5.281	4.035	1.984	96.38
13.	170-180	4	65.15	1.814	176.17	2.246	5.044	4.074	1.837	68.71	216.65	2.336	5.457	4.238	2.09	123.03
14.	180-190	2	74.0	1.869	183.0	2.262	5.117	4.228	1.882	76.21	223.5	2.349	5.518	4.390	2.129	134.59
15.	190-200	3	92.0	1.964	193.0	2.286	5.226	4.489	1.978	92.6	235.0	2.371	5.622	4.657	1.99	93.2
16.	200-210	2	109	2.037	201.0	2.303	5.303	4.691	2.027	108.46	249.01	2.393	5.726	4.874	2.056	110.02
17.	210-220	2	125	2.097	210.0	2.322	5.392	4.869	2.08	124	258.0	2.412	5.818	5.089	2.113	125.95
18.	220-230	2	152	2.182	221.0	2.344	5.494	5.115	2.147	149.56	267.01	2.427	5.890	5.296	2.158	150.32
19.	230-240	2	178	2.250	229.0	2.359	5.565	5.308	2.192	173.41	275.0	2.439	5.949	5.488	2.194	173.57
		110		Σ Log W = 28.713		Σ Log SL = 40.411	Σ Log (SL)^2 = 86.56	Σ Log SL X Log W = 62.859				Σ Log TL = 42.016	Σ Log (TL)^2 = 93.515	Σ Log TL X Log W = 65.302		

The 'Kn' value is a physiological indicator of general well being of any fish living in a given environment (George *et al.*, 1985 and Raj Kumari *et al.*, 2006). The 'K' value greater than 1 indicates that the general well-being of the fish is good whereas its values less than 1 in some age group indicate that all is not well in their habitat. In present study the 'Kn' values remain almost constant in all size groups (Fig. 3). The three highest values delineated in graph (Fig. 3) reflect well being of the fish and coincide with the findings of Jana and Dasgupta (2008). The sudden decline of 'Kn' value at 230-240 mm group indicated the first maturity of fish and confirmed the view of Raj Kumari *et. al.* (2006) in *Catla catla*. The records of highest value in the group of lower length ranges are also reported by Narejo *et al.* (2002) and Jana and Dasgupta (2008) and confirmed the present findings. Further, when b = 3, 'Kn' value would remain constant. If, the weight increases more rapidly than the cube of the length, 'Kn' would increase with increase in length. When the weight increases less than the cube of the length, 'Kn' would tend to decrease with the growth of the fish. Hence, in present study the values of 'Kn' are indicative of the suitability of water body for good fish growth in different length range except few exceptions (Fig. 3) and less value may be due to the competition for food and space within different fish communities in water body. Consequently, the *Schizothorax richardsonii* (Gray) is an ideal fish in the present agro climatic condition because the value of slope 'b' is (3.0) and 'Kn' is almost constant as such confirmed the findings of Hile (*op cit*.) and Martin (*op cit*.).

Table-2 : Regression equation of weight on standard length and Total length of *Schizothorax richardsonii* (Gray) and test of significance

Parameter	Regression Coefficient (n)	Intercept (a)	Correlation (r)
S.L.	2.933	– 4.727	0.9838
T.L	3.00	– 5.123	0.9870

SUMMARY

The specimen of snow trout, *Schizothorax richardsonii* (Gray) of different size were sampled from the various tributaries of Beas River to know the length-weight relationship. The 'b' and 'Kn' values were calculated. The value of 'b' recorded in the present study is 2.993 and 3.00 with standard length and total length respectively. The 'Kn' values are almost constant as narrow range of variation was there. Thus, on the basis of the length-weight relationship and relative condition factor, it is inferred that the growth pattern follows the cube law and ideal for the fish in the present ecological conditions. The studies are the first reference on length-weight relationship of *Schizothorax richardsonii* (Gray) in this River system.

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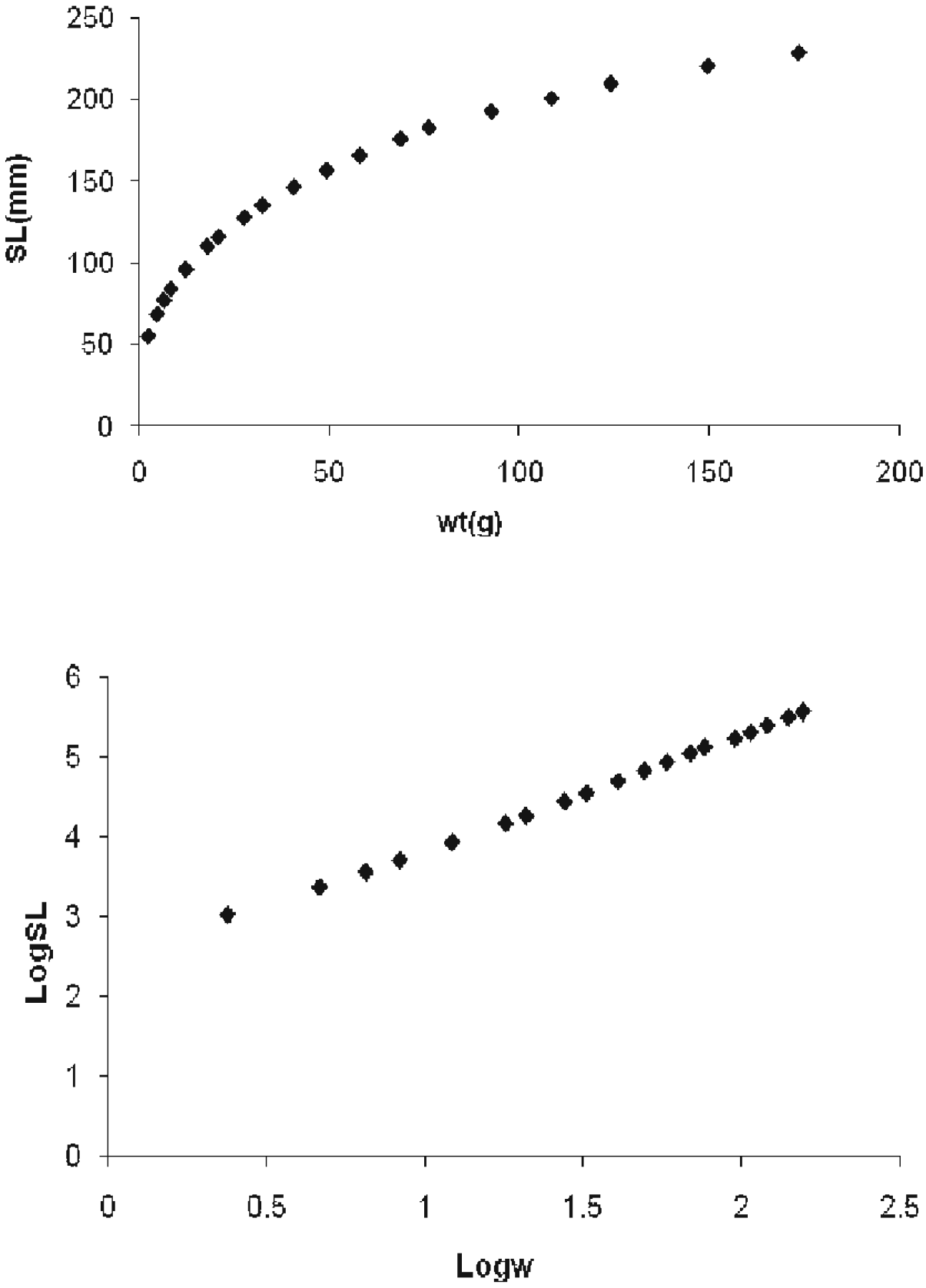

Fig. 1. Length-weight relationship of *Schizothorax richardsonii* (Gray)

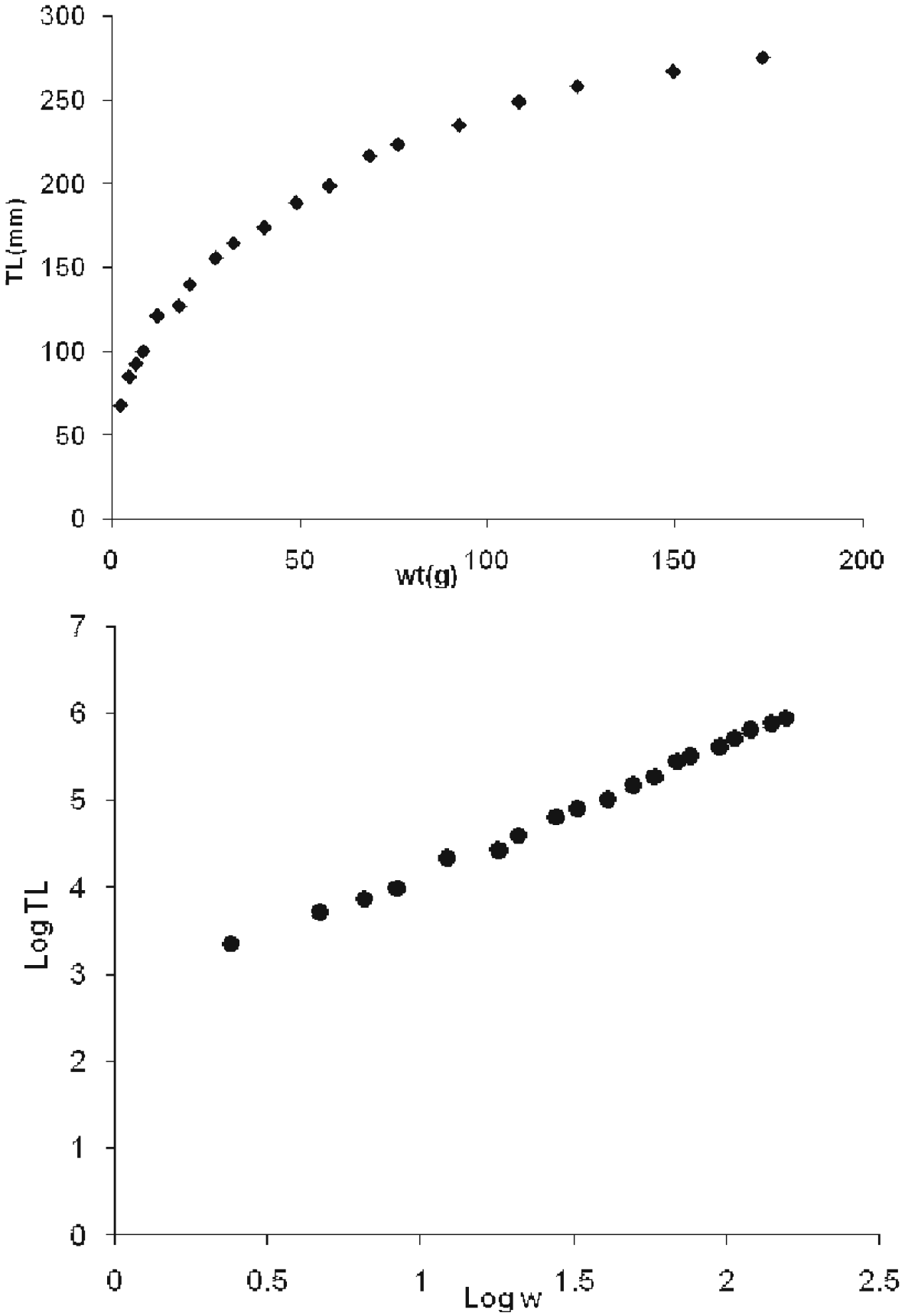

Fig. 2. Length-weight relationship of *Schizothorax richardsonii* (Gray)

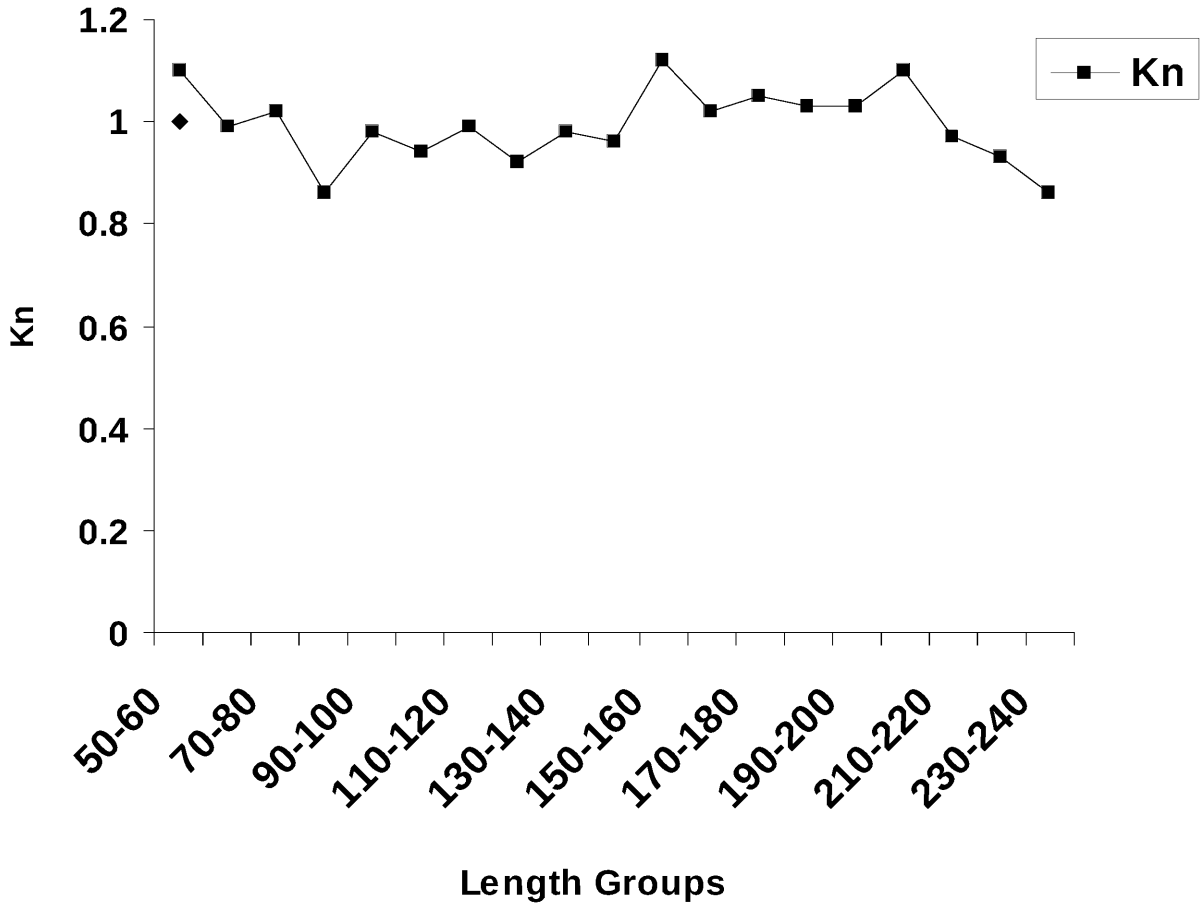

Fig. 3. Relative Condition (Kn) in relation to different length range of *Schizothorax richardsonii* (Gray)

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