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Length-weight Relationships for Nine Freshwater Teleosts Collected from River Ganga, India

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ABSTRACT

The Length-Weight Relationships (LWRs) of fish were studied covering six families and nine species (*Bagarius bagarius*, *Sperata aor*, *Channa striatus*, *Clarias batrachus*, *Sperata seenghala*, *Wallago attu*, *Hypophthalmichthys molitrix*, *Labeo rohita* and *Catla catla*) collected from the river Ganga during the period from January 2010 to June 2011. A total of 1827 specimens were used to estimate the length-weight relationship parameters. Estimates of b ranged from minimum of 2.586 for *C. batrachus* to a maximum of 3.249 for *S. aor*; two species (*B. bagarius* and *W. attu*) showed isometric growth (b = 3), three species (*S. aor, L. rohita* and *C. catla*) showed positive allometric growth (b>3), while four species (*C. batrachus*, *C. striatus*, *S. seenghala* and *H. molitrix*) showed negative allometric growth (b<3). The r^2 value ranged from 0.91 to 0.99. One maximum length (*H. molitrix*) was new to science against FishBase.

Key words: Length-weight relationship, river Ganga, teleosts

INTRODUCTION

The mathematical relationship between length and weight of fishes is a practical index suitable for understanding their survival, growth, maturity, reproduction and general well being (Le Cren, 1951). Length-weight relationships are also widely used for conversion of the growth-in-length equation to growth-in-weight for use in stock assessment models and estimation of biomass from length observations (Weatherley and Gill, 1987; Wootton, 1990; Moutopoulos and Stergiou, 2002). Establishment of a relationship between weight and length is essential for the calculation of production and biomass of a fish population (Anderson and Gutreuter, 1983; Dulcic and Kraljevic, 1996; Moutopoulos and Stergiou, 2002) and also allowing for morphological comparisons among species or among populations of the same species from different habitats and/or regions (Moutopoulos and Stergiou, 2002). Our study estimates length-weight relationships of nine fish species belonging to six families (Clariidae, Channidae, Cyprinidae, Siluridae, Sisoridae and Bagridae) having high economic and conservation values. Of the nine species studied, one is listed in the category of Lower Risk-Least Concern (LRlc) (*Channa striatus*), three as vulnerable (VN) (*Catla catla*, *Clarias batrachus* and *Bagarius bagarius*), two as Lower Risk-Near Threatened (LRnt) (*Labeo rohita* and *Wallago attu*) in India (Molur and Walker, 1998). Studies on length-weight relationships of threatened and commercially important fishes are highly significant for management and conservation of populations in natural waterbodies.

Of the nine species examined in the present study, to the best of our knowledge no previous reports were available from the selected river except for *L. rohita* and *C. catla*; and no information

of length-weight relationship was available for *B. bagarius* however, the LWR information of some species was available from some other waterbodies (Froese and Pauly, 2010). In view of the above, our study constitutes the first information on LWRs of the seven fish species from the river Ganga.

MATERIALS AND METHODS

Fish samples were randomly collected monthly from the river Ganga using nets of various mesh sizes from January 2010 to June 2011. 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 the Uttarkashi district of Uttarakhand, India. It travels along the five Indian states of Uttarakhand, Uttar Pradesh, Jharkhand, Bihar and West Bengal. Fishes were sampled using gill nets, cast nets and drag nets. All species were identified according to Talwar and Jhingran (1991), Jayaram (1999) and rechecked against FishBase (2010). Total Length (TL) of each fish was measured from the tip of snout to the longest fin ray of the caudal fin. 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.

For each fish species, the length-weight relationships were measured and described using the equation $W = aTL^b$, where W is the body weight (g), TL is the total length (cm) (Ricker, 1973), the statistical significance level of r^2 was estimated and the parameters a and b were estimated by least square regressions performed by the log-transformed equation, log BW = log a+b log TL (Beverton and Holt, 1957). The coefficient of determination (r^2) was used as an indicator of the quality of the linear regression (Scherrer, 1984). The value of b provides information on the fish growth type. All statistical analyses were done using SPSS (version 16.0).

RESULTS AND DISCUSSION

A total of 1827 specimens of nine species belonging to six families (Channidae, Clariidae, Bagridae, Siluridae, Sisoridae and Cyprinidae) were measured. Samples collected for the present study had fishes of varied size and form. Table 1 presents the sample size, minimum and maximum length range, coefficient of determination (r^2), slope regression (b), antilog of a (intercept of regression) and standard error of slope b. Linear regressions on log transformed data were highly significant ($p<0.001$) for all analyzed species, showing $r^2>0.9$.

The calculated allometric coefficient b ranged from a minimum of 2.586 for *C. batrachus*, to a maximum of 3.249 for *S. aor*. The exponent b often has a value close to 3 but varies between 2 and 4 (Tesch, 1971). Values of b equal to 3 indicate that the fish grows isometrically; values other than 3 indicate allometric growth (Tesch, 1971). The results revealed that *B. bagarius* and *W. attu* showed isometric pattern of growth, *C. striatus*, *C. batrachus*, *S. seenghala* and *H. molitrix* exhibited negative allometric growth (b<3) while *S. aor, L. rohita* and *C. catla* showed positive allometric growth (b>3). According to Hile (1936) the value of b usually remains constant at 3.0 for an ideal fish. According to Froese (2006), values of b = 3 indicate that the small specimens have the same form and probably same condition as large specimens. However, Beverton and Holt (1957) suggested that the departure of the b value from 3 is rare in adult fishes. In the present research work most of the fishes showed deviations from the ideal value. The length-weight relationships in fishes can be affected by several factors including habitat, gonad maturity, sex, health and stomach fullness (Tesch, 1971; Wootton, 1998), however, all these factors were not evaluated in the present study.

A comparison of published reports on length-weight relationship parameters from other geographical areas available on FishBase (Froese and Pauly, 2010) has been presented in Table 2. The value of b (Table 2) for *L. rohita* (Jhingran, 1952), *S. aor* (Ramakrishniah, 1988) and

Table 1: Linear regression equation parameters for Length-weight Relationships (LWR) of nine freshwater fish species collected from river Ganga

		Total length range (cm)						
Species	N	Min	Max	Family	a	b	r^2	S.E. (b)
Labeo rohita	218	55	160	Cyprinidae	0.005	3.203	0.98	0.03
Catla catla	242	35	145	Cyprinidae	0.005	3.226	0.99	0.02
Bagarius bagarius	116	60	165	Sisoridae	0.005	3.027	0.95	0.23
Channa striatus	140	55	71.5	Channidae	0.002	2.929	0.97	0.24
Clarias batrachus	342	28.5	40	Clariidae	0.017	2.586	0.95	0.16
Sperata aor	184	72	95	Bagridae	0.002	3.249	0.98	0.11
Sperata seenghala	205	40	115	Bagridae	0.005	2.866	0.95	0.18
Wallago attu	165	69	80	Siluridae	0.004	3.097	0.91	0.39
Hypophthalmichthys molitrix	215	45	107.5	Cyprinidae	0.008	2.969	0.99	0.10

N, total number of samples; a, intercept; b, slope; SE (b) standard error of slope b; r^2, coefficient of determination

Table 2: Comparison of seven freshwater fish species Length-weight relationship parameters reported in FishBase (Froese and Pauly, 2010) from varions geographical locations

Species	Authors	Location	Country	Sex	N	L_{min}-L_{max}	a	b
Channa striatus	Satrawaha and Pilasamorn (2009)	Chi river	Thailand	Unsexed	451	15.5-51.0	0.0111	2.944
	Garcia (2010)	Pampanga river, Candaba	Philippines	Unsexed	-	12.6-41.1	0.0180	2.960
Sperata aor	Ramakrishniah (1988)	Nagarjunsagar reservoir	India	Unsexed	300	29-68	0.0046	3.006
Wallago attu	IGFA (2009)	Sangklaburi	Thailand	-	2	102-145	0.0046	3.000
Hypophthalmichthys molitrix	Rame Rao and Natarajan (1979)	Govindsagar reservoir	India	Unsexed	-		0.0287	3.227
Clarias batrachus	De (1985)	Bankura, west Bengal (Aquaria)	India	-	-	-	0.0240	2.500
	Garcia (2010)	Pampanga river	Philippines	Unsexed	-	15.8-28.9	0.0280	2.700
Labeo rohita	Khan and jhingran (1975)	Ganga river system	India	Unsexed	-	5-62.0	0.0155	3.014
	Ahmad and Saha (1996)	Kapati lake	Bangladesh	Unsexed	-	27.5-84.5	0.0073	3.149
Catla catla	Johal and Tandon (1992)	Harike river	India	Unsexed	-		0.0066	3.23
		Govindsagar reservoir	India	Unsexed	-	-	0.0153	3.058

N: Number of samples; a: Intercept; b: Slope

H. molitrix (Rame Rao and Natarajan, 1979) is different from those reported in the present study. The observed differences in the values can be attributed to the combination of one or more of the following factors: (i) differences in environmental or habitat factors; (ii) differences in the utilized types and length ranges; and (iii) differences in the number of specimen examined. One maximum length (107.5 cm) for *H. molitrix* was new to science against FishBase which also did not show any record of length-weight relationship for *S. seenghala* and *B. bagarius* (Froese and Pauly, 2010).

The b values of nine fish species were within the normal range of 2.5-3.5 (Froese, 2006). Thus we considered our results to be adequate estimation of the length-weight relationships. As the fish samples were collected during different seasons throughout the sampling period, these data could be used as mean annual values for each species and are not representative of particular season and are close to the median values of a and b (Froese, 2006). The results presented contribute as the new information on the length-weight relationships of seven fish species from the river Ganga whereas LWRs of two species contribute to the existing knowledge on the subject from the river.

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REFERENCES

Ahmed, K.K. and S.B. Saha, 1996. Length-weight relationships of major carps in Kaptai Lake Bangladesh. NAGA., 19: P. 22.

Anderson, R.O. and S.J. Gutreuter, 1983. Length, Weight and Associated Structural Indices. In: Fisheries Techniques, Neilsen, L.A. and D.L. Johnson (Eds.). American Fisheries Society, Bethesda, MD., pp: 283-300.

Beverton, R.J.H. and S.J. Holt, 1957. On the dynamics of exploited fish populations. Fish. Invest., London, ser II, 19: 533.

De, S., 1985. The undulatory movements of fishes. Sci. Cult., 51: 344-346.

Dulcic, J. and M. Kraljevic, 1996. Weight-length relationships for 40 fish species in the Eastern Adriatic (Croatian waters). Fish. Res., 28: 243-251.

Froese, R. and D. Pauly, 2010. FishBase. World Wide Web Electronic Publication. http://www.fishbase.org/search.php

Froese, R., 2006. Cube law, condition factor and weight-length relationships: History, meta analysis and recommendations. J. Applied Ichthyol., 22: 241-253.

Garcia, L.M.B., 2010. Species composition and length-weight relationship of fishes in the Candaba wetland on Luzon Island, Philippines. J. Applied Ichthyol., 26: 946-948.

Hile, R., 1936. Age and growth of the cisco, *Leucichthys artedi* (Lesueur) in the lake of Northeastern highlands Wisconsin. Bull. US. Bur. Fish., 48: 211-317.

IGFA, 2009. Database of IGBA angling records until 2009. International Game Fish Association (IGFA), Fort Lauderdate, USA.

Jayaram, K.C., 1999. The Freshwater Fishes of the Indian Region. Narendra Publishing House, Delhi, India.

Jhingran, V.G., 1952. General length-weight relationship of three major carps of India. Proc. Natl. Inst. Sci. India, 18: 449-460.

Johal, M.S. and K.K. Tandon, 1992. Age and growth of the carp *Catla catla* (Hamilton, 1822) from Northern India. Fish. Res., 14: 83-90.

Khan, H.A. and V.G. Jhingran, 1975. Synopsis of biological data on rohu *Labeo rohita* (Hamilton, 1822). FAO Fish. Synop, (111), pp: 100.

Le Cren, E.D., 1951. The length-weight relationships and seasonal cycle in gonad weight and condition in perch (*Perca fluviatilis*). J. Anim. Ecol., 20: 201-219.

Molur, S. and S. Walker, 1998. Report of the workshop conservation assessment and management plan for freshwater fishes of India. Zoo Outreach Organisation, Conservation Breeding Specialist Group, (CBSG), Coimbatore, India, pp: 156

Moutopoulos, D.K. and K.I. Stergiou, 2002. Length-weight and length-length relationships of fish species from Aegean Sea (Greece). J. Applied Ichthyol., 18: 200-203.

Ramakrishniah, M., 1988. Age, Growth and Fishery of *Mystus aor* (Hamilton) from Nagarjunasagar Reservoir. In: The First Indian Fisheries Forum, Proceedings, Joseph, M.M. (Ed.). Asian Fisheries Society, Indian Branch, Mangalore, India, pp: 185-189.

Rame Rao, Y. and A.V. Natarjan, 1979. A study of the first ever naturalized population of exotic carp, *Hypophthalmichthys molitrix,* its fishery and implication in Govindsagar. In Summer Inst. http://dx.doi.org/.

Ricker, W.E., 1973. Linear regressions in fishery research. J. Fish. Res. Board Can., 30: 409-434.

Satrawaha, R. and C. Pilasamorn, 2009. Length-weight and length-length relationships of fish species from the Chi River, Northeastern Thailand. J. Applied Ichthyol., 25: 787-788.

Scherrer, B., 1984. Biostatistique. 1st Edn., Morin, Montreal, Paris, ISBN: 9782891050937.

Talwar, P.K. and A.G. Jhingran, 1991. Inland Fishes of India and Adjacent Countries. Vol. 1-2, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Calcutta, India, pp: 1158.

Tesch, F.W., 1971. Age and Growth. In: Methods for Assessment of Fish Production in Fresh Waters, Ricker, W.E. (Ed.). Blackwell Scientific Publications, Oxford, UK., pp: 98-103.

Weatherley, A.H. and H.S. Gill, 1987. The Biology of Fish Growth. Academic Press, London, pp: 14-21.

Wootton, R.J., 1990. Ecology of Teleost Fishes. 1st Edn., Chapman and Hall, London, ISBN-13: 9780412317200, Pages: 404.

Wootton, R.J., 1998. Ecology of Teleost Fishes. 2nd Edn., Kluwer Academic Publishers, Dordrecht, The Netherlands, ISBN-13: 9780412642005, Pages: 386.