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Original Article

Length-weight, length-length relationships and condition factor of fishes of family cyprindae from the Indus River, Pakistan

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Abstract
This study was carried out to describe the length-weight relationship (LWR), length-length relationships (LLRs) and condition factor (K) in 926 specimens belonging to 20 freshwater fish species of family cyprinidae. Fish samples were collected on a monthly basis from August 2013 to July 2014 at Taunsa barrage from the Indus River, Punjab, Pakistan. The values of parameter b for LWRs ranged from 2.16 – 4.10 suggesting the isometric and allometric growth pattern in fishes of family cyprinidae. The results of K factors ranged from 0.645 – 1.836 also determine both negative growth tendency in some fish species and positive growth tendency in other fish species. This study aimed to incorporate some more information in the aquaculture sector of the country to depict the population conditions of fish species in the Indus River.
Key Words: Cyprinidae, isometric, allometric, condition factor, Taunsa Barrage

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INTRODUCTION

Cyprinidae is the largest family in freshwater fishes and vertebrate animals. They are stomachless and toothless jawed fishes. They chewed their food efficiently by gill bow the specialized gill rackers. They are omnivorous fishes feeding on planktons, plants, small fishes, mollusks, crustaceans, insects and organic debris. Many species has commercial and culinary importance as farmed fishes, popular ornamental aquarium fishes, sport fishes and model organism for genetic development research (Nelson, 1994). Nelson (2006) reported that there are about 2420 species and 220 genera and this family make more than eight percent of the fishes of worlds. Eschmeyer and Fong (2016) reported that there are 3038 species and 371 genera in cyprinidae family. The study of biometric relationships provided data from the field about appropriate indices to regulate research and fisheries management. To establish a mathematical relationship between the length and weight of a given species of fish length weight relationship (LWRs) study is carried out. In the field of fish biology and fisheries LWR can be used to understand many life aspects of fish like growth rate, metamorphosis, onset of maturity and taxonomic unit's differentiation (Sarkar *et al*. 2013).

The comparison of the population with time and space and the estimation of landed fish number can be calculated by setting yield equations with the help of LWR parameter. In fisheries science the a and b parameters of LWR are imperative to understand the comparison of morphology and life history of populations of different regions, determination of condition indices and estimation of the weight of individual fish from its given length (Sani *et al*. 2010). The knowledge of natural history and conservational strategies of commercially important fish species can be effectively improved and regulated by the estimation of fish length - weight empirical relationship. Furthermore, the effect of human activities on aquatic ecosystem and important clues of environmental and climatic changes can be estimated from length-weight data (Sarkar *et al*. 2013). The corporal level of development of an organism can be quantitatively expressed by an equating of length-weight relationship.

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Determination of the state of well-being and conditions of recent feeding of an individual fish specimen belonging to particular fish species can be calculated by condition factor (K). The K factor can be determined by calculating the relationship between weight and length of a fish specimen in the field of fisheries and fish biology. The degree of available food from sources, sexual maturity, gender determination in some species of fish and age can be indicated by calculating the different values of K factor (Froese, 2006). The available study of length-weight, length-length relationships and condition factor of fish species of family cyprinidae from the Indus River of Pakistan is sparsely available in the literature.

Therefore, the present study was aimed to describe the length-weight relationship and condition factor of 20 species and length-length relationships of 17 species of family cyprinidae from the Indus River at Taunsa barrage Punjab, Pakistan. This study will contribute some more valuable information for conservation practices and management strategies in the field of fisheries sector in the Indus River, of Pakistan

MATERIALS AND METHODS

Sample collection and data analysis

A total of 905 fish samples were collected on a monthly basis from the Indus River at Taunsa barrage randomly by using gill nets, cast nets and drag nets between August 2013 and July 2014. Immediately after collection each specimen was tagged and weighted in grams by digital balance with calculating capacity upto 0.01g.

The length parameters including total length, standard length and fork length were measured on measuring board upto 0.1cm. The process of tagging, weighting and length parameter measurements were carried out at Government Fish Laboratory of the Punjab Fisheries Office Taunsa Barrage. Then specimens were preserved in 10% formalin in the labeled plastics buckets and transported to the Fish Disease and Health Management laboratory, Department of Zoology, University of the Punjab, Lahore. The fish specimens were identified upto species level by using taxonomic key of Mirza and Sharif (1996).

Statistical analysis

The length- weight relationship (LWRs) and length-length relationships (LLRs) were calculated by using regression equations $W=aL^b$ and $Y=aX^b$. The values of condition factor (K) was calculated by equation $K=100W/(TL)^3$. Where W is total body weight and TL is total body length. The LWRs and LLRs parameters of regression equation were calculated by Microsoft excel 2013.

RESULTS

The fish specimens of family cyprinidae that were studied belong to 20 species at the Taunsa barrage from the Indus River. The range of total body weight and total length, regression parameters and condition factor for all the 20 studied species of family cyprinidae are given in (Table I). The lowest value of regression coefficient b for length–weight relationship was calculated for *Puntius conchinus* (2.16) and highest value in *Puntius ticto* (4.10). The lowest value of condition factor (K) was recorded in *Puntius conchinus* (0.45) and highest value was calculated in *Labeo calbasu* (1.83). Similarly the results of length, length regression equation with mean value, standard deviation and regression equation relationship between total length and standard length, total length and fork length and standard length with fork length are given in the Table II.

The lowest value of total body weight was calculated in *C. cachius* (0.2 g) while highest value was recorded in *L. rohita* (52 g). Lowest value of total length of the body was recorded in *P. sophore* (3 cm) and highest value was calculated in *L. rohita* (30.5 cm). The lowest and highest mean value of total body length was calculated in *P. sophore* (5.9 cm) and *L. calbasu* (20.3 cm) respectively (Table 2). Similarly the lowest value of condition factor was recorded in *P. conchinus* (0.65) and highest value was recorded in *L. calbasu* (1.83). The lowest and highest mean value of fork length was recorded in *P. sophore* (5.1 cm) and *L. calbasu* (17 cm) respectively. The lowest mean value of standard length was calculated in *P. sophore* (4.5 cm) and highest value was recorded in *L. calbasu* (16.1). The lowest value of regression coeffient b in total length and standard length relationship was calculated in *P. ticto* (0.92) and highest mean value was calculated in *P. ticto* (16.1).

The lowest value for regression coefficient b of total length and fork length relationship was recorded in *L. dyocheilus* (0.86) and highest value was recorded in *Salmophasia punjabensis* (1.04*)*. The lowest and highest value of regression coefficient b for standard length and fork length relationship was

calculated in *Labeo dyocheilus* (0.91) and *P. ticto* (1.04) respectively (Table II).

Table I: Length–weight relationship and condition factor of species of family cyprindae of the Indus River.

Species	Weight range (g)	Length range (cm)	N	a	B	95% CI of a		95% CI of b		r^2	K	G.T
						Lower limit	Upper limit	Lower Limit	Upper limit			
Labeo rohita	4 – 522	7 – 30.5	120	-1.68	2.72	-1.88	-1.49	2.53	2.90	0.88	1.41	A-
L. calbasu	4 – 273	7.5 – 28.7	11	-2.08	3.13	-2.30	-1.86	2.95	3.30	0.99	1.83	A+
L. gonius	1 – 196	6 – 26	97	-2.06	3.04	-2.21	-1.90	2.89	1.19	0.94	1.51	I
L. boggut	21 – 316	13.5–28.8	10	-2.33	3.24	-2.93	-1.72	2.73	3.76	0.96	1.55	A+
L. dyocheilus	11 – 65	10 – 18.2	16	-1.45	2.50	-1.96	-0.94	2.05	2.96	0.91	1.02	A-
Catla catla	27 – 305	13 –28.3	17	-2.20	3.22	-2.70	-1.71	2.82	3.62	0.95	1.45	A+
Cirrhinus mrigala	12 – 229	10 –28.8	105	-2.09	3.04	-2.25	-1.93	2.90	3.18	0.95	1.05	I
C. reba	2 – 155	6.5 – 14.1	169	-2.07	3.02	-2.18	-1.95	2.92	3.12	0.95	0.84	A-
Puntius sophore	0.3 – 9	3.0 – 8.5	132	-2.02	3.18	-2.20	-1.84	2.94	3.42	0.84	1.60	A+
P. chola	0.5 – 10	3.0 – 8.3	38	-1.84	3.02	-2.04	-1.65	2.76	3.28	0.94	1.83	I
P. conchinus	0.5 – 4	3.2 – 4.3	11	-1.22	2.16	-2.05	-0.38	0.86	3.47	0.83	0.64	A-
P. terio	0.5 – 10	4.3 – 9.4	16	-2.10	3.20	-2.94	-1.27	2.12	4.28	0.81	1.39	A+
P. ticto	0.5 – 10	4.4 – 9.4	16	-2.80	4.10	-3.48	-2.12	3.24	4.96	0.89	1.58	A+
S. punjabensis	0.5 – 3	4.1 – 8.1	17	-2.20	2.99	-2.65	-1.75	2.43	3.55	0.90	0.73	I
S. bacaila	1 – 24	4.9 – 16.3	23	-2.16	2.88	-2.61	-1.71	2.44	3.33	0.90	0.67	A-
Chela cachius	0.2 – 1	3.3 – 4.4	12	-2.26	3.30	-4.13	-0.38	0.12	6.48	0.90	0.91	I
Osteobrama cotio	2 – 32	5.5 – 9.2	31	-1.44	2.42	-2.68	-0.21	1.03	3.82	0.89	1.31	A-
Securicula gora	2 – 24	7.3 – 16.9	10	-2.20	2.95	-2.49	-1.91	2.69	3.22	0.99	0.69	A-
A. morar	1 – 8	5 – 8.9	20	-2.09	3.00	-2.67	-1.51	2.29	3.71	0.99	0.96	A+
Systomus sarana	20 – 109	11– 19.5	50	-1.80	2.95	-1.98	-1.63	2.80	3.10	0.97	1.48	A+

N=Number of specimens, a= intercept, b= slope, cl= confidence interval, r^2= coefficient of determination, K= condition factor, G.T= growth type, I= isometric growth, A^+ = positive allometric growth and A^-= negative isometric growth

DISCUSSIONS

The values of regression coefficients b in this study for most of the fish species of family cyprinidae were within the expected range 2.5 - 3.5 as suggested by Froese (2006) except *P. ticto*, *C. reba* (1.612), *P. conchinus* and *Osteobrama cotio* (Table I). The values of b parameter of regression equation were 3 in *Labeo gonius*, *C. mrigala, C. reba*, *P. chola*, *Salmophasia punjabensis* and *Cabdio morar*, show isometric growth pattern. The value of b parameter of regression equation were less than 3 in *L. rohita*, *L. dyochelus*, *C. reba*, *P. conchinus*, *Salmophasa bacaila*, *O. cotio, Securicola gora* and *Systomus sarana*

represents negative allometric growth pattern. The values of regression coefficient b were higher than 3 in *L. calbasu*, *L. boggut*, *Catla catla*, *Puntius sophore*, *Puntius terio*, *Puntius ticto* and *Chela cachius* indicate positive allometric growth rate.

Table II: Length-length relationships of fishes of family cyprinidae of Indus River.

Sr. No.	Species Mean±SD (TL)	Parameter	Mean + SD	Equation	a + b	r^2
1	*Labeo rohita*	FL	10.6 ± 3.2	FL= a + bTL	0.809 + 1.026TL	0.980
	12.4±3.5	SL	9.8 ± 3.0	SL= a + bTL	0.689 + 1.058TL	0.986
		FL	----------	FL= a + bSL	1.167 + 0.968SL	0.989
2	*Labeo calbasu*	FL	17 ± 9.2	FL= a + bTL	0.953 + 0.959TL	0.999
	20.3±11.3	SL	16.1 ± 8.8	SL= a + bTL	0.851 + 0.978TL	1.000
		FL	----------	FL= a + bSL	1.180 + 1.023SL	1.000
3	*Labeo gonius*	FL	9.1 ± 3.2	FL= a + bTL	0.996 + 0.933TL	0.954
	10.8±3.9	SL	8.4 ± 3.0	SL= a + bTL	0.866 + 0.956TL	0.951
		FL	----------	FL= a + bSL	1.154+ 0.973SL	0.996
4	*Labeo boggut*	FL	15.3 ± 5.1	FL= a + bTL	0.898 + 0.987TL	0.997
	17.7±5.9	SL	14.3 ± 5.0	SL= a + bTL	0.736 + 1.033TL	0.997
		FL	----------	FL= a + bSL	1.207 + 0.955SL	0.998
5	*Labeo dyocheilus*	FL	12.6 ± 1.7	FL= a + bTL	1.267 + 0.863TL	0.969
	14.4±2.2	SL	11.7 ± 1.7	SL= a + bTL	0.917 + 0.956TL	0.985
		FL	----------	FL= a + bSL	1.360 + 0.907SL	0.991
6	*Catla catla*	FL	15.4 ± 3.6	FL= a + bTL	0.839 + 1.001TL	0.989
	18.3 ± 4.3	SL	14.3 ± 3.5	SL= a + bTL	0.664 + 1.055TL	0.986
		FL	----------	FL= a + bSL	1.251 + 0.944SL	0.994
7	*Cirrhinus mrigala*	FL	12.8 ± 2.6	FL= a + bTL	0.886 + 0.992TL	0.981
	14.8 ± 3.0	SL	12 ± 2.5	SL= a + bTL	0.802 + 1.004TL	0.978
		FL	----------	FL= a + bSL	1.123 + 0.980SL	0.988
8	*Cirrhinus reba*	FL	11.2 ± 2.0	FL= a + bTL	0.849 + 1.009TL	0.972
	13.7 ± 10.3	SL	10.3 ± 1.9	SL= a + bTL	0.726 + 1.037TL	0.981
		FL	----------	FL= a + bSL	1.178 + 0.966SL	0.976
9	*Puntius sophore*	FL	5.1 ± 1.2	FL= a + bTL	0.835 + 1.019TL	0.970
	5.9 ± 1.3	SL	4.5 ± 1.0	SL= a + bTL	0.688 + 1.057TL	0.965
		FL	----------	FL= a + bSL	1.214 + 0.955SL	0.987
10	*Puntius chola*	FL	5.1 ± 1.4	FL= a + bTL	0.881 + 0.992TL	0.988
	5.9 ± 1.6	SL	4.5 ± 1.2	SL= a + bTL	0.794 + 0.979TL	0.984
		FL	----------	FL= a + bSL	1.124 + 1.007SL	0.991
11	*Puntius ticto*	FL	5.1 ± 1.2	FL= a + bTL	0.923 + 0.970TL	0.994
	6.1 ± 1.4	SL	4.5 ± 1.0	SL= a + bTL	0.885 + 0.924TL	0.987
		FL	----------	FL= a + bSL	1.062 + 1.042SL	0.992
12	*Puntius terio*	FL	5.1 ± 1.2	FL= a + bTL	0.870 + 1.006TL	0.986
	5.9 ± 1.4	SL	4.6 ± 1.0	SL= a + bTL	0.819 + 0.975TL	0.964
		FL	----------	FL= a + bSL	1.119 + 1.001SL	0.963
13	*S. punjabensis*	FL	5.2 ± 0.9	FL= a + bTL	0.812 + 1.037TL	0.932
	5.9 ± 1.0	SL	6.3 ± 0.9	SL= a + bTL	0.678 + 1.077TL	0.895
		FL	----------	FL= a + bSL	1.224 + 0.939SL	0.991
14	*Salmophasia bacaila*	FL	9.4 ± 2.9	FL= a + bTL	0.827 + 1.034TL	0.995
	10.5 ± 3.0	SL	8.7 ± 2.7	SL= a + bTL	0.711 + 1.066TL	0.992
		FL	----------	FL= a + bSL	1.158 + 0.967SL	0.997
15	*Securicula gora*	FL	10.8 ± 3.4	FL= a + bTL	0.796 + 0.938TL	0.995
	12 ± 3.6	SL	10.0 ± 3.3	SL= a + bTL	0.644 + 1.104TL	0.999
		FL	----------	FL= a + bSL	1.210 + 0.950SL	0.995
16	*Cabdio morar*	FL	5.7 ± 1.0	FL= a + bTL	0.895 + 0.996TL	0.982
	6.5 ± 1.1	SL	5.2 ± 0.9	SL= a + bTL	0.712 + 1.061TL	0.965
		FL	----------	FL= a + bSL	1.257 + 0.926SL	0.990
17	*Systomis sarana*	FL	12.1 ± 1.5	FL= a + bTL	0.799 + 1.027TL	0.953
	14.1 ± 1.6	SL	11.4 ± 1.4	SL= a + bTL	0.713 + 1.045TL	0.977
		FL	----------	FL= a + bSL	1.158 + 0.967SL	0.944

The value of condition factor in most species of the family cyprinidae was calculated 1 or more than 1, except *C. reba*, *P. conchinus*, *S. punjabensis*, *S. bacaila*, *C. cachius* and *S. gora*. If the value of condition factor is 1 or more than 1 it is indicative of wellbeing of fish with availability of good food resources (Sarkar *et al.* 2013). Thus it is evident from this study that most of fish species of family cyprinidae of the Indus River is in good health conditions. The results of this study are close to the da Costa and Arauj (2003), Pervaiz *et al*. (2012), Datta *et al.* (2013), Sarkar *et al.* (2013), Kamikawa *et al.* (2015), Sharma *et al.* (2015) and Liang *et al.* (2016).The results of length-length regression equation between different parameters of length depicted strong correlation between the growth rate of total length, fork length and standard length in all the species of family cyprinidae (Table 2). This data will provide some important information for the freshwater fish species that are present in the Indus River water to improve the stocking strategies of these species for the maintenance of their natural stock in natural habitat.

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REFERENCES

DA COSTA, M.R. AND ARAÚJO, F.G. 2003. Length-weight relationship and condition factor of *Micropogonias funieri* (Desmarest) (Perciformes, Sciaenidae) in the Sepetiba Bay, Rio de Janeiro State, Brazil. *Rev. Bras. Zool.,* **20**: 685-690.

ESCHMEYER, W.N. AND FONG, J.D. 2016. *Species by family/subfamily in the Catalog of Fishes*, California Academy of Sciences San Francisco.

DATTA, S.N., KAUR, V.I., DHAWAN, A. AND JASSAL, G. 2013. Estimation of length-weight relationship and condition factor of spotted snakehead *Channa punctata* (Bloch) under different feeding regimes. *SpringerPlus*. **2**: 436. DOI:1186/2193-1801-2-436

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

KAMIKAWA, K.T., CRUZ, E., ESSINGTON, T.E., HOSPITAL, J., BRODZAIK, J.K.T. AND BRANCH, T.A. 2015. Length–weight relationships for 85 fish species from Guam. *J. Appl. Ichthyol.,* **31**: 1171-1174.

LIANG, Y.Y., HEI, D.K., SUI, X.Y., SHEN, Z.X., XIONG, W. AND CHEN, Y.F. 2016. Length–weight and length–length relationships of four native fish species of the Qinghai-Tibet Plateau, China. *J. Appl. Ichthyol.,* **32**: 134-136.

MIRZA, M.R. AND SHARIF, H.M. 1996. *A key to fishes of the Punjab*. Ilmi Kitab Khana, Lahore, Pakistan.

NELSON, J.S. 1994. *Fishes of the World,* Third Edition. John Wiley & Sons, New York:

NELSON, J.S. 2006. *Fishes of the World*. John Wiley and Sons, Chichester:

PERVAIZ, K., IQBAL, Z., MIRZA, M.R., JAVED, M.N., NAEEM, M. AND ISHTIAQ, A. 2012. Length–weight, length–length relationships and feeding habits of wild Indus Mahseer, *Tor macrolepis*, from Attock, Pakistan. *J. Appl. Ichthyol.,* **28**: 673-676.

SANI, R., GUPTA, B.K., SARKAR, U.K., PANDEY, A., DUBEY, V.K. AND LAKRA, W.S. 2010. Length weight relationship of 14 Indian freshwater species from river Betwa (Yamuna River tributary) and Gomti (Ganga River tributary). *J. Appl. Ichthyol.,* **26**: 456-459.

SARKAR, U.K., KHAN, G.E., DABAS, A., PATHAK, A.K., MIR, J.I., REBELLO, S.C., PAL, A. AND SINGH, S.P. 2013. Length weight relationship and condition factor of freshwater fish species found in River Ganga, Gomti and Rapti, India. *J. Env. Biol.,* **34**: 351-356.

SHARMA, N.K., MIR, J.I., SINGH, R., AKHTAR, M.S. AND PANDEY, N.N. 2015. Length–weight relationships for eight fish species from the Ravi River, north-western India. *J. Appl. Ichthyol.,* **31**: 1146-1147.