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Studies on Length-weight and Length-length Relationships of Four Freshwater Fishes Collected from River Ganga

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ABSTRACT

This study describes length-weight and length-length relationships of four species (*Labeo bata*, *Channa punctata*, *Ompok pabda* and *Mastacembelus armatus*) collected from river Ganga. A total of 856 specimens were examined for the study. Length-Weight Relationship (LWR) indicated isometric pattern of growth for *L. bata*, positive allometric growth for *O. pabda* and *C. punctata* while negative allometric growth for *M. armatus*. Length-length relationships (LLR) for all the four species were highly significant (R^2>0.9, p<0.001). For two species length-weight and length-length relationships were not available on FishBase.

Key words: Length-weight relationship, length-length relationship, river Ganga, fish species

INTRODUCTION

The length-weight and length-length relationships have been applied for the assessment of fish stocks and populations (Ricker, 1968). The weight-length relationship and its parameters (a and b) have a wide application in fish biology and fisheries management, ranging from the estimation of weight from length data (or vice versa) (Le Cren, 1951; Anderson and Gutreuter, 1983; Petrakis and Stergiou, 1995; Froese, 2006) to the calculation of production and biomass of a fish population (Giacalone *et al.*, 2010). LWR is also useful in local and interregional, morphological and life historical comparisons in species and populations (Kara and Bayhan, 2008). There are a number of length-weight reports available on freshwater fishes collected from river Ganga (Sarkar *et al.*, 2009; Khan *et al.*, 2011, 2012). However, such data on selected fish species (*Channa punctata, Labeo bata, Ompok pabda* and *Mastacembelus armatus*) from river Ganga is not available.

In the present study, we report the Length-Weight Relationship (LWR) and Length-Length Relationship (LLR) for four fish species collected from the river Ganga. Fishes selected for the present study are *Channa punctata* (Bloch), *Labeo bata* (Hamilton), *Ompok pabda* (Hamilton) and *Mastacembelus armatus* (Lacepede). Of the four species selected for the study, two species are listed in the category of Lower Risk-near threatened (LR-nt) (*L. bata* and *C. punctata*), one as Endangered (*O. pabda*) (Molur and Walker, 1998) and one as Least concern (*M. armatus*) in India (IUCN, 2011). Studies on Length-Weight Relationships (LWRs) and Length-Length Relationships (LLRs) of threatened fishes are the most important biological parameters to provide information on the growth and condition of fish species and the entire fish community and are highly significant

for management and conservation of populations in natural water bodies (Sarkar *et al.,* 2009; Hossain *et al.,* 2012). To the best of our knowledge, no previous reports of length-weight and length-length relationships on these fish species are available from the selected river. Further, FishBase database (Froese and Pauly, 2012) showed no record of length-weight and length-length relationships for two fish species (*L. bata* and *O. pabda*).

MATERIALS AND METHODS

Fish specimens were collected monthly from the river Ganga using nets of various mesh sizes from January 2010 to January 2012. The river Ganga rises in the Gangotri glacier (30°54'N; 78°54'E) in the Himalayas at an altitude of 7010 m above mean sea level in Uttarkashi district of Uttarakhand, India. It travels along the five Indian states of Uttarakhand, Uttar Pradesh, Jharkhand, Bihar and West Bengal. All species were identified according to Talwar and Jhingran (1991), Jayaram (1999) and rechecked against FishBase database (Froese and Pauly, 2012). Total Length (TL), Fork Length (FL) and Standard Length (SL) of all fish samples were measured to the nearest 0.1 cm. Body weight was recorded as Total Weight (TW) including gut and gonads to the nearest 0.1 g. Sex was macroscopically determined by gonad examination.

The length-weight relationship is described by the equation $W = a L^b$, where W is the total weight in grams, L is the total length in centimeters, a is the intercept and b is the regression coefficient (Froese, 2006). For each species, the parameters a, b and R^2 (coefficient of determination) was estimated by least-squares regression analysis of the logarithm-transformed LWR expression log W = log a+b log L (Garcia, 2010). Standard Length (SL) and Fork Length (FL) were also measured to the nearest cm to make the relationships TL vs SL, SL vs FL and FL vs TL by linear regression (Hossain *et al.,* 2006). All statistical analyses were done using MS-Excel and SPSS (version 17.0).

RESULTS AND DISCUSSION

Length-weight relationships were calculated for a total of 856 individuals of four species belonging to four different families (Channidae, Cyprinidae, Mastacembelidae, Siluridae). The parameters of the length-weight relationship for each species are given in Table 1, together with the regression coefficient (R^2), the number of specimens measured (n), standard error of slope b and the total size of the smallest (min) and largest (max) specimens measured. Linear regressions on

Table 1: Parameters of length-weight relationship of four fish species collected from river Ganga

					Length range (cm)					
Species	Study	Sex	Location	N	Min.	Max.	a	b	R^2	SE (b)
Labeo bata	Present study	Combined	Ganga river	265	35.0	90.0	0.006*	3.0210	0.99	0.12
	Chatterji *et al.* (1977)	Males	Kali river	-	-	-	0.281*	3.3109	-	-
	Chatterji *et al.* (1977)	Females	Kali river	-	-	-	0.338*	3.2026	-	-
Ompok pabda	Present study	Combined	Ganga river	118	15.0	28.5	0.003*	3.1300	0.95	0.20
	Gupta *et al.* (2011)	Combined	Gomti river	201	7.10	16.8	-2.020	2.8700	0.9	-
Channa punctata	Present study	Combined	Ganga river	284	16.8	29.8	0.006*	3.1210	0.94	0.14
	Hossain *et al.* (2006)[1]	Combined	Mathabhanga river	-	6.00	18.9	0.012*	3.0370	-	-
Mastacembelus armatus	Present study	Combined	Ganga river	104	45.0	80.6	0.013*	2.8940	0.99	0.12
	Narejo *et al.* (2003)[1]	Males	-	-	23.7	47.5	0.007*	2.6000	-	-
	Narejo *et al.* (2003)[1]	Females	-	-	14.8	41.7	0.005*	2.7200	-	-

N: Total No. of samples, a: Intercept, b: Slop, R^2: Coefficient of determination, *Anti-log a, [1]Length-weight relationship of parameters reported in FishBase

Table 2: Parameters of length-length relationship of four fish species collected from river Ganga

Species	Equation	N	a	b	R^2
Labeo bata	FL = a+bSL	265	1.154	1.016	0.98
	TL = a+bFL	265	0.185	1.131	0.96
	TL = a+bSL	265	1.294	1.160	0.96
Ompok pabda	FL = a+bSL	118	1.488	0.935	0.93
	TL = a+bFL	118	3.471	0.887	0.91
	TL = a+bSL	118	5.528	0.779	0.94
Channa punctata	TL = a+bSL	284	0.009	1.205	0.93
Mastacembelus armatus	TL = a+bSL	104	2.620	0.993	0.99

TL: Total length, FL: Fork length, SL: Standard length, R^2: Coefficient of determination

log transformed data were highly significant ($p<0.001$) for all analyzed species, showing $R^2>0.9$. When the specific gravity of a fish remains unchanged and retains the same shape during its lifetime, it is growing isometrically and the value of length exponent b, would be exactly 3.0 (Wootton, 1990). In the present study, calculated allometric coefficient b ranged from a minimum of 2.894 for *M. armatus*, to a maximum of 3.130 for *O. pabda*. Froese (1998) recommended that the exponent (b) of the length-weight relationships should fall within the expected range of 2.5-3.5. The results revealed that *L. bata* (3.021) showed isometric pattern of growth, *M. armatus* (2.894) showed negative allometric growth (b<3) while *C. punctata* and *O. pabda* (3.130) showed positive allometric growth (b>3). A number of factors are known to influence the length-weight relationship in fishes, including growth phase, season, degree of stomach fullness, gonad maturity, sex, size range, health and general fish condition and preservation techniques (Tesch, 1971). However, these factors were not accounted for in the present study. In addition to present study, Table 1 also gives a comparison of published length-weight relationship parameters from other geographical areas. The value of b for *L. bata* (Chaterjii *et al.*, 1977), *O. pabda* (Gupta *et al.*, 2011) and *C. punctata* (Hossain *et al.*, 2006) is different from those reported in the present study. The observed differences in the values may be due to the environmental differences, differences in the utilized types and length ranges or differences in the number of specimen examined.

All LLRs presented in Table 2 were highly significant ($p<0.001$), with most of the coefficient of determination values being >0.9. In conclusion, this study provides basic information on LWRs and LLRs for four fish species that would be of academic and applied significance.

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