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MORPHOMETRIC STUDIES ON *OREOCHROMIS NILOTICA* (MALE) IN RELATION TO BODY SIZE FROM ISLAMABAD, PAKISTAN

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Abstract: Twenty nine *Oreochromis nilotica* (♂) of different body sizes ranging from 7.0-25.5 cm total length and 6.1 - 328.8gm body weight were used for the analysis of morphometric variable of head length, head width, pectoral fin length, dorsal fin length, body girth, body depth, tail length and 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 correlations. Slopes of the log transformed data were used to compare with an isometric slope (b = 1 or b = 0.33 or b = 3). It was found that all the parameters examined showed isometric growth except head length, dorsal fin length and tail length, which showed positive allometry in relation to total length and body weight. Growth in weight is almost proportional to the cube of its length, the values of the slope (b = 3.1) coincide with the slope of an ideal fish. Regression parameters were found to be highly significant.

Key words: *Oreochromis nilotica*, Length-Weight relationship, Condition factor; Predictive equations.

INTRODUCTION

Oreochromis nilotica is an exotic species. It was introduced in Pakistan in 1984 from Thailand. This species originated from upper Nile in Uganda. It also colonized Central and West Africa. It feeds on blue green algae and can assimilate 70-80 % of the carbon ingested. In environments having suitable temperature conditions, they are able to establish and stable populations contributing to the local fishery resources (Salam *et al.*, 1996). Keeping in view the importance of this species, it is urgently needed that the biology of this species be thoroughly studied.

A fish can change its weight without changing in 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, 1998).

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)

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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; Weatherley and Gill, 1987; Wooton, 1990, 1998).

Several studies on length-weight relationship have been reviewed by LeCren, 1951; Sarkar, 1957; Chakrabarty and Singh, 1963; Saigal, 1964; Willis, 1988; Wootton, 1990, 1998). The present topic has received attention in Pakistan (Salam and Janjua, 1991; Naeem, *et. al.*, 1992, 2000; Salam *et. al.*, 1993, 1994; Ali *et. al.*, 2000, 2002). The present study is the first attempt in assessing length-weight, condition factor and growth allometry of an introduced exotic fish *Oreochromis nilotica* (a), is becoming important as food fish and monosex culture in farming system of Pakistan.

MATERIAL AND METHODS

Twenty-nine farmed *Oreochromis nilotica* (♂) of different body size ranging from 7.0-25.5 cm total length and 6.1-328.8 gm 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, blotted dry and weighed to nearest 0.01 g on an electronic digital balance. Body length measurements were taken to nearest 0.1 cm by using Perspex measuring tray having a millimeter scale. Total length was taken as the length from tip of the snout to the tip of the caudal fin. Head length as the distance from the most anterior point on snout to the posterior edge of opercula bones, 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 fine, body depth from dorsal and ventral surface at deepest point, body girth circumference of body 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 a formula $K = 100 \times W/L^3$ following the method of Weatherley and Gill (1987) and Wootton (1990, 1998).

Statistical analysis, including regression analysis and calculation of correlation was carried out by using 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 in logarithmic form (Fig.2) a linear relationship is obtained with a high correlation coefficient ($r = 0.998$; $P<0.001$), having the general form:

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

The values of these constants and other regression parameters are given in (Table- I) .The regression coefficient "b" has a value almost equal to $b = 3.0$.

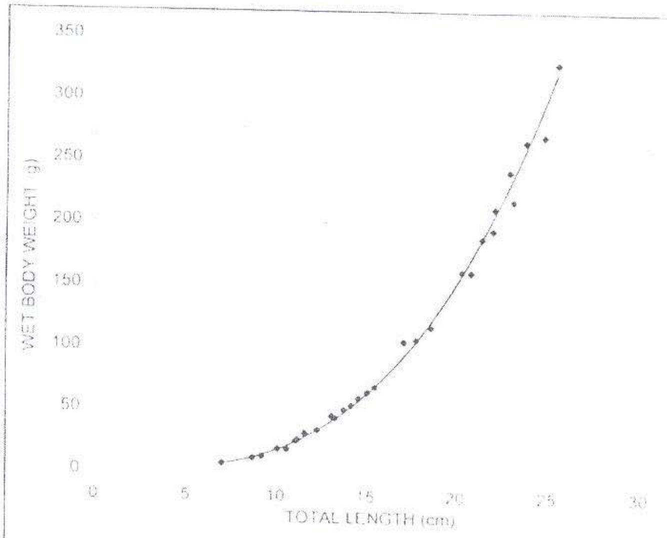

Fig. 1. Relationship between total length (cm) and wet body weight (g) in *Oreochromis nilotica* (*male*).

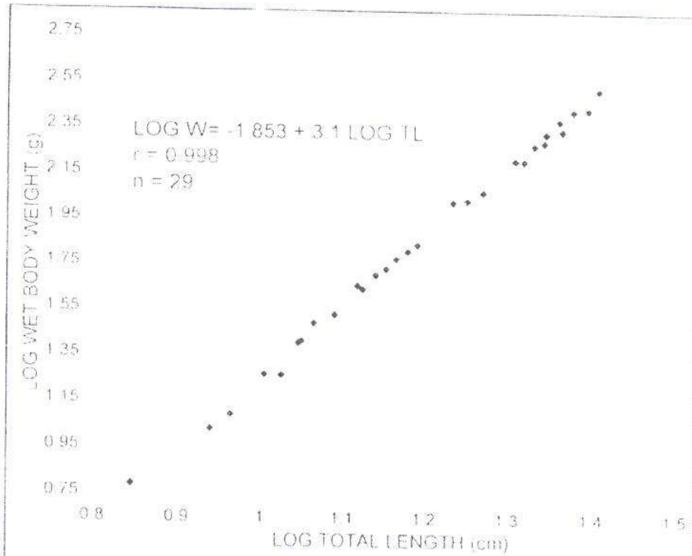

Fig. 2. Relationship between log total length (cm) and log wet body weight (g) in *Oreochromis nilotica* (*male*).

Table I: The regression parameters of body weight (W) on total length (TL) for *Oreochromis nilotica* (♂)

Regression equation	No. of observation (N)	Correlation coefficient (r)	Proportion of variance accounted for by the regression (r^2)	S.E. (b)	t-value when compared with b=3
Log W = -1.853 + 3.1 log TL	29	0.998***	0.996	0.0337	0.296$^{N.S}$

*** P<0.001

Table II: The regression parameters of condition factor (K) on wet body weight (W) and total length (TL) for *Oreochromis nilotica* (♂)

Regression equation	No. of observation (N)	Correlation coefficient (r)	Proportion of variance accounted for by the regression (r^2)	S.E. (b)	t-value when compared with b=3
K = 1.818 – 0.0171 TL	29	0.506**	0.257	0.0056	3.053**
K = 1.625 + 0.0007 W	29	0.408**	0.167	0.0003	2.333*

** P<0.01; * P<0.05.

Condition factor "k" when plotted against total length and wet body weight, shows an decreasing trend with increasing length and increasing trend with increasing weight (Table-II). 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 (TLL) and tail width (TLW) 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 III-IV).

Table III: The regression parameters of head length (HL), head width (HW), pectoral fin length (PFL), dorsal fin length (DFL), body depth (BD), body girth (BG), tail length (TLL), tail width (TL.W) on total length (TL) and wet body weight (W) for *Oreochromis nilotica* (♂)

Regression equation	No. of observation (N)	Correlation coefficient (r)	Proportion of variance accounted for by the regression (r^2)
HL = 0.224 + 0.239 TL	29	0.994***	0.988
HW = -0.086 + 0.166 TL	29	0.965***	0.932
PFL = -0.255 + 0.307 TL	29	0.962***	0.925
DFL = -0.724 + 0.511 TL	29	0.998***	0.996
BD = 0.022 + 0.375 TL	29	0.987***	0.974
BG = 0.044 + 0.750 TL	29	0.987***	0.974
TLL = 0.236 + 0.162 TL	29	0.975***	0.952
TLW = -0.086 + 0.1662 TL	29	0.965***	0.932
HL = 2.676 + 0.013 W	29	0.962***	0.926
HW = 1.598 + 0.009 W	29	0.950***	0.904
PFL = 2.836 + 0.017 W	29	0.962***	0.926
DFL = 4.511 + 0.028 W	29	0.965***	0.932
BD = 3.868 + 0.020 W	29	0.955***	0.912
BG = 7.737 + 0.041 W	29	0.955***	0.912
TLL = 1.875 + 0.009 W	29	0.971***	0.943
TL.W = 3.639 + 0.018 W	29	0.956***	0.915

*** $P<0.001$.

Table IV: The regression parameters of head length (HL), head width (HW), pectoral fin length (PFL), dorsal fin length (DFL), body depth (BD), body girth (BG), tail length (TLL), tail wirth (TLW) on total length (TL) and wet body weight (W) for *Oreochromis nilotica* (♂)

Regression equation	No. of observation (N)	Correlation coefficient (r)	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 = -0.506 + 0.926 Log TL	29	0.994***	0.988	0.0191	3.874***
Log HW = -0.796 + 1.000 Log TL	29	0.963***	0.928	0.0535	$0.000^{N.S}$
Log PFL = -0.538 + 1.001 Log TL	29	0.963***	0.928	0.0575	$0.017^{N.S}$
Log DFL = -0.456 + 1.101 Log TL	29	0.998***	0.997	0.0097	10.412***
Log BD = -0.439 + 1.012 Log TL	29	0.988***	0.977	0.0292	$0.410^{N.S}$
Log BG = -0.138 + 1.012 Log TL	29	0.988***	0.977	0.0292	$0.410^{N.S}$
Log TLL = -0.591 + 0.869 Log TL	29	0.976***	0.953	0.0370	-3.600***
Log TLW = -0.359 + 0.918 Log TL	29	0.967***	0.936	0.0459	$-1.822^{N.S}$
Log HL = 0.050 + 0.297 Log W	29	0.991***	0.982	0.0077	-4.285***
Log HW = -0.194 + 0.320 Log W	29	0.958***	0.918	0.0183	$-0.552^{N.S}$
Log PFL = 0.063 + 0.321 Log W	29	0.959***	0.920	0.0181	$-0.497^{N.S}$
Log DFL = 0.204 + 0.353 Log W	29	0.996***	0.993	0.0055	4.181***
Log BD = 0.165 + 0.326 Log W	29	0.990***	0.981	0.0085	$-0.470^{N.S}$
Log BD = 0.466 + 0.326 Log W	29	0.990***	0.981	0.0085	$-0.470^{N.S}$
Log TLL = -0.068 + 0.278 Log W	29	0.971***	0.943	0.0130	-4.000***
Log TLW = 0.191 + 0.295 Log W	29	0.965***	0.933	0.0151	$-2.317^{N.S}$

*** P<0.001; N.S P<0.05

Table V: Length-weight relationship for different fish species from different localities

Fish species	Slope (b)	Reference
Labeo rohita Immature	3.01	Jhingran, 1952
Labeo rohita Ripe females	3.38	Khan, 1972
Labeo rohita Immature	3.06	Salam and Janjua, 1991
Cirrhinus mrigala	3.02	Salam and Khaliq, 1992
Labeo bata	3.17	Chatterji *et al.*, 1977
Gadusia chapra	3.06	Venkateswarlu & Banerjee, 1971
Clarias batrachus	3.33	Sinha, 1975
Oncorhynchus mykiss	2.98	Salam *et al.*, 1994
Oncorhynchus mykiss	3.12	Naeem *et al.*, 2000
Aristichthys nobilis	2.80	Salam *et al.*, 1993
Oreochromis nilotica Males & Females	2.99	Naeem *et al.*, 1992
Oreochromis nilotica Males	3.10	Present study

DISCUSSION

A review of the 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 = 3.1 which is not significantly different from b = 3.0 (the slope for an ideal symmetrical fish). Regression parameters were found to be highly significant (Table I).

Condition factor (K) shows decreasing trend with increasing length and increasing trend with increasing 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 increase more rapidly than cube of length, the K would increase with increase in length. When weight increases less than the cube of length, K would tend to decrease with the growth of the fish (Naeem *et. al.*, 2000).

The species under study *Oreochromis nilotica* (♂) is the ideal fish because value of slope "b" of length-weight relationship is not significantly different from b = 3.0 (the slope for an ideal symmetrical fish). This species has been well adapted in aquatic environment of Pakistan after its introduction.

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, 1971). In this study values of "b" of various relationships as given in table-IV showed isometric growth except head length, dorsal fin length and tail length which showed positive allometry in relation to total length and body weight. The reason for isometric growth is due to the proportionate growth of weight and length parameters, while head length, dorsal fin length and tail length which showed positive allometry in relation to total length and body weight. This is due to the fact that this species is also showing trend of faster growth and its organs/parts are also growing faster.

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