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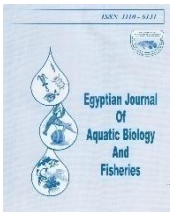

Some Morphometric and Meristic Characters of *Catla catla* from research farms of MNS University of Agriculture Multan, Punjab Pakistan

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ABSTRACT

Catla catla is a member of the major Indian carp family and is a widely cultivated fish individual found in rivers, lakes and ponds throughout the world, including India, Pakistan, Bangladesh and Sri Lanka. To investigate the length-weight relation and length-to-length relationship for the cultivated *Catla catla*, 125 fish samples were collected from the research farm of Muhammad Nawaz Shareef-University of Agriculture Multan, Panjab, Pakistan. Weights of fish samples were measured and reported; condition factors with relationship or other morphometric parameters, such as eye diameter, total length, standard length, forked length, body weight, and body girth were addressed. The mean values of total length and the weight of the fish body of *Catla catla* were 5.04±1.43cm and 40±48.3g, respectively. Results of statistical analyses showed a highly significant correlation between the length-weight relationship and the length-length relationship of cultivated *Catla catla*. The intercept value (b) was 3.18 for length-weight relationships (LWRs) of cultivated *Catla catla*, indicating that the growth pattern is positively allometric. The current report provided information on unlike features in *C. catla* fish of other deviations to increase the body weight of fish marketable growth. In addition, this study is the primary effort to address the growth condition of this important species and other selected cyprinid species for their sustainable management and protection.

INTRODUCTION

Catla catla is the member of the carp's family naturally found in rivers, lakes and the culture farms and ponds **(Jhingran**, **1968)**. It is an important commercial cultured fish species, with a radical role in freshwater fish production in addition to its extreme market place demand **(Bhuiyan & Islam**, **1990)**. Thus, the study of morphometric length and weight relationship and other variation and modification in the organisms with different size and shape of the fishes **(Webster, 2006)** is fundamendal. The morphometric study is significant in evaluating the relationship among numerous portions of the body of fish **(Carpenter *et al.*, 1996)**.

Moreover, the morphometric features are valuable means to investigate morphometric dimension to categorize the stock assessment of fish **(Turan, 2004)**. Total length of fish (TL) and body weight (BW) are two vital investigational variables with various uses in population'sassessment, and they are regularly used in standard evaluation studies **(Jellyman *et al.*, 2013)**. There are some collective means to regulate the morphometric processes, together with the proportion of total length (TL), fork length (FL), standard length (SL), body weight (BW), condition factor (K), body girth (BG) and eye diameter (ED) **(Naeem *et al.*, 2010)**.

The record of morphological dimensions is helpful for their taxonomic position in aquatic atmosphere. Usually, fish show larger changes in morphological characters among the population and inside the species rather than other vertebrates. Fish are very sensitive to environmental variations and rapidly adjust themselves by changing essential morphometries. The condition factor, the length to length, and the length to weight correlations enhance valuable facts of the cultivated species of fish that is useful to determine growth, population concentrations and the mass of fish **(Hossain *et al.*, 2006; Araneda *et al.*, 2008; Ferdaushy & Alam, 2015)**. Notably, the physical growth of a living being is furthermore stated based on the length-weight relation. To estimate the parameters of length- weight relationship (W= aLb) for an organism, if "a" interrupts the value of "b", the slope of log correlation shows that fish weight value increases with the increase in length **(Le Cren, 1951; Froese, 2006)**. Furthermore, the condition factor is regulated via the association between the fish's length and wet body weight (**Froese, 2006)**. On the other hand, different values of "K" reflect availability of the nutrition, age and their sexual growth (**Gomiero & Braga, 2005).**

The present study was conducted to determine the approximate numerous weight-length relations of *Catla catla*, providing an evidence of fish existence and development under a specific aquatic atmosphere in the pond culture system of Muhammad Nawaz Shareef University of Agriculture Multan, Pakistan.

MATERIALS AND METHODS

Fish sampling and study site

125 samples of *Catla catla* were randomly gathered from the culture farm which is situated at C Block of Muhammad Nawaz Shareef University of Agriculture Multan, Punjab, Pakistan using a net that is commonly called drag net. Fish samples were immediately transferred to the Fisheries Research Lab of MNS-University of Agriculture Multan Punjab, Pakistan.

Morphonetric analysis

- **Forked length:** it was measured starting from the mouth till the fork of the caudal fin, likely related to the total length measurement.
- **Total body length:** fish length was measured from the mouth till the end of the tail.
- **Fish standard length:** also known as full body length in which whole body length measured from snout of fish till the end of caudal fin**.**
- **Eye diameter:** the diameter of eyes was measured by putting a measuring scale on the eye and checking the eye's diameter.

The morphometric variables revealed changes in weight and length. Regression analysis was applied to statistical research using Microsoft Excel.

According to following formulas, the relationship between the length & weight is an exponential process:

$$W=aL^b$$

Body weight is represented by W, length by L, is utilized for the value of a, and b denotes value of slope. b value exhibits a positive/ negative form of allometric growth according to the log equation. If it was larger than 3, then fish gained weight in proportion to increases in fish mass; if it was lower than 3, then fish showed a negative allometric form of growth **(Bagenal & Tesch, 1978)**.

$$LogW=\log a \pm b \log L$$

Some of the tools like board, scale and measuring tape were used in the complete process. Then, a digital weight balance was used maintaining its value as lower than 0. 1gram. All fish samples were separately measured, and their data were recorded. Before weight measuring, fish samples were cleaned, and their bodies were totally devoid of mud.

Coefficient of correlation

In the current study, correlation coefficient was conducted to access the relationship. A linear regression analysis was determined at 5% level of significance ($P<0.05$). A value of $r \leq 0.50$ indicates weak correlation; if $r \geq 0.60$, then it indicates a moderate correlation, however if $r>0.70$, a strong correlation is indicated. This assesses the direct relationship between weight and length of fish, concluding that if length of the fish increases, fish weight increases accordingly.

Condition factor

Fulton's condition factor (K) was determined using the following formula as given by **Fulton (1902):**

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

Where, W indicates weight of fish, and L indicates length of fish.

RESULTS

125 samples *Catla catla* were taken from C Block MNS-University of Agriculture, Multan Punjab, Pakistan. The body weight and total length of fish ranged from 6- 217g and 3- to 9.2cm, respectively. The total mean and the standard deviation were approximately 40 ± 48.3g for the total weight although the mean total length recorded a value of around 5.04 ± 1.43 cm. The values for the different morphometric variables of *C. catla* are shown in Table (1).

Table 1. Some various measurements of external parameters of *C. catla* (n = 125)

External dimension	Mean ± S.D.	Range
Wet body weight (g)	40 ± 48.3	6 - 217
Total length (cm)	5.04 ± 1.43	3 - 9.2
Condition factor	39.5 ± 11.2	22.0 - 85.1
Fork length (cm)	4.57 ± 1.41	2.7 - 8.7
Standard length (cm)	4.25± 1.43	2.3 - 8.2
Body girth (cm)	2.97± 1.31	0.8-7
Eye diameter (cm)	0.28±0.07	0.2-0.5

The relationship among the various values of the body wet weight (W) showed that all the factors increased with body weight (W). The connection among the parameters indicated highly significant positive relationships between the body weight and the length of all the external morphometric measurements, except the condition factor (Table 2).

All the b values of external morphometrics recorded a highly significant correlation with the wet weight of the body. The length-weight correlations of fish showed that the weight of fish has a relationship with overall length, except for the condition factor (Table 3 & Fig. 1). The lines of regression created by graphing the log data (1og length against log weight) were parallel, indicating a linear relationship between the fish's log length and log weight. These results supported the observation of a straight-line association in carps reported in Fig. (2).

Particularly, relationships of body wet weight and total length of other body various parameters showed a strongly positive correlation. In addition, a positive relationship trend between all those elements of various body characteristics and the rise in total body length was evident. While, a favorable trend was seen in the log total length, using a research external morphometric parameter (Table 3). With a rise in body weight, the statistical study showed that total body weight and other various body parameters increased, demonstrating the positive association with wet body weight. In this process of log fish wet weight with various body variables, all displayed a positive correlation, except for the condition factor that showed a non significant correlation (Tables 4, 5).

Morphometric parameter showed the log length and log weight relationship as follows: Log W= 0.792+ 3.18 log TL, with r= 0.965 (Table 3). Body weight and overall total length showed a greater consequential link in the regression study. The coefficient of regression's b value was 3.18, which denotes an allometric relationship that is quite near to the isometric value. There was a highly substantial relationship between the total length and wet weight of the fish body, which was measured as a linear relationship (Table 3). For growth parameters, most length-weight relationships were allometric in *C. catla*. Moreover, a highly significant correlation of *P*> 0.01 was detected among total length, body weight, body girth, fork length, condition factor and the eye diameter.

Table 2. Statistical results of total length with different morphometric parameters for *C. catla*

Correlation variables	Parameters correlation		95% CI of a	95% CI of b	r	r^2
	a	b				
SL = a + bTL	-0.715	0.984	-0.875, -0.556	0.9531,1.014	0.985***	0.971
W = a + bTL	-117.186	31.129	-129.14, 105.22	28.850, 33.407	0.925***	0.856
ED = a + bTL	0.121	0.033	0.086, 0.1553	0.027, 0.040	0.667***	0.444
K = a + bTL	47.516	-1.586	40.327, 54.703	-2.956, 0.217	$0.203^{n.s}$	0.041
BG= a + bTL	-1.343	0.855	-1.645, 1.0411	0.798, 0.913	0.936***	0.876
FL= a + bTL	-0.356	0.976	-0.455, 0.257	0.958, 0.995	0.994***	0.989

Table 3. Some statistical considerations of log total length with different morphometric variables for *C. catla*

Correlation variables	Parameterscorrelation		95% CI of a	95% CI of b	r	r^2
	a	B				
Log SL = a +b log TL	-0.189	1.156	-0.216, -0.161	1.117, 1.196	0.982***	0.965
Log W = a +b log TL	-0.792	3.188	-0.898, -0.685	3.035, 3.341	0.966***	0.933
Log ED = a +b Log TL	-0.967	0.601	-1.058, -0.877	0.472, 0.730	0.640***	0.409
Log K = a+ b Log TL	1.773	-0.281	1.649, 1.898	-0.459, -0.102	0.270 n.s	0.073
Log BG= a + b Log TL	-0.570	1.461	-0.656, -0.484	1.338, 1.584	0.905***	0.818
Log FL= a + b Log TL	-0.090	1.065	-0.105, -0.075	1.043, 1.086	0.994***	0.988

Table 4. Some statistical considerations with wet body weight different morphometric variables for *C. catla*

Correlation variables	Parameters correlation		95% CI of a	95% CI of b	r	r^2
	a	b				
SL = a + b W	3.172	0.027	3.034, 3.310	0.025, 0.029	0.909***	0.827
TL = a + b W	3.950	0.028	3.824, 4.076	0.025, 0.030	0.925***	0.856
ED = a + b W	0.253	0.001	0.240, 0.266	0.001, 0.001	0.592***	0.351
K = a + b W	38.973	0.013	36.377, 41.570	-0.028, 0.055	0.057n.s	0.003
BG= a + b W	1.998	0.024	1.865, 2.130	0.022, 0.027	0.899***	0.809
FL= a + b W	3.498	0.027	3.372, 3.624	0.025, 0.029	0.922***	0.851

Table 5. Statistical consideration of log body weight (W) with different morphometric variables for *C.catla*

Correlation variables	Parameter correlation		95% CI of a	95% CI of b	r	r^2
	a	b				
Log SL = a + b log W	0.129	0.341	0.102, 0.156	0.322, 0.360	0.956***	0.914
Log TL = a + b log W	0.278	0.293	0.258, 0.298	0.278, 0.307	0.966***	0.933
Log ED = a + b log W	-0.808	0.181	-0.864, -0.751	0.142, 0.220	0.636***	0.405
Log K = a + b Log W	1.612	-0.023	1.531, 1.693	-0.079, 0.033	0.073n.s	0.005
Log BG = a + b Log W	-0.182	0.440	-0.237, -0.126	0.402, 0.478	0.900***	0.810
Log FL= a + b Log W	0.205	0.312	0.182, 0.228	0.296, 0.328	0.962***	0.926

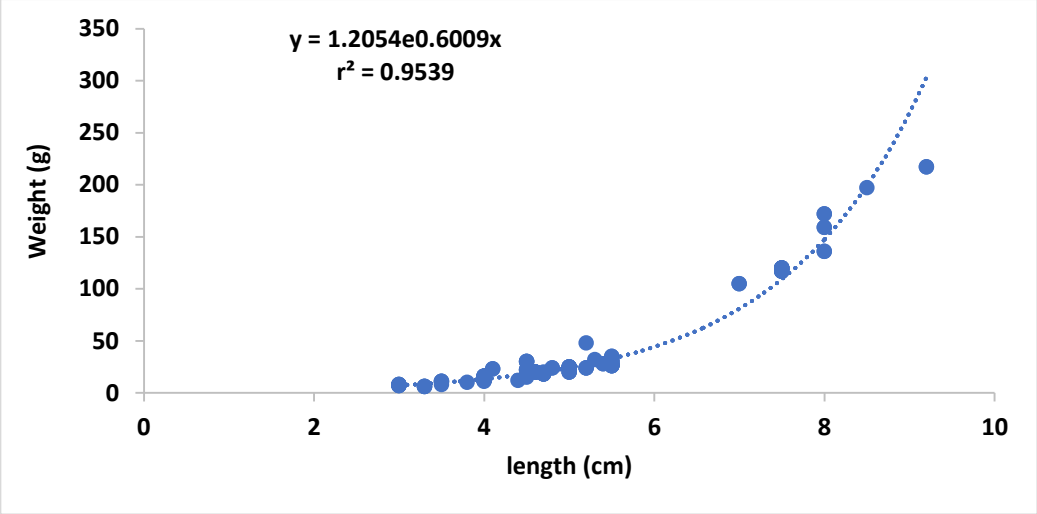

Fig.1. Graphical values of length-weight relationship

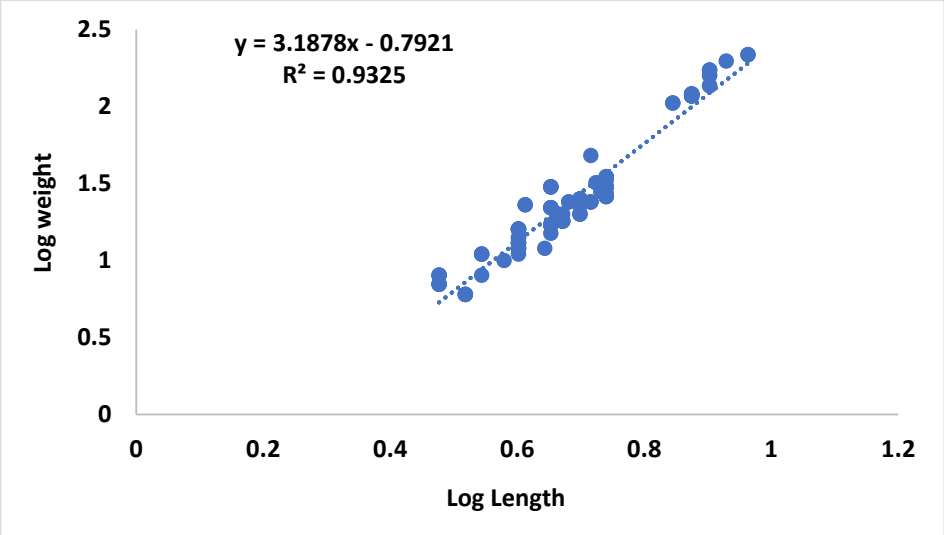

Fig. 2. A graphical representation of log values of length and weight

DISCUSSION

For this study, 125 fish samples of *Catla catla*, with a body weight ranging from 6-217g, total length of fish body ranging from 3- 9.2cm, and a condition factor value of 22-85.1 were employed for the evaluation of the morphometric parameters between the length-weight and condition factor (K) of certain samples. A crucial technique for understanding fish growth, systematics and variations is the morphometric analysis **(Kov & Coppet, 1999)**.

The study displayed a value of 'b' that differs from that of the '**Cube Law**' since the former remains continuous at 3.0 for a fish in a specific ecological situation. The current outcomes showed that the probably correlation of b values must be surrounded by the typical range (2.5 - 3.5) recorded in the studies of **Carlander (1969)** and **Froese (2006)**. When the fish length increases, then comparatively the wet body increases, mirroring an exponent "b" lower than 2.5; on the contrary, an exponent "b" greater than 3.5 shows an increase of the body weight of fish, compared to length **(Froese, 2006)**.

Length and weight correlation showed that the pattern of growth will be negatively allometric if slope value (b) is lower than 3 for males, females and while both genders were collective. On the other hand, in the current research work, when the value of the b was greater than 3, the growth showed a positively allometric development of *Catla catla*; some of the samples were grown more in weight compared to length; indicating that the samples were in great nutritive surroundings during sampling time **(Froese, 2006)**. The outcomes of this study coincides with those of **Singh and Lakhwinder (2015)**, who recorded the slope value with 3.18 for *Catla catla.* Whereas, the study of **Ishtiaq and Naeem (2016)** assessed an isometric growth for *Catla catla.*

The exponential value of the condition factor of fish is good health with superior environment. The value of K ranged from 0.87 to 0.96, with a mean value of 0.915, as recorded in the present investigation. While, **Abowei (2009)** and **Shakir *et al.* (2010)** determined that a value of condition factor equals to 1, displaying an isometric development, and the value of K > 1, indicating positive allometric development and the value of K < 1, showing that the growth is negatively allometric. The condition factor in the present investigation is nearly 1 (0.95). **Naeem *et al.* (2011a)** demonstrated that in *Oreochromis niloticus*, the condition factor had a very important link with body weight but a smallest important relationship was detected with the total distance **(Naeem *et al.*, 2011b)**. Several additional elements, as well as sex or the age growth, nutrition accessibility or the changing development seasons in the summer time and winter can also affect K value.

CONCLUSION

In this study, 125 samples of *Catla catla* were collected and transported to MNS-University of Agriculture Multan, Pakistan. Using a measuring scale, all parameters values were recorded. It was deduced that, when the length of fish body increased, the wet weight of body increased. Length and weight relationship showed different morphometric parameters. Thus, data in the current study is recommended to be used for comparing the morphometric relationships of *Catla catla* in different locations worldwide.

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