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Length-Weight Relationship and Condition Factor of Indian Major Carps and Few Local Fishes in Bilawali Tank, Indore City (M.P.), India

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Abstract: The current study was aimed to elucidate the length-weight relationship and condition factor of Indian major carps (3) and some local fishes (5) in Bilawali tank, Indore city (M.P.) during September to November month of 2021 to understand the fisheries status in terms of health condition. The mean value (n=30) of total lengths and weight for each fishes were analyzed during studied month whereas the minimum and maximum value of Condition Factor (K) were calculated as 1.20 and 3.55 for *Cirrhinus mrigala* (November) and *Channa punctata* (September) respectively which exhibits the good health condition of fishes in Bilawali tank. Furthermore, the length and weight variables of the studied fish show linear relationships which are demonstrated by exponent values 'b' (illustrates negative allometric growth, b<3) and coefficient correlation (r). The exponent values (b) ranges from 1.38 (*Cyprinus carpio*) to 2.07 (*Cirrhinus mrigala*) during November month for both. Results provides the basic information regarding fish productivity which may be suitable for better management of Indian major carps and some studied local fishes in Bilawali tank.

Key words: Length-weight relationship · Condition Factor (K) · Indian major carps · Local fishes and Bilawali tank

INTRODUCTION

Length-weight relationships are necessary for the conversion of growth-in-length to growth-in-weight equations, which are used for stock assessment models to analysed the stock assessment biomass through a limited sample size as indicators of fish condition [1]. It is used to compare the life history of certain species among regions and other aspects of fish in context of population dynamics [2, 3] and; alsoto track seasonal changes in growth of fish fauna [4]. The increase in length and weight are major criteria to determine the fish growth [5]. Length-weight relationships can also confers the information on the stock condition of fish species [6, 7].

The condition factor (K) provides information on food availability, its utilization by fish species and sexual maturity. It also tells about a body of water's suitability for fish growth and serves as an index for an average size of fish species [8]. The condition factor (K) also helps to contribute information in context of ages and sexes of some fish fauna [9]. It was found that the condition factor along with relative condition factor also helps to assess the significant alteration in body shape of various species of fishes [10]. There are a scarce literature has been available on Length-weight relationships for most of the tropical and sub-tropical fish species [11, 12] and also there are no literature has been available on Length-weight relationships of fishes from Bilawali tank, Indore City (M.P.), India. In view of this, the attention has been focused to elucidate the Length-weight relationships and condition factor of the freshwater fish species (Indian major carps and some local fishes) in Bilawali tank, Indore city.

MATERIALS AND METHODS

Study Area: Indore city is a part of central India and located at latitudes 22°39'N and longitudes 75°52'E in Madhya Pradesh. The Lake 'Bilawali' was constructed on Indore-Khandwa Road around the beginning of the 20th century and now it is under the control of the Indore Municipal Corporation. The catchment area and surface area of lake was 1.5 sq m and 0.77-0.97 sq m respectively whereas average depth of lake was observed as 9.14

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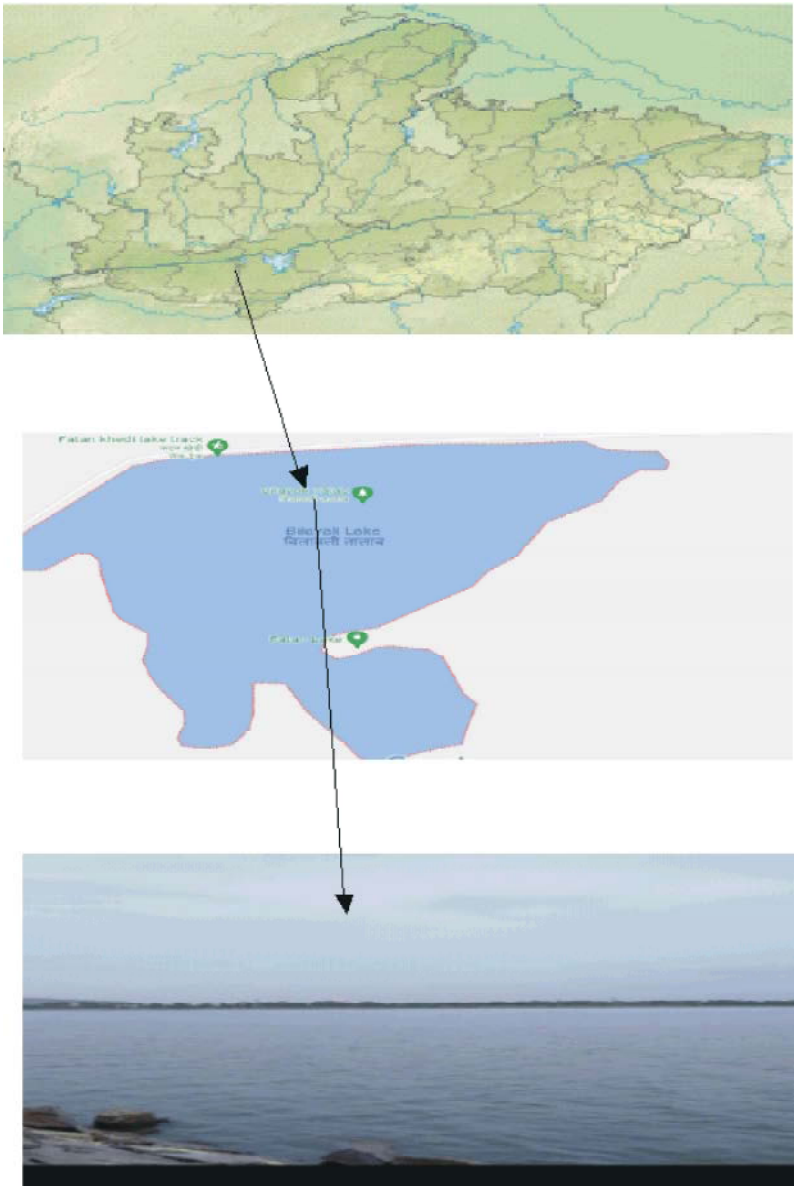

Fig. 1: Upper two diagram (Google map) and Lower Photograph (Digital Camera)

metres. The water bodies of Bilawali Lake has been used for drinking purpose and also important for aquaculture point of view (Fig-1).

Sample Collection and Data Analysis: The sampling were done thrice in each specified month and there are a 10 fish was collected for each eight (8) species at one time over a period of 10 days and thus there are a total 720 fish sample (10 x 3=30 sample for each species and 30x8=240 sample for 8 species during 1 month and; a total 240 x 3=720 fish sample during 3 month) were collected during three specified month (September to November, 2021).Length-weight relationships of fish samples for each eight species (3 Indian major carps *viz;Catla catla, Labeo rohita* and *Cirrhinus mrigala* and 5 local fish species *viz; Heteropneustes fossilis,Clarias batrachus,Cyprinus carpio,Channa punctata,Wallago attu*) were analyzed through log transformed data, based on length and weight measured during each specified month(September to November, 2021). The total length of ichthyofaunal species were measured from snout tip to the last end of caudal fin by using measuring tape and the body weight (after removing mucus and water) was measured with the help of digital balance.

For establishment of statistical relationship between length and weight [13], there are a following parabolic equation [10] were used -

$$W = aL^b$$

This relationship was fitted into straight line in the logarithmic form [14].

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

where,
W = weight of fish (g), L = length of fish (cm), a = Coefficient/ intercept and b = Exponent/regression slope

Furthermore, the condition factor (K) was calculated by following formula [15].

$$K = (W \times 100) / L3$$

where, W = Weight of fish (g) and L = Total length of fish (cm)

Statistical Analysis: The regression parameters of Length -Weight relationship were analyzed through SPSS software (Version-16) however analysis of S.D. and SEM were carried out with the help of Graph Pad prism software (version-7).

RESULTS

There are a total 720 fish sample (30 sample for 8 species during 3 month) were taken for study of length-weight relationships and condition factors for three Indian major carps (*Labeo rohita,Catla catla* and *Cirrhinus mrigala*) and five local fish species (*Heteropneustes fossilis, Clarias batrachus,Cyprinus carpio,Channa punctata* and *Wallago attu*) from September to November month (2021), have been documented in Table (1). Moreover, the percent (%) increase in average growth rate for studied ichthyofaunal species were also summarized in Table 2. The highest and lowest increase in average length were noticed as 28.69 and 8.08 % for *Labeo rohita* and *Heteropneustes fossilis* respectively whereas the

Table 1: Average growth rate of ichthyofaunal species during three months, September to November (2021) in Bilawali tank

						Regression parameters of Length - Weight relationship		
S.No.	Fish Species	Month	Length (cm) Mean (SEM±SD)	Weight (gm) Mean (SEM±SD)	Condition Factor (K)	'a' Value	'b' Value	R^2 Value
1	*Labeo rohita*	September	33.80(1.0214±1.7692)	1100(11.55±20.00)	2.84	-6896.995	2.00	0.908
		October	37.40(1.1719±2.0298)	1220(52.92±91.65)	2.33	-6774.646	1.98	0.905
		November	43.50(1.5308±2.6514)	1410(20.82±36.06)	1.71	-6816.253	1.99	0.907
2	*Catla catla*	September	47.50(1.4933±2.5865)	3100(77.67±134.54)	2.89	-7201.644	2.05	0.914
		October	51.30(1.6166±2.8000)	3550(179.26±310.48)	2.62	-7182.363	2.03	0.911
		November	54. 50(1.7349±3.0050)	3940(184.75±320.00)	2.43	-7169.390	2.05	0.912
3	*Cirrhinus mrigala*	September	38.40(0.8737±1.5133)	1000(20.82±36.06)	1.76	-7107.194	2.03	0.914
		October	41.50(0.7506±1.3000)	1140(34.64±60.00)	1.59	-7214.937	2.06	0.916
		November	47.00(0.7000±1.2124)	1250(51.96±90.00)	1.20	-7318.158	2.07	0.908
4	*Heteropneustes fossilis*	September	19.80 (1.3650±2.3643)	250 (7.638±13.229)	3.22	-6082.595	1.84	0.859
		October	20.50 (1.2124±2.1000)	255.5(2.021±3.500)	2.96	-5353.484	1.71	0.835
		November	21.40 (0.9539±1.6523)	270 (2.930±5.074)	2.75	-4891.621	1.63	0.822
5	*Clarias batrachus*	September	16.20(1.3279±2.3000)	110.00(5.29±9.17)	2.58	-4343.065	1.53	0.804
		October	17.50(0.4041±0.7000)	125.00(13.23±22.91)	2.33	-3997.576	1.46	0.796
		November	18.10(0.9597±1.6623)	160.00(4.62±8.00)	2.69	-3744.647	1.42	0.791
6	*Cyprinus carpio*	September	22.30 (1.6462±2.8513)	320 (3.61±6.24)	2.88	-3621.587	1.40	0.789
		October	25.70 (0.5508±0.9539)	380 (4.16±7.21)	2.23	-3577.460	1.39	0.794
		November	28.50 (1.0116±1.7521)	420 (6.93±12.00)	1.81	-3574.168	1.38	0.797
7	*Channa punctata*	September	15. 00(0.924±1.600	120 (1.803±3.122)	3.55	-5511.223	1.75	0.844
		October	16.50(0.866±1.500)	128.5 (2.179±3.775)	2.86	-4689.073	1.60	0.818
		November	17.80 (0.723±1.253)	140 (3.617±6.265)	2.48	-4214.833	1.52	0.808
8	*Wallago attu*	September	27.00 (1.323±2.291)	550 (20.82±36.06)	2.79	-4107.783	1.50	0.810
		October	28.00 (1.386±2.400)	620 (17.32±30.00)	2.82	-4032.577	1.49	0.812
		November	29.40 (0.693±1.200)	750 (15.28±26.46	2.95	-3983.805	1.48	0.815

Table 2: Percent (%) increase in average growth rate of ichthyofaunal species during three months, September to November (2021) in Bilawali tank

Fish Species	% increase in length (cm)	% increase in weight (gm)
Labeo rohita	28.69	28.18
Catla catla	14.73	27.09
Cirrhinus mrigala	22.39	25.00
Heteropneustes fossilis	8.08	8.00
Clarias batrachus	11.72	45.45
Cyprinus carpio	27.8	31.25
Channa punctata	18.66	16.70
Wallago attu	8.88	36.36

increase in average weight were estimated maximum and minimum as 45.45 and 8.00 % for *Clarias batrachus* and *Heteropneustes fossilis* respectively (Table, 2).

In undertaken work, the mean total length for *Labeo rohita,Catla catla* and *Cirrhinus mrigala* were ranges from 33.80(1.0214±1.7692) - 43.50(1.5308±2.6514), 47.50(1.4933±2.5865) - 54. 50(1.7349±3.0050) and 38.40(0.8737±1.5133) - 47.00(0.7000±1.2124) cm respectively whereas the mean total weight of these carp fishes varied from 1100(11.55±20.00) - 1410(20.82±36.06), 3100(77.67±134.54) - 3940(184.75±320.00) and 1000(20.82±36.06) - 1250(51.96±90.00) gm respectively. Moreover, the mean total length for *Heteropneustes fossilis, Clarias batrachus, Cyprinus carpio, Channa punctata* and *Wallago attu* were noticed in the ranges of 19.80 (1.3650±2.3643) - 21.40 (0.9539±1.6523), 16.20(1.3279±2.3000) - 18.10(0.9597±1.6623), 22.30 (1.6462±2.8513) - 28.50 (1.0116±1.7521), 15.00(0.924±1.600 - 17.80 (0.723±1.253) and 27.00 (1.323±2.291) - 29.40 (0.693±1.200) cm, respectively further, the ranges of mean total weight of these fishes were estimated as 250 (7.638±13.229) - 270 (2.930±5.074), 110.00(5.29±9.17) - 160.00(4.62±8.00), 320 (3.61±6.24) - 420 (6.93±12.00), 120 (1.803±3.122) - 140 (3.617±6.265), 550 (20.82±36.06) - 750 (15.28±26.46) gm,respectively (Table, 1).

DISCUSSION

Length-weight relationship is found to be an important tool for fundamental fishery management as it provides information on the population dynamics of ichthyofaunal species as well as stock condition also [16]. In current study, the average length and weight of three Indian major carps (*Labeo rohita,Catla catla* and *Cirrhinus mrigala*) and five local fish species (*Heteropneustes fossilis, Clarias batrachus,Cyprinus carpio,Channa punctata* and *Wallago attu*) has been documented from September to November month (2021) are observed to be more or less similar according to the findings of previous authors [17-26].

The values of Condition Factor (K) among all the studied ichthyofaunal species were ranges from 1.20 (*Cirrhinus mrigala* for November) to 3.55 (*Channa punctata* for September) in Bilawali tank (Table 1). Whereas, the condition factor for *C. capoeta* and *C. gibelio* was ranged from 0.075±0.244 to 1.021±0.143 during study of six cyprinid fish species in Zarrineh River, Iran [27]. The average values of computed condition factor (K) for all specimen of *Labeo rohita* and *Cirrhinus mrigala* was reported as 2.12 and 1.91 respectively [23]. The highest values of condition factor for *Labeo rohita* (Ham.) was reported to be 1.3932 in Barnoo reservoir, M.P. [21]. The Condition Factor (K) for *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* were ranged from 1.4875 to 2.5343, 1.1883 to 2.4142 and 1.3664 to 2.3233, respectively, which exhibits the good health condition of ichthiofaunal species in Morvan Dam (Neemuch District), M.P., India [24]. It has been previously reported that the deviation of Condition Factor (K) from 1 may be due to some factors *viz*;, water quality, water temperature, DO content and changes in the abundance of food [28]. The condition factor (K) for *Garra rufa* were noticed in the ranges of 0.651 - 2.198 exhibits a non-welfare condition in Cholvar River [29].

Moreover, it has also been noticed that the condition factor (K) are affected by gonadal development since most of the energy being transferred to the gonads during the reproductive phase of the fish fauna [30].

In present study, the minimum and maximum exponents values ('b') in Regression parameters of Length - Weight relationship, has been reported as 1.38 and 2.07 for *Cyprinus carpio* and *Cirrhinus mrigala* respectively during November month. Moreover, the R^2 Value were varied from 0.789 (*Cyprinus carpio* during September) to 0.916 (*Cirrhinus mrigala* during October) towards three months of study period (Table-1). The coefficient values 'b' for male, female and combined sex of *Mystus tengara* are found to be 2.941, 3.119 and 3.071 respectively which illustrates positive allometric growth for female and combined sex but negative allometric growth for male [31]. Furthermore, the exponent 'b' value has been noticed in the range of 2.845 - 3.10 for five small freshwater indigenous ichthyofaunal species from the Pagla river, Bangladesh [8]. The regression coefficient values "b" were range from 2.429 (*A. microlpis*) to 3.71 (*C. keyvani*) whereas the condition factor were noticed in the ranges from 0.544 (*O. bergianus*) to 0.940 (*P. cyrius*) during study of seven fish species in Totkabon River of Iran [32]. However, the ranges of growth parameter "*b*" were noticed from 2.75 (*R. amarus*) to 3.62

(*C. morar*) and condition factor was noticed from 0.6 (*R. persus*) to 1.47 (*R. amarus*) towards study of ten ichthyofaunal species [33] whereas the growth coefficient value (b) were noticed in the range of 2.53 (*Paraschistur aturcmenica*) to 3.2 (*Garr arufa*) and also the condition factor (K) was calculated as 0.89 and 1.53 respectively for *P. turcmenica* and *G. rossica* [34] in Iranian inland waters. The "b″ value in *C. cachius* was ranged between from 2.42 (October) to 3.55 (July)in old Brahmaputra River, Bangladesh [35] and from 3.52 (for *Cirrihinus mrigala*) to 2.11 (for *Labeo gonius*) in the Ken River (Central India) for all species from December 2007 to January 2009 [36]. Further, the exponent 'b' value were analyzed in the ranges of 2.5 (*Channa marulius*) to 3.5 (*Heteropneustes fossilis)* in Ganga basin which exhibits isometric growth [37]. The exponent value for *C. mrigala* and *L. rohita* were reported to be 3.11 and 3.04 whereas mean values of condition factor (K) for all specimen of *L. rohita* and *C. mrigala* was found to be 2.12 and 1.91 respectively in Sutiapat reservoir located in kabirdham district, Chhattisgarh [23]. Regression parameters (exponents 'b') of Length - Weight relationship illustrates the values ranges from 1.111-6.990 for Indian major carpsin Morvan Dam (Neemuch District), M.P., India [24]. Whereas, the value of exponents 'b'for *L. dero* and *T. putitora* was reported as 3.187 and 3.102 respectively, exhibits a positive allometric growth ($b > 3$) but these value were noticed for *S. richardsonii* as 1.915, illustrates a negative allometric growth since, $b < 3$ [38].

Previous report illustrate that the condition factor (K) and exponent 'b' value arefound to be directly proportional to each other. The 'K' value remains constant at 1 when exponent 'b' value is equal to 3. Further, the exponent 'b' are either greater than 3 or less than 3, then K value is found to be either increase or decrease [39, 40]. Previous report illustrates that the exponent 'b' value unlikely may alters between habitats and may also vary seasonally and even daily [41, 42]. Eventually, a deviation in the 'b' value (lower than 3) has been also noticed in current investigation, exhibits that it does not follow the cube law exactly which exhibit conformities to *L. calbasu* from Jawahar Sagar Dam, Southern Rajasthan [43] and *P. ranga* from Wetland, East Kolkata [44].

Moreover, this study provides baseline information for measurement about the health condition of ichthyofaunal resources and; also helps to formulate the population dynamics along with its scientific and sustainable management in Bilawali tank for forthcoming fishery biologists.

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