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GROWTH COEFFICIENT AND CONDITION FACTOR OF THREE CARP SPECIES REARED UNDER SEMI-INTENSIVE CULTURE

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Abstract: To study length weight and condition factor relationship of *Cirrhinus (C) mrigala, Labeo (L) rohita* and *Catla (C) catla,* nine specimen of each species were collected from Punjab University Fish Research Farm, Lahore, Pakistan. The mean total length was measured 39.92±3.66 cm, 37.49±3.62 cm and 37.01±3.1947 cm for *C. mrigala, L. rohita* and *C. catla*, respectively. While mean total wet body weight was measured 645±194.71 g for C. mrigala, 633±182.01 g for *L. rohita* and 624±167.23 g for *C. catla*. Total length and wet body weight of the species did not differ significantly ($P>0.05$), while condition factor showed highly significant difference ($P<0.001$) among these species. Log transform regression was used to study the growth. Growth coefficients (b) of *C. mrigala* (3.24), *L. rohita* (3.14) and *C. catla* (3.18) indicated positive allometric growth pattern (weight gain more rapidly as compared to the cube of the length) in these carp species.

Key words: *Cirrhinus mrigala, Labeo rohita, Catla catla,* pond culture

INTRODUCTION

Growth of organisms is considered in terms of increase in volume. The volume is represented by weight, which is related to the cube of length. It is therefore, true that a relationship exits between length (linear dimension) and weight in animals. Measurement of growth as length quantifies axial growth, while measurement as weight quantifies growth in bulk. These two categories of growth are highly correlated. The relationship between weight and length for fish in a given population can

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be analyzed by measuring weight and length of the same fish throughout their life or of a sample fish taken at a particular time (Wootton, 1998). Weight-length relationship has been commonly used for two different purposes. Firstly, to describe the mathematical model between weight and length so as to derive one from the other (Wootton, 1998). Since length can be easily and accurately measured even in the field, the data on length are available in various studies. It is highly valuable in cases where weight can be assessed from length having a relationship available for a given species.

Secondly, weight length relationship is used to compute the deviation from the expected weight for length of the individual fish or a group of fishes as indications of fitness or degree of well being of fish. This relationship is called "condition factor". This parameter helps to assess the experimental improvements in an environment for an existing fish and for the purpose of new stocking.

The study of weight-length has its applied value in fish biology. Significance of the study in fishes is to assess the growth of fish in different environments. For instance, while defining a population, fish length is measured and predicted average weight is assigned to all fish in a given length group. This is often faster and more convenient than weighing fish individually, especially when large number of live fish is sampled. Weight-length relationship is used on commercial scales in population assessments (Steeby *et al*., 1991; Ali *et al*., 2000). Several authors described the importance of length weight relationship on various fish species (Willis, 1988, Naeem *et al.;* 1992; Shakir *et al*., 2008; Hussain et al., 2009). The present study deals with the length weight and condition factor relationships of three carp fish species *viz., Cirrhinus mrigala*, *Labeo rohita* and *Catla catla* cultivated in earthen ponds. The information is useful for assessing growth profile of these commonly cultivated fish species in Pakistan in different culture conditions.

MATERIALS AND METHODS

Nine specimens each of *Cirrhinus (C) mrigala* (mori), *Labeo (L) rohita* (rohu) and *Catla (C) catla* (thaila) were collected from Punjab University Fish Research Farm, Lahore, Pakistan. The fishes of comparable size were selected for the present study. The wet body weight of each fish after blot-drying excess water on body and total length *i.e.*, from the tip of

snout to distal end of the caudal fin ray was recorded using electronic digital top-pan balance and measuring tray with millimeter scale, respectively.

According the growth coefficient (b)/relationship between wet body weight and length was determined using log transform regression equation

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

Further, the relationship between wet body weight (W) and total length (L) was established as:

$$W = aL^b$$

Where

a =intercept = regression coefficient; b = slope = growth factor/growth coefficient. Condition factor (K) was calculated by standard relation

$$K = (W \times 100)/ (L)^3$$

Statistical analysis

Data were statistically analyzed using Minitab software. The length, weight and condition factor of the sampled fish specimens were declared highly significant if $P < 0.001$, significant if $P < 0.01$ and less significant if $P < 0.05$. Turkey test was used for detailed comparison ($P > 0.05$).

RESULTS AND DISCUSSION

In the present study, mean total length 39.92±3.66 cm of *C. mrigala*, 37.49±3.62 cm of *L. rohita* and 37.01±3.20 cm of *C. catla* were measured. Had corresponding mean wet body weights of 645±194.71 g, 633±182.01 and 624±167.24 g. Total length and weight did not differ significantly ($P > 0.05$) among the sampled fish species. Mean condition factor (K) in *C. mrigala* was calculated as 0.99±0.10, in *L. rohita* as 1.17±0.07 and in *C. catla* as 1.20± 0.07 g/cm^3. The mean values of 'K' appeared significantly different among the carp species (Table I). Fish with high value of K are heavy, while fish with a low K value are lighter for length (Wootton, 1998). Results of the present study showed 'K' value greater than 1 which indicated that the fish were being feed adequately. In this regards Nikos (2004) reported that fish sufficiently fed would have 'K' equal or greater than 1 while undernourished fish will express a 'K' value of less than 1. In this study, it was observed that conditions factor (K)

appears to increase with increasing length or weight of the fish. K values fluctuated between the fish species as well as within fish species due to feeding differences, climate and environmental conditions, (Lizama *et al.*, 2002). Means of total length and body weight were use to calculate the growth coefficient (b) for the sampled specimens. Had values of 'b' as 3.24, 3.14 and 3.18, the fish species *C. mrigala, L. rohita and C. catla* respectively (Table II).

Table I: Biometric profile of sampled fish species from Punjab University Fish Research Farm.

Sr. No.	Parameter	*Cirrhinus mrigala*	*Labeo rohita*	*Catla catla*	SEM and Significance
1	Weight (g) Range (Mean)	364-898 (645^{a})	332-878 (633^{a})	376-882 (624^{a})	60.555
2	Length (cm) Range (Mean)	32.8-43.7 (39.92^{a})	31.8-41.5 (37.49^{a})	32.9-42.6 (37.01^{a})	1.166
3	Condition factor (K) g/cm^3 Range (Mean)	0.82-1.17 (0.99^{b})	1.03-1.25 (1.17^{a})	1.06-1.28 (1.20^{a})	0.026^{***}

Means sharing a common letter did not differ significantly. *** highly significant ($P<0.001$)

Table II: Growth profile of the sampled fish species.

Sr. No.	Parameter	*Cirrhinus mrigala*	*Labeo rohita*	*Catla catla*
1	Exponential equation	$W_t = 0.00794(TL)^{3.24}$	$W_t = 0.00691(TL)^{3.14}$	$W_t = 0.00617(TL)^{3.18}$
2	Regression equation	Log W = - 2.40 + 3.24Log L	Log W = - 2.16 + 3.14Log L	Log W = - 2.21 + 3.18Log L
3	Regression coefficient (R^2)	0.92	0.96	0.96
4	Regression Probability (P)	$P<0.001$	$P<0.001$	$P<0.001$

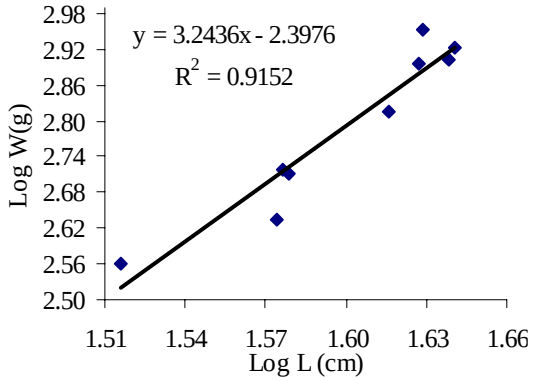

Figure I: Weight and length relationship in *Cirrhinus mrigala* (mori).

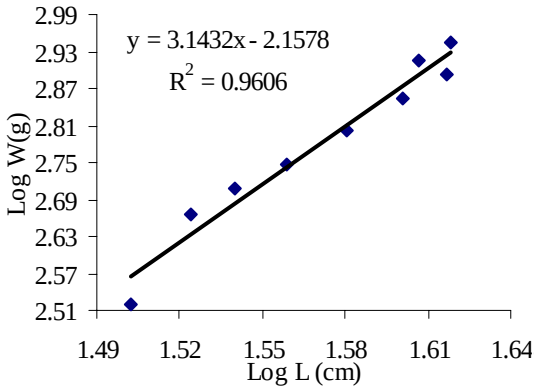

Figure II: Weight and length relationship in *Labeo rohita* (rohu).

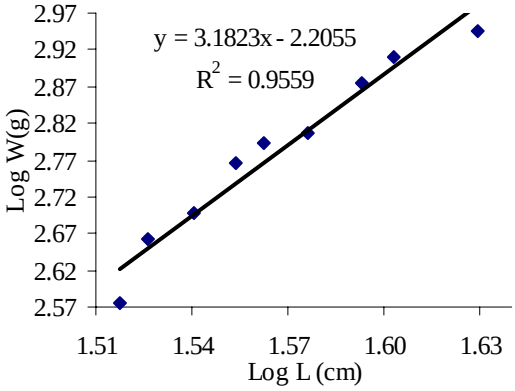

Figure III: Weight and length relationship in *Catla catla* (thaila).

When fish retains the same shape, its specific gravity remains unchanged during lifetime and "b" would be exactly 3.0 indicating isometric growth (Ricker, 1975). A value significantly larger or smaller than 3.0 indicates allometric growth. A value less than 3.0 shows that the fish becomes lighter (negative allometric) while greater than 3.0 indicates that the fish becomes heavier (positive allometric) for a particular length as it increases in size (Wootton, 1998). The value of "b" may vary with feeding (Le Cren, 1951), state of maturity (Frost, 1945), sex (Hile and Jobes, 1940) and for different populations of a species (Jhingran, 1968) indicating taxonomic differences in small populations.

In the present study, all the sampled fish species showed 'b' value greater than 3 showing that weight of the fish increases greater than cube of its length (positive allometric growth). Thus one can consider the aquaculture conditions and feeding regimes being practiced at the research fish farm of university of the Punjab, Pakistan as standard for further efforts directed towards escalating growth of the cultureable fish species in this region. Allometric growth has been described by several workers in different fish species (Chatterji *et al*. 1977; Salam and Janjua, 1991; Shakir *et al.,* 2008).

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