Length-weight Relationship & Condition Factor

LENGTH-WEIGHT AND CONDITION FACTOR

Introduction

Measurement of length and weight of the fishes has different biological use, to calculate the relationship between length of fish (Distance from the tip of snout to the tip of longest ray of caudal fin) and its body weight is considered to be very important in the study of fishery biology. To length of a fish is closely related with some factors such as age, weight and maturity etc. So the length data and concerned factors are helpful to determine the state of maturity. For the establishment of length weight relationship for all species, recording of the length of fishes is essential. The study of length-weight relationship is not only useful in the relationship of different size group but also helpful in setting up yield equation for estimating the number of landed fish population at a time and space (Pandey *et al.* 1974). The calculated length and derived weight at a fish can help in the preparation of corresponding size of fish for better catch per unit. The result of length-weight relationship has practical value to make possible to convert length into weight and vice versa. Another approach has been made to determine the coefficient of condition with expressing the condition of fish in numerical term.

The notable biologists who gave their contribution on the length weight relationship of freshwater fishes are Khan and Hussain (1941), Jhingran (1952), Majumdar (1971), Sinha (1972), Rangrajan (1973), Bhatt (1970), Bhatt (1971 a), Chatterji *et al.* (1977 b), Mustafa (1978), Malhotra (1982), Roy (1987), Khan (1988), Zofair and Mustafa (1991).

Considerable amount of published work is not available on the length-weight relationship of freshwater catfish *Mystus seenghala*. The present study is an attempt to fill the paucity of length-weight relationship of *Mystus seenghala*.

Materials and Methods

The length-weight relationship is expressed by the equation given by LeCren (1951):

$$W = aL^b$$

Where W= Body weight of fish in gm.

L=Body length of fish in cm.

a=Constant

b=exponent value of 'a'

LeCren indicate the length weight relationship would first be calculated as the logarithmic formula-

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

Where log a and log b are constant.

For the study of length-weight relationship 481 live specimens were collected from Gomti River by using cast and drag net. Out of 481 fishes, the number of males, females and Juveniles fish were 180, 210 and 91 respectivly and their size ranged between 31 cm. to 48 cm. Total length of each fish from snout to end of caudal fin was measured up to nearest 1 mm. and body weight of each fish was taken by using pan balance sensitive up to 0.01 gm. For the identification of male and female, gonads are examined. Correlation coefficient was obtained by using the formula given by Michael (1984), while the method of least-square were applied for calculation of regression of log-weight on log-length. The observed average weight was plotted and again observed average length for the examination of nature of parabola.

Results

The regression equation of Juveniles, males and females and combined data of males and females in logarithm are obtained which are mentioned below-

Juveniles : $\text{Log } w = -7.2416 \pm 4.3458 \log L$

Males : $\text{Log } W = -6.9732 \pm 4.1215 \log L$

Females : Log W = - 8.2153 + 4.5395 log L

Combined : Log W = -7.4942 + 4.3305 log L

(Males and Females)

The parabolic equation of juveniles, males, females and combined are given below :

$W = 8.305 \times 10^{-08} L_{4.6519}$

$W = 2.316 \times 10^{-07} L_{4.3215}$

$W = 8.561 \times 10^{-09} L_{4.0326}$

$W = 5.434 \times 10^{-08} L_{4.1519}$

The correlation coefficient for above relationship is 1.0914, 1.0912, 1.0918, for Juveniles, males and females respectively. The value of correlation coefficient were highly significant at $p<0.001$ (Table 1, Fig 1). The exponent value of Juveniles males and females were found to be more than the cube of standard length. Rate of increase of weight in relation to length was higher in juveniles (4.3958) than combined (males *and* females) 4.3305, but among the males and females, it was observed higher in females (4.5395) than males (4.1215). The high value of 'b' in juveniles and females show the high growth rate than the males. The comparatively high value of 'b' for juveniles are due to high feeding intensity and in females due to their enormous growth of ovary. The significance of variation estimated from cube law was tested by 't'

test and obtained value were 33.1053, 42,5412, 35.4992 for juveniles, males and females respectively, which are highly significant at 5% level. Covariance analysis of length-weight relationship of males and females show the significant difference between their slopes (6.13, d.f., 1419) which indicate the separate equations for both males and females. The rate of increase of weight compare to length were obtained up to 43 cm., after that, no increase in weight with increase in length were noted in *Mystus seenghala*. Males were heavier than females in between the length of 19-31 cm, therefore first maturity stage in females occur in this size range (19-31 cm.) .

The comparative study of observed and calculated weight (Table-3) of *Mystus seenghala* indicates close relationship. The observed weight of small fishes was less than their calculated weight while observed weight of large individuals was more than the calculated weight.

Discussion

The hypothesis of cube law suggests that the 'b' value is 3.0 for an ideal fish. If 'b' value is more than '3' then it shows the good physical condition of a fish and if the 'b' value is less than '3' it indicates poor physical conditions of the fish. The value of 'b' shows the variation in interspecific as well as intraspecific within the species. The interspecific and intraspecific variations

within the species show the environmental condition of water body from where individuals have been taken (LeCren's 1951).

However, (Hile, 1936, Martin, 1949) reported that 'b' value can deviate significantly from 3.0, so that it may vary between 2.5-4.0. Antony Raja (1967) found the range of 'b' value from 2.0-5.4 in marine teleost. The ecological factors such as availability of forage organism to the fish can deviate from the principle of cube law. Moreover, morphological change of fish of advance age may also deviates the 'b' value from the value of 3.0. Mustafa (1978) find variation in length-weigh relationship of *E. danricus* with habitat difference; and stated that the small growth of fish living in stagnant water as compared to fish living in running water. In the present study fishes were caught form the river, which gives action of different factors such as temperature, nutrients, high concentration of dissolved oxygen and circulation of water etc. are the causes of high value (<3) of 'b' for juveniles, males and females of *M. seenghala*. But, the value of 'b' were different in males, females and juveniles (Table 2), marked the maturity stage linked with value of 'b' failed to occur the maturity stage of male and female. The males of the size ranged between 13-31 cm. where found heavier than the females of same size group in adult specimen. In addition, the development of ovary in females is reason for their high weight than the males. Moreover, females

being in better condition than the males. The present finding of 'b' value of males and females are also supported by the finding of Sarojini (1958); Chakarborty and Singh (1963) and Gowda *et al.* (1987) in case of *M.parsia, C.mrigala, V.seneli* respectivly. But Pillay (1957) did not find the variations in the value of 'b' between male and female in *Mugil tade.* However, Pathak (1975), Chatteraj *et al.* (1976) and Hoda (1987) in *L. calbasu, L. bata,* and *N. Japonicus* respectively find that the weight of females increase slowly than the males.

The plotted curve of length-weight for females lies below the curve of length-weight for males up to the length of 33 cm. The same finding was also reported by Chakarborty and Singh (1963) in *C. mrigala,* Kumar and Siddiqui (1991) in *P. sarana.* The intersection point of curve for both sexes in present study represents the size at its first maturity stage (Natrajan and Jhingran (1963) in *Cirrinus mrigala*). They have also found the difference at the point of intersection of curves of males and females which attribute the difference in growth of both sexes.

In the present study, it was observed that the calculated weight of Juveniles and adult individuals was higher than the observed weight of juveniles and adult individuals, but calculated weight in large individuals was

less than the observed weight. So, the growth in length of large sized fish was less than the growth in the weight.

The similar results have also been given by Chatterji *et al.* (1977 b) in *Labeo bata*, but Ansari (1988) in *Gadusia chapra* reports the close agreement between observed and calculated weight.

Table-1

Source	Regression equation	Parabolic equation	Correlation coefficient
Juveniles	Log w=-7.2416 ± 4.3958 log L	$8.305 \times 10^{-08} L^{4.6519}$	0.99138
Males	Log W= - 6.9732 ± 4.1215 log L	$2.316 \times 10^{-07} L^{1.3215}$	0.99013
Females	Log W = - 8.2153 + 4.5395 log L	$8.561 \times 10^{-09} L^{4.0326}$	0.99805
Combined	Log W =-7.4942 + 4.3305 log L	$5.434 \times 10^{-08} L^{4.1519}$	0.99805

Table-2

Source	Intercept (a)	Regression Coefficient (b)	S.S. due to regression	Residual SS	Degree of freedom D.F.	Variance (F)	Correlation Coefficient	Significance
Juveniles	-7.216	4.3958	45.18	6.95	109	1015.36	0.99138	S
Males	-6.9732	4.1215	23.35	19.13	236	317.92	0.99013	NS
Females	-8.2153	4.5395	12.96	11.16	117	149.42	0.99147	NS
Combined	-7.4942	4.3305	36.31	30.29	353	457.34	0.99805	NS
Difference between slopes			00.131	0.1.12	001			

Comparison of slopes 6.13, d.t. 1419

Table-3

Calculated and observed weight of *M. Seenghala* at different length group

Length Group (cm)	Mean Value	Observed Weight (gm.)	Calculated Weight (gm.)
13-23	17.61	63.25	69.92
24-33	27.49	170.50	182.63
34-43	39.52	296.11	302.82

Fig. 1
Relationship between length and weight in *M. seenghala*

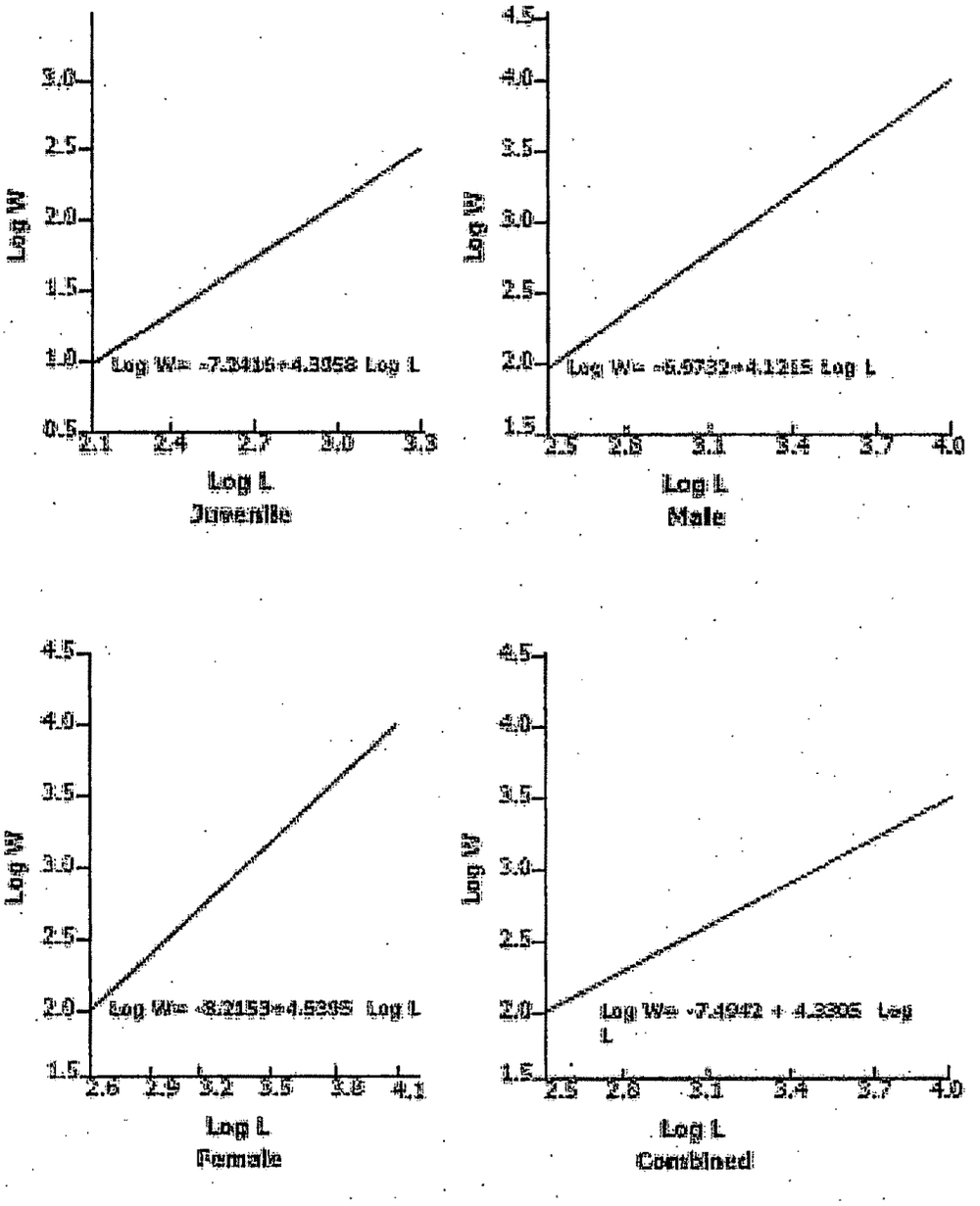

Fig.-2

Calculated and observed weight in various length group of *Mystus seenghala*