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SOME MORPHOMETRIC STUDIES OF COMMON CARP *CYPRINUS CARPIO* IN RELATION TO BODY SIZE, FROM ISLAMABAD, PAKISTAN

A. Salam and M. Naeem

Institute of Pure and Applied Biology, Zoology Division, Bahaudin Zakariya University, Multan - 60800, Pakistan.

Abstract

Thirty three farmed *Cyprinus carpio*, of different body sizes ranging from 6.1-25.5cm total length and 3.3-330gm body weight were used for the analysis of morphometric variables (head length, head width, dorsal fin length, body girth, body depth, tail length and tail width) in relation to total length and body weight of the fish to investigate allometric growth. It was observed that all these relations showed very high correlation. Slopes of the log transformed data were used to compare with an isometric slope. It was found that all the parameters examined showed isometric growth except head width which showed positive allometry in relation to total length. Head length, head width and tail length showed positive allometry while other parameters showed isometric growth in relation to body weight. Growth in terms of weight was almost proportional to the cube of its length, the values of the slope (b= 3.17) were not consistent with cube law (positive allometry, b<3.0). Regression parameters were found to be highly significant.

Keywords: *Cyprinus carpio,* Length-weight relationship, Condition factor, Morphometry

Introduction

Cyprinus carpio is an exotic species. It was introduced in Pakistan in 1964 from Thailand (Ali, 1999). This species originated from China and has now been introduced in many parts of the word. It is well adapted for pond culture as it tolerates low oxygen and high carbon dioxide concentration. It is an omnivorous species and mostly bottom feeder. Breeds in confined waters during January- April. Temperature tolerance is 20-25^{0}C (Talwar and Jhingran, 1991).

Fish can change its weight without changing the length or vice versa. The relationship between weight and length for fish of a given population can be analyzed either by measuring weight and length of the same fish throughout their life or of a sample of fish taken at a particular time (Wootton, 1990). The relationship between weight (W) and length (L) typically takes the allometric form: $W = aL^b$, or in the linear form Log W= Log a + b Log L, where a and b are constants estimated by regression analysis. If fish retains the same shape it grows isometrically and the length exponent has the value b = 3.0, a value significantly higher or lower than b=3.0 shows allometric growth (Bagenal and Tesch, 1978; Ricker, 1979).

The weight-length relationship provides an opportunity to calculate an index commonly used by fisheries biologists to compare the "condition factor" or well being of a fish (Bagenal and Tesch 1978), this index is condition factor, "K" ($K= 100XW/L^3$). Fish with a high value of "K" are heavy for its length, while fish with a low "K" value are lighter (Weatherley,1972., Bagenal and Tesch 1978., Wooton, 1990, 1998). Several studies on length-weight relationship have been carried out in other parts of the world on various fish species (Le Cren, 1951., Chakrabarty and Sing, 1963., Saigal,1964., Willis,1988).The present topic has received some attention in Pakistan (Javaid and Akram, 1972., Salam and Janjua, 1991.,Naeem, *et al*, 1992, 2000., Salam *et al*, 1993, 1994., Ali *et al*, 2000, 2002).

Present study is the first attempt in assessing length-weight, condition factor and growth allometry of an introduced exotic fish *Cyprinus carpio*, one of the important fish in farming system. Keeping in view the importance of this species, it is urgently needed that the biology of this species be thoroughly studied in local environmental conditions.

Materials and Methods

Thirty three farmed *Cyprinus carpio* of different body size, ranging 6.1-25.5cm total length and 3.3-330gm body weight, were sampled from reservoir of Fish Seed Hatchery, Islamabad. Fish were selected at random and caught using a hand net. They were transported live to the laboratory in plastic containers. Fishes were killed with a blow on the head, blotted dry and weighed to nearest 0.01g on an electronic digital balance. Body length measurements were taken by using measuring tape to nearest 0.1cm. total length was taken as the length from tip of the snout to the tip of the tail. Head length as the distance from the most anterior part of snout to the posterior edge of operculum, head width from broadest part of the head, pectoral fin length from dorsal base of pectoral fin., dorsal fin length between anterior and posterior end along the base of fin, body depth from dorsal and ventral surface at deepest point, body girth at its deepest point, tail length as difference between total length and standard length and tail width as maximum width of caudal fin were measured. Condition factor was calculated using the formula $=100 \times W / L^3$ following the method of Weatherly and Gill (1990,1998).

Statistical analysis, including regression analysis and calculation of correlation was carried out by a computer package Lotus 1-2-3 and Excel.

Results

The relationship between wet body weight (W) and total length (L) is exponential having the general form $Y = aX^b$, (Fig. 1), or $W = aL^b$. When the data is transformed into logarithmic form (Fig. 2) a linear relationship is obtained with a high correlation coefficient ($r=0.997$; $P< 0.001$), having the general form.

The regression coefficient "b" has a value almost equal to b = 3.0. The regression equation of body weight (W) on total length (TL) is presented below.

Log W = 2.006+3.1702 log TL ($r = 0.997$)

($r^2 = 0.995$).

Condition factor "K" when plotted against total length and wet body weight, shows an increasing trend with increasing length or weight. The regression parameters of condition factor (K) on wet body weight (W) and total length (TL) are presented below

K = 1.250 + 0.0199 TL ($r = 0.654$)

($r^2 = 0.428$)

K = 1.418 + 0.0015 W ($r = 0.728$)

($r^2 = 0.530$)

When the data of head length (HL), head width (HW), pectoral fin length (PFL), dorsal fin length (DFL), body depth (BD), body girth (BG), tail length (TI.L) and tail width (TI.W) was plotted against total length and wet body weight, these relationships were found to be highly significant, though in all these cases log transformed data generated high correlation coefficient (Table I – II).

Discussion

A review of literature on different fish species collected from commercial as well as from natural waters shows that there is a tendency for their regression coefficient (b) in the relation $W= aL^b$ to be close to or greater than b =3.0. Thus growth in many cases tends to be isometric (Salam *et al*, 1994., Wootton, 1990) since b = 3.0 for isometric growth. In the present study value of b = 3.17 which is significantly higher than b = 3.0. It shows that in this fish, increase of weight was higher as compared to the cube of its length Regression parameters were found to be highly significant.

Condition factor (K) shows an increasing trend with increasing length and weight in the present study. The condition factor may vary with increasing length when average weight of fish does not increase in direct proportion to the cube of its length (Salam *et.al.*,1994). Therefore when b = 3.0, K remains constant, if however the weight increases more rapidly than cube of length, the K would increase with increase in length. When weight increase is less than the cube of length, K would tend to decrease with the growth of the fish (Naeem, *et.al.*, 2000).

During growth, changes in size bring about changes in shape and body proportions. Allometric exponents on log-log scale relating body weight to the length of body parts is b = 0.33 and body length to length of body parts b =1.0 representing isometric growth relationship (Alexander and Mcneil, 1971). In the present study values of "b" of various relationships given in table-2 show isometric growth except head width which shows positive allometry in relation to total length. Head length, head width and tail length showed positive allometry while other parameters showed isometric growth in relation to body weight. This is due to the fact that his species is growing faster and its organs/parts are also growing faster.

The species under study *Cyprinus carpio* is growing faster with increasing size and violating the cube law, and leads to conclusion that the hatchery conditions are much suitable for its rearing and stocking and achieved allometric growth. This species has been well adapted in aquatic environment of Pakistan after its introduction. On the basis of the conclusion, this species is favorably recommended for culture in fish farms.

Table : 1. The regression parameters of various body parts in relation to total length (TL) and wet body weight (W) of *Cyprinus Carpio*

Regression equation	No of observation N	Correlation Coefficient r	Proportion of variance accounted for by the Regression r^2
HL = 0.342 + 0.217TL	33	0.990***	0.980
HW = 0.323 + 0.125TL	33	0.923***	0.960
PFL =-0.144 +0.190TL	33	0.966***	0.983
DFL =-0.277+0.331TL	33	0.993***	0.987
BD = -0.347+0.357TL	33	0.976***	0.953
BG =- 0.694+0.714TL	33	0.976***	0.953
TIL =0.264 +0.147TL	33	0.975***	0.952
TLW =-0.702+0.451TL	33	0.969***	0.939
HL = 2.422 +0.013W	33	0.917***	0.842
HW = 1.529 +0.007W	33	0.879***	0.774
PFL = 1.670 + 0.012W	33	0.917***	0.842
DFL = 2.839+ 0.021W	33	0.947***	0.897
BD =2.944 + 0.024W	33	0.959***	0.920
BG =5.888 + 0.048W	33	0.959***	0.920
TI.L =1.680 +0.009W	33	0.897***	0.806
TI.W= 3.564 +0.029W	33	0.913***	0.834

Head length (HL). Head width (HW), pectoral fin length (PEL). Dorsal fin length (DFL), body depth (BD), body girth (BG), tail length (Ti. L), tail width (TI.W)

*** **P < 0.001**

Table: 2. Variance parameters of various body parts in relation to total length (TL) and wet body weight (W) of *Cyprinus carpio.*

Regression equation	No of Obser-vation N	Correlation Coefficient	Proportion of variance accounted for by the regression r^2	S.E (b)	t value when compared with b=1.00 or b=0.33
Log HL = 0.525+0.922 Log TL	33	0.992***	0.985	0.0198	-3.393 N.S
Log HW =.0.661+0.856 Log TL	33	0.975***	0.951	0.0346	-4.235***
Log PEL =.0.837+1.078 Log TL	33	0.987***	0.974	0.0311	2.516 N.S
Log DFL =.0563+1.048 Log TL	33	0.999***	0.989	0.0191	2.526 N.S
Log BD =.0.546+1.056 Log TL	33	0.987***	0.975	0.0303	1.866 N.S
Log BG =.0.245+ 1.056 Log TL	33	0.987***	0.975	0.0303	1.866 N.S
Log TI.L =-0.655+0.894 Log TL	33	0.972***	0.945	0.0383	-2.767 N.S
Log TI.W =-0.558+1.132 Log TL	33	0.956***	0.914	0.0622	2.129 N.S
Log HL =0.060+0.289 Log W	33	0.990***	0.981	0.0071	-5.857***
Log HW =.0.118+0.269 Log W	33	0.976***	0.953	0.0106	-6.100***
Log PFL =-0.154+0.339 Log W	33	0.987***	0.974	0.0098	1.000 N.S
Log DFL = 0.101+0.329 Log W	33	0.993***	0.986	0.0069	-0.166 N.S
Log BD =0.119+0.334 Log W	33	0.993***	0.987	0.0067	0.666 N.S
Log BG =0.420+0.334 Log W	33	0.933***	0.987	0.0067	0.666 N.S
Log TI.L =-0.086+0.280 Log W	33	0.968***	0.938	0.0128	-4.166***
Log TI.W =.0156+0.358 Log W	33	0.961***	0.924	0.0183	1.555 N.S

Head length (HL).head width (HW), pectoral fin length (PFL). Dorsal fin length (DFL), body depth (BD), body girth (BG), tail length (Ti. L), tail width (TI.W)

***P < 0.001, N.S P> 0.05**

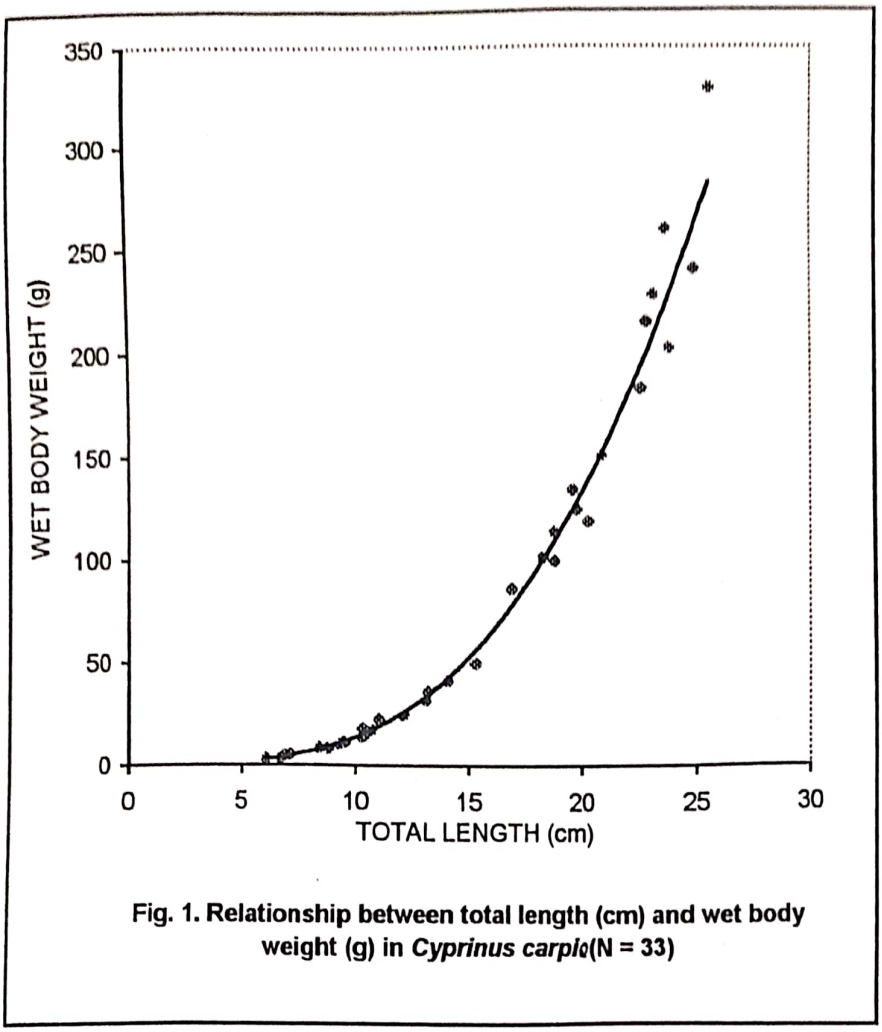


Fig. 1. Relationship between total length (cm) and wet body weight (g) in *Cyprinus carpio*(N = 33)

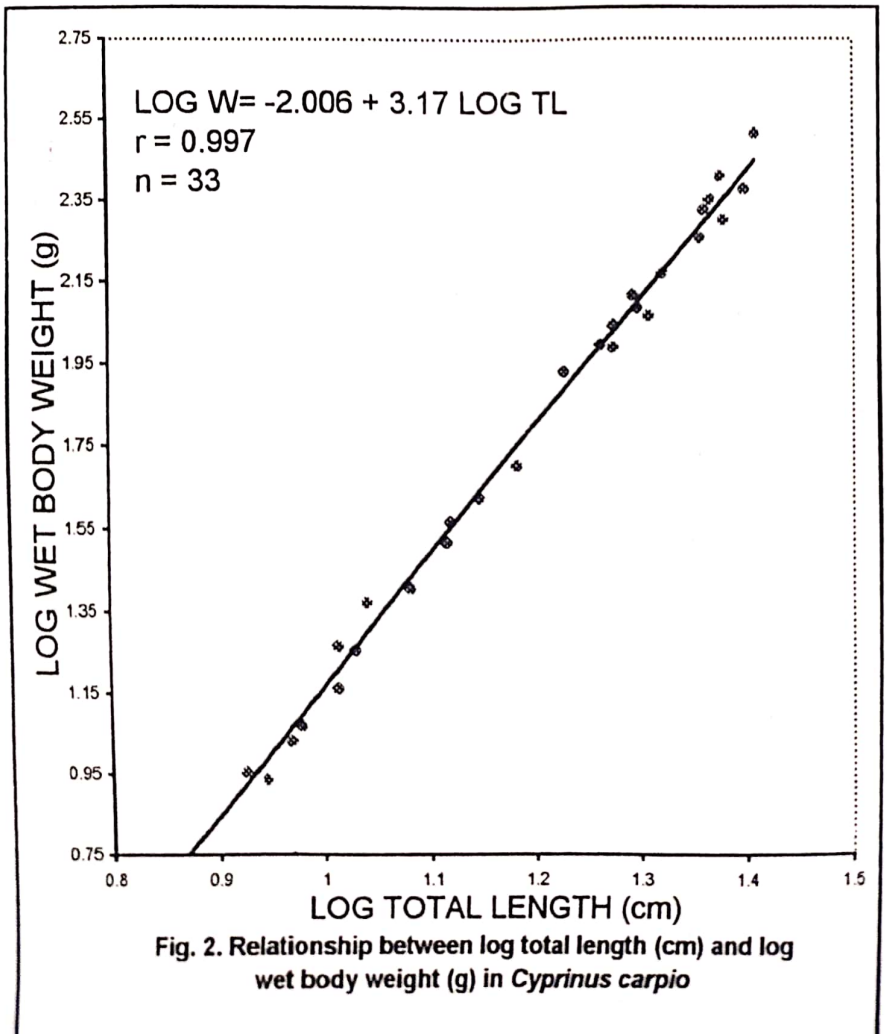


Fig. 2. Relationship between log total length (cm) and log wet body weight (g) in *Cyprinus carpio*

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