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Length-Weight Relationship and Condition Factor of Five Wild Freshwater Fish Species from River Ganga in India

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Abstract: *The length–weight relationships of 718 fish individuals covering two families, four genera and five freshwater fish species (Labeo rohita, L. calbasu, Cirrhinus mrigala, Catla catla and Chitala chitala) captured in the River Ganga from May 2005 to March 2010. The regression coefficient (b) value ranged from 3.09 for Chitala chitala, to 3.27 for Cirrhinus mrigala, with a mean of 3.16 at p < 0.01 for all species. The condition factor (K) varied considerably from 1.06 ± 0.09 and 1.75 ± 0.32, with a mean value of 1.40 ± 0.32. No information regarding length-weight relationships and condition factor of one of our near threatened species, Chitala chitala was available in database of FishBase. So, this study is the first attempt to bring out the growth condition of this important species and other selected cyprinid species in wild habitat for their sustainable fishery management and conservation.*

Keywords : Regression coefficient, Condition factor, Wild habitat, Conservation.

Introduction

Fisheries management and research often require the use of biometric relationships in order to transform data collected in the field into appropriate indices (Patiyal *et al*., 2010). Length-weight relationship (LWR) of fishes are important in fisheries and fish biology because they allow the estimation of the average weight of the fish of a given length group by establishing a mathematical relation between them (Mir *et al*., 2012). Like any other morphometric characters, the LWR can be used as a character for the differentiation of taxonomic units and the relationship changes with the various developmental events in life such as metamorphosis, growth and onset of maturity (Thomas *et al*., 2003). Besides this, LWR can also be used in setting yield equations for estimating the number of fish landed and comparing the population in space and time (Singh *et al*., 2011). Fulton's condition factor (K) is widely used in fisheries and fish biology studies. This factor is calculated from the relationship between the weight of a fish and its length, with the intention of describing the "condition" of that individual fish (Froese, 2006). Different values in K of a fish indicate the state of sexual maturity, the degree of food sources availability, age and sex of some species (Anibeze, 2000). These relationships are also an important component of FishBase (Froese and Pauly, 2012). In addition, the data on length and weight can also provide important clues on climate and environmental changes, and change in human subsistence practies (Sani *et al.,* 2010). Regression data are available for most European and North American freshwater fishes, but are lacking for most tropical fish (Dubey *et al*., 2012; Mir and Mir, 2012). In River Ganga, there are limited studies on the LWRs and condition factor of fishes (Sarkar *et al*., 2008; Mir *et al*., 2012).

Our study estimates LWRs of 5 indigenous freshwater species including both food fishes (*L. rohita, L. calbasu, C. mrigala* and *C. catla*) as well as one aquarium fish, *C. chitala* (Froese and Pauly, 2012) belonging to two families (Cyprinidae and Notopteridae) from River Ganga. To the best of our knowledge, no previous reports of length-weight and condition

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factor on *C. chitala* was available and for other selected species if available is scattered. Therefore, this study provides baseline information on some commercially important fish species, which may serve as a tool for management and conservation practices.

Materials and Methods

Sample collection

Fishes were captured from River Ganga in Allahabad (25.45°N 81.85°'E) from May 2005 to March 2010. Altogether 718 samples were collected using various fishing gears. After collection, measurements of large sized specimens were taken at site and small sized specimens were preserved in 10% formalin solution and then measured. Total length (TL) of each fish was taken from the tip of the snout (mouth closed) to the extended tip of the caudal fin nearest 0.1 mm by digital caliper (Mitutiyo) and weighed to the nearest 0.01 g (total weight) by digital weighing machine (ACCULAB Sartorious Group). Some species were far more abundant than others, thus the sample size varied accordingly.

Length-weight relationship

The relationship between length and weight of fish was analyzed by measuring length and weight of fish specimens collected from study area. The statistical relationship between these parameters of fishes were established by using the parabolic equation by Froese (2006).

$$W = aL^b$$

Where, W = weight of fish in grams, L =length of fish in mm, *a* = constant and *b* = an exponential expressing relationship between length-weight.

The relationship ($W = aL^b$) when converted into the logarithmic form gives a straight line relationship graphically

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

Where b represents the slope of the line, Log a is a constant.

Condition factor (K)

Condition factor is used for comparing the condition, fatness, or well-being (Mir *et al*., 2012) of fish, based on the assumption that heavier fish of a given length are in better condition. The coefficient of condition, K was calculated using Fulton (1904).

$$K = W*100/L^3$$

Where, W = weight in grams, L = Length in cm and 100 is a factor to bring the value of K near unity. All the statistical analysis was done in Excel 2007.

Results and Discussion

Length-weight relationship

The descriptive statistics of LWRs of five freshwater fish species is give in Table 1 and the linear regression equations are given in Fig. 1. A total of 718 specimens of 5 fish species belonging to two families were sampled: *L. rohita*, *L. calbasu*, *C. mrigala*, *C. catla* and near threatened *C. chitala*. The calculated linear regression indicated significant differences between the slopes of the LWR among species.

In our study values of *b* varied from 3.09 for *C. Chitala* to 3.27 for *C. mrigala*. The mean *b* for all species was 3.16. The coefficient of determination (r^2) ranged from 0.92-0.98. All linear regressions were statistically significant ($P < 0.01$). Out of 5 studied species, information on LWR was not available *C. chitala* in the FishBase database (Froese and Pauly, 2012). Review of literature showed that in most fishes b value ranges from 2.7 to 3.3 (Froese, 2006). The b values of the present study confirm the studies of earlier researchers (Sani *et al*., 2010; Mir *et al*., 2012, Naeem *et al*., 2012). Our study also corroborated with the study of LWRs reported by Ujjania *et al*. (2012) in Indian major carps from Rajasthan. In another study, Sarkar *et al*. (2009) showed allometric negative and positive growth in *C. chitala* in Ganga basin. Negative allometric growth was recorded in pond reared *L. rohita*

(Bhat, 2011). Zafar *et al*. (2003) recorded positive allometric growth in *C. catla* from dam in Pakistan. According to Ozaydin and Taskavah (2007), the parameter *b* unlikely may vary seasonally, and even daily, and between habitats.

Difference in b values can be attributed to the combination of one or more factors: (i) number of specimens examined; (ii) area / seasonal effect; (iii) habitat; (iv) degree of stomach fullness; (v) gonadal maturity; (vi) sex; (vii) health and general fish condition; (viii) preservation technique; and (ix) differences in the observed length ranges of the specimens caught were not accounted for in this present study.

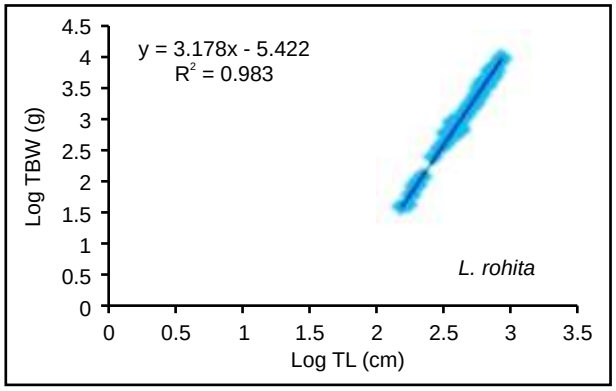
Condition factor

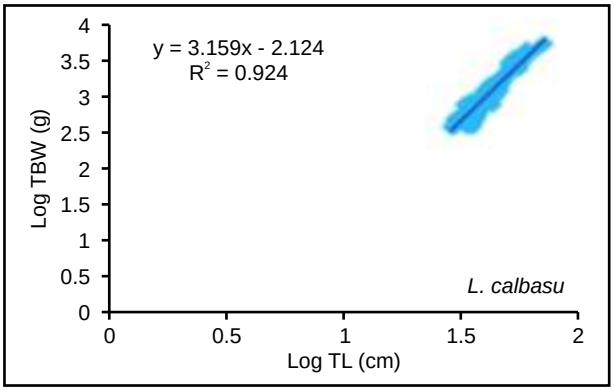
The condition factor was highest in *L. rohita* (1.75 ± 0.32) and lowest in *L. calbasu* (1.06 ± 0.09) in (Fig. 2) and all the values were significant at $p<0.05$. The average condition factor varied from species to species and in overall study it was 1.40 ± 0.32. This may be due to the dissimilar food availability and random seasonal collection of the samples throughout the year. All the studied regressions were highly significant ($p< 0.01$) with the coefficient of determination in the range of 0.92 to 0.98, which corroborated with the study of Isa *et al*. (2010) in seven catfishes. Mir *et al*. (2012) reported similar type of observations in *Labeo rohita* from Ganga basin in India.

In conclusion, our study has provided the first basic and baseline information on the LWR of 5 indigenous fishes from River Ganga that would be beneficial for fishery biologists and conservationists to impose adequate regulations for sustainable fishery management and conservation of these species in River Ganga.

Table 1 Estimated parameters of length-weight relationships and descriptive statics of five fish species from Ganges River in Allahabad, India.

Species	N	Length range (cm)	*a*	*b*	95% CI of *b*	R^2
Labeo rohita	153	16.7-90.5	-5.42	3.17	2.99-3.27	0.98
Labeo calbasu	148	30.4-75.5	-2.12	3.15	2.89-3.21	0.92
Cirrhinus mrigala	184	18.5-85.3	-5.64	3.27	3.01-3.34	0.98
Catla catla	121	28.5-94.5	-5.30	3.15	3.00-3.31	0.98
Chitala chitala	112	11.4-57.5	-2.08	3.09	2.87-3.23	0.96





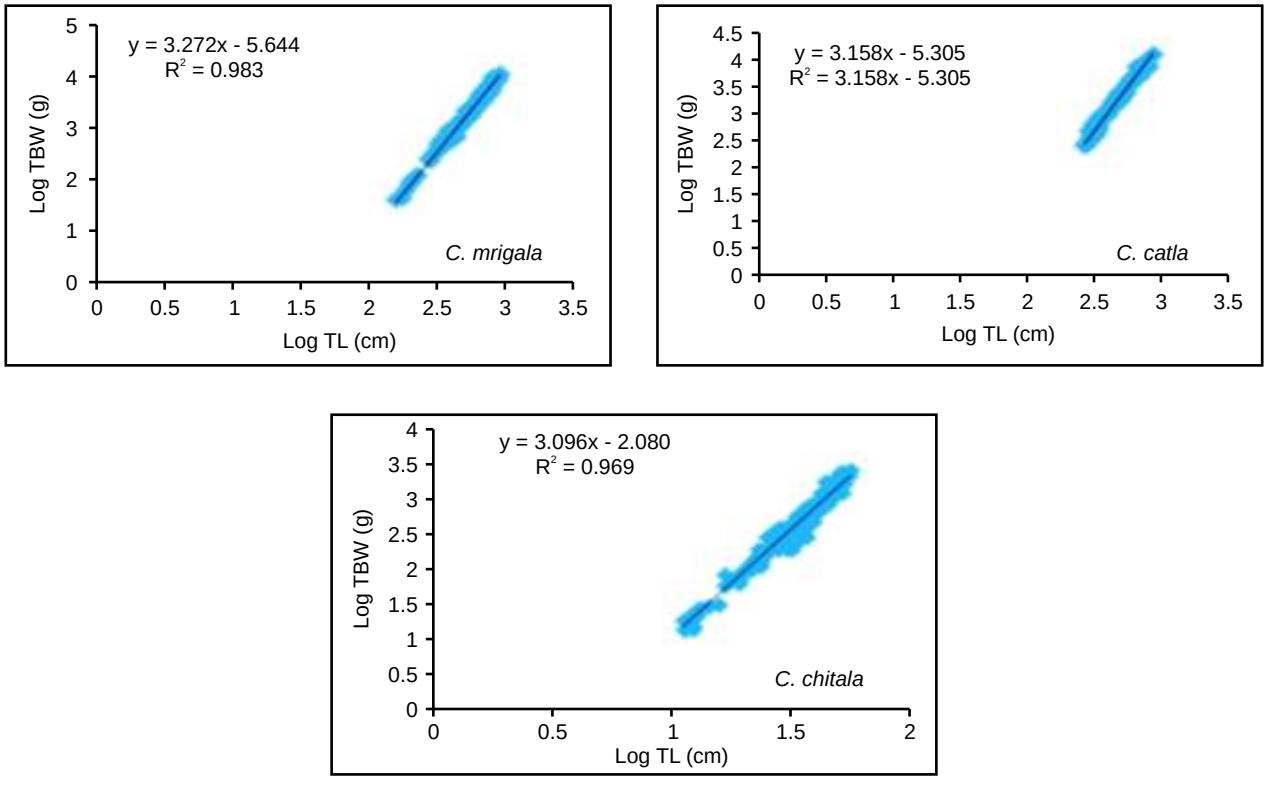


Fig. 1 Linear regression plots showing length-weight relationship in five fish species of Ganga River in India.

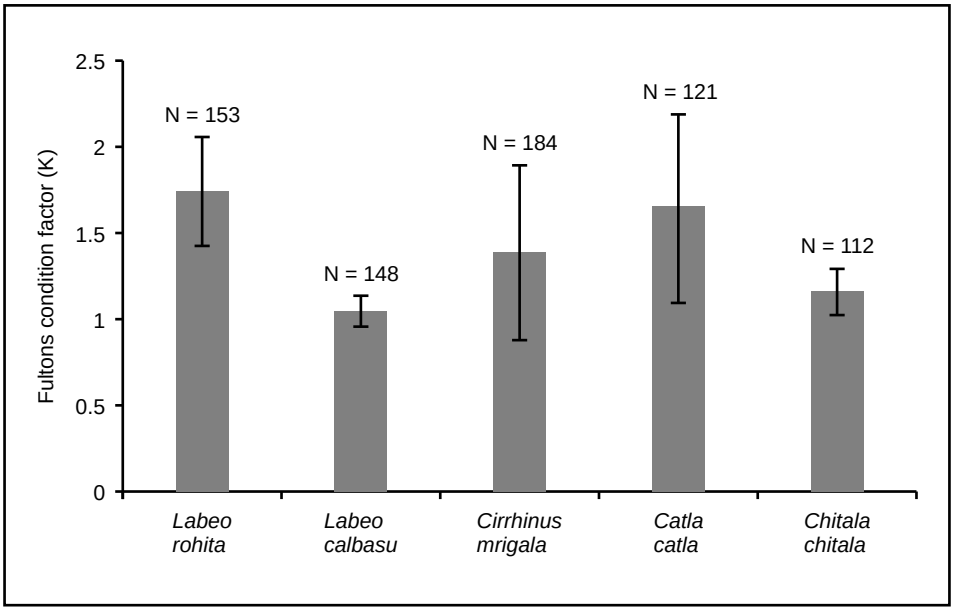


Fig. 2 Species wise depiction of condition factor (K) in five freshwater fish species from River Ganga in India.

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