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LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF *CATLA CATLA, LABEO ROHITA* AND *CIRRHINA MRIGALA* REARED UNDER POLYCULTURE CONDITION OF POND FERTILIZATION AND FEED SUPPLEMENTATION

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Length-weight relationships of three major carps viz. *Catla catla, Labeo rohita* and *Cirrhina mrigala,* in ponds treated differently with inorganic, organic fertilizers and artificial feed, followed the cube law, indicating an isometric pattern of growth during the year-round study period. The condition factor varied with size and season. The effect of treatment on the coefficient of condition was non-significant. However, the weight of all the three fish species increased slightly more than the cube of the length except for *Cirrhina mrigala* under cow-dung and artificial feed treatments. The condition factor of fish in relation to size appeared to be influenced by feeding rhythm of the fish with age.

INTRODUCTION

Length-weight relationship is of great importance in fisheries investigations. Length is considered as an independent variable, while weight as dependent one. The main aspect of length-weight relationship is to determine the variation from the expected weight of fish or a group of fish as an indication of fatness or degree of well-being. This relationship is called condition factor or coefficient of condition.

In the present study the major interest revolves round the observations on the degree of well-being of fish within a year as affected by different treatments. LeCren (1951) used the coefficient of condition to compare the relative heaviness and suitability of an environment. Factors like environment, food and parasitization can affect condition factor directly and also indirectly through changes in average size and growth rate. The length-weight relationships have been worked out by curvilinear regression (Snedecor, 1955 and Kartha and Rao, 1990) and linear regression methods (Snedecor, 1955 and Dasgupta, 1991).

Keeping in view the great importance of major carps viz. *Catla catla, Labeo rohita* and *Cirrhina mrigala* as food fish and having fast growth, an attempt has been made to study the length-weight relationships of these food fish for deriving the growth pattern and to know their weight composition under different fertilizing and feeding regimes.

MATERIALS AND METHODS

Six earthen ponds, with surface area of 720 m^3 per pond, available at Fisheries Research Farms, University of Agriculture, Faisalabad were used for the study of length-weight relationships and condition factor of three major carps viz. *Catla catla, Labeo rohita* and *Cirrhina mrigala* under the influence of following treatments:

	T1	T2	T3	T4	T5
Nutrient	Inorganic fertilizer	Broiler manure	Layer manure	Cow manure	Artificial feed
Nitrogen (%)	20.00 ± 0.03	4.60 ± 0.09	3.84 ± 0.10	1.48 ± 0.04	4.80 ± 0.02
Phosphorus (%)	20.00 ± 0.14	1.62 ± 0.12	1.84 ± 0.08	1.08 ± 0.03	2.25 ± 0.05
Potassium (%)	3.00 ± 0.04	1.32 ± 0.04	1.20 ± 0.02	1.27 ± 0.05	0.98 ± 0.07

Five months and four days old fingerlings, *Catla catla, Labeo rohita* and *Cirrhina mrigala* (induced bred) were stocked, randomly, to each of the ponds with the following stocking density at 2.87 m^3 per fish:

Fish species	Number of individuals	Average weight (g)	Average fork length (mm)
Catla catla	63	2.68 ± 0.06	55.30 ± 0.07
Labeo rohita	150	2.46 ± 0.03	55.00 ± 0.05
Cirrhina mrigala	38	2.25 ± 0.04	59.03 ± 0.07
Species ratio:	*Catla catla*	*Labeo rohita*	*Cirrhina mrigala*
	25 :	60 :	15

Fertilization of T_1, T_2, T_3 and T_4 and supplementation with artificial feed of T_5 was done at the rate of 0.10 g of nitrogen per 100 g of wet fish weight daily for one year. However, control pond received no additives. The cultured fish stock was sampled every 15th day (fortnightly) by using nylon drag net from each of the ponds under study. The morphometric characteristics of fish viz. wet weight and fork length were recorded under different treatment regimes. The sample size for each fish species, from each of the ponds, remained eleven (with three repeated samplings, total fish samples = 33) as determined by the formula:

$$n = \frac{t^2 s^2}{d^2}$$

where

t = the value from the normal probability table against $\alpha = 0.05$,

s^2 = the variance among units in the population from previous experiment (Javed, 1984), and d = desired margin of error in the estimates.

The length-weight relationships were fitted to the mean values obtained from the weights (g) and fork lengths (mm) of each fish species at each fortnight. The length-weight relationships were calculated, based on average measurements expressed logarithmically. Since the sex of the fish could not be considered separately, the relationships of combined sex were determined using the formula:

$$\log W = \log c + n \log L \text{ (LeCren, 1951).}$$

The values of "c" and "n" were obtained through computer. From these values calculated weights were determined for known fork-lengths for which the mean observed weights were also known. The relative condition factor "Kn" (LeCren, 1951) was calculated from the formula:

$$Kn = \frac{W}{W_1}$$

where

W = observed average weight and
W_1 = calculated weight for the observed fork length. Fluctuation in "Kn" values were examined for 24 fortnights of the year.

RESULTS AND DISCUSSION

Entire length-weight data, for each fish species under different treatments, were pooled into a single equation form as presented in Table 1. A high degree of positive correlation between fork length and weight of all the three fish species was indicated by high values of correlation coefficients (r). These high values of "r" (nearly one) for each equation indicated high precision of the regression model. Shrivastava *et al.* (1981) also observed highly significant correlation between body weight and total length of *Labeo rohita*.

The exponential values of the fork length-weight relationship (b) for all the three fish species under different treatments varied between 2.958 (for *Catla catla* under T6) and 3.306 (for *Cirrhina mrigala* under T3). These values of "b" followed the cube law (LeCren, 1951), indicating thereby an isometric growth in the fish. Nautiyal (1985) observed the "b" value as 2.944 for the *Tor putitora* from Garhwal Himalayas. According to Martin (1949) the value of "b" usually ranged between 2.50 and 4.00. Allen (1938) suggested that the value of "b" remained constant at 3.00 for an ideal fish. However, Beverton and Holt (1957) suggested that the departure of "b" value from 3.00 is rare. Kartha and Rao (1990) also observed isometric growth pattern in *Catla catla* with "b" value of 2.8347 which was non-significantly different from the cubic value of three.

Table 2 shows non-significant differences for the condition factor of the three fish species for the fork length-weight data under all the six treatments, showing no difference among the fish species for their length-weight relationships. However, the differences were significant ($P<0.05$) at fortnightly levels as the first fortnight differed from the remaining except the last one. During the year "K" values fluctuated in five phases among which the differences were statistically significant. The data indicated that in early life, the increase in overall fish weight, under the influence of six treatments, was slow in relation to length but after attaining a length of 141.20 mm, the weight gains were rapid. Growth beyond 197.20 mm of fish, the increase in weight was more as compared to fork length between 13th and 14th fortnights for which the values of "K" remained 1.02 and 1.04, respectively. The cubic law of isometric growth was observed to be followed as the values of slope "n" were computed to be around 3.00 for each fish species under all the six treatments. However, the weights of the three fish species increased slightly more than the cube of the length except for *Cirrhina mrigala* under T_4 and T_5.

Table 1. Length-weight relationships of fish

Treatment	Regression equation	r
Catla catla		
T1	log W = -10.73 +3.015 log Fork length (0.064)	0.995
T2	log W = -10.78 +3.023 log Fork length (0.054)	0.996
T3	log W = -10.69 +3.009 log Fork length (0.060)	0.995
T4	log W = -10.62 +3.003 log Fork length (0.065)	0.995
T5	log W = -10.92 +3.052 log Fork length (0.062)	0.995
T6	log W = -10.48 +2.958 log Fork length (0.089)	0.990
Labeo rohita		
T1	log W = -12.31 +3.303 log Fork length (0.075)	0.994
T2	log W = -11.91 +3.203 log Fork length (0.057)	0.996
T3	log W = -12.01 +3.227 log Fork length (0.059)	0.996
T4	log W = -11.29 +3.116 log Fork length (0.045)	0.998
T5	log W = -11.44 +3.139 log Fork length (0.056)	0.996
T6	log W = -11.27 +3.115 log Fork length (0.077)	0.993
Cirrhina mrigala		
T1	log W = -11.39 +3.078 log Fork length (0.052)	0.997
T2	log W = -12.09 +3.239 log Fork length (0.049)	0.997
T3	log W = -12.49 +3.306 log Fork length (0.036)	0.999
T4	log W = -10.94 +2.996 log Fork length (0.064)	0.995
T5	log W = -10.78 +2.985 log Fork length (0.066)	0.994
T6	log W = -11.33 +3.076 log Fork length (0.098)	0.989

Values within brackets are the standard errors.
W = Fish weight (g); Fork length (mm).

Table 2. Analysis of variance on condition factor of fish

S.O.V.	D.F.	Mean squares
Treatment	5	0.0001^{NS}
Fortnight	23	$0.1340^{<0.01}$
Species	2	0.0010^{NS}
Treatment x species	10	0.0001^{NS}
Error	391	0.0180

Comparison of means

Fortnight	Mean	Fortnight	Mean	Fortnight	Mean
1	0.84 h	9	1.05 bcdef	17	0.99 cdefg
2	0.95 fg	10	1.10 ab	18	1.01 bcdefg
3	1.05 bcdef	11	1.09 abcd	19	0.99 cdefg
4	1.10 abc	12	1.01 bcdefg	20	0.99 defg
5	1.17 a	13	1.02 bcdefg	21	0.98 efg
6	1.09 abcd	14	1.04 bcdef	22	0.95 fg
7	1.07 abcde	15	1.05 bcdef	23	0.93 g
8	1.07 abcde	16	1.01 bcdefg	24	0.92 gh

Fortnightly means with the same letters in a column are statistically similar at $P<0.05$.

The above findings show that the fluctuations in the condition factors of all the three fish species in relation to size appeared to be influenced by feeding rhythm of the fish with age.The environment under all the six treatments tended to be conducive for fish rearing. Some evidence from different studies is also available showing seasonal fluctuations in condition factor brought about by feeding rhythm of the fish (Qayyum and Qasim, 1964). The results of the present study substantiated the findings of Javed (1984) and Kartha and Rao (1990), they reported isometric growth pattern of major carps under different rearing methods.

REFERENCES

Allen, K.R. 1938. Some observations on the biology of trout *(Salmo trutta)* in Windermere. J. Anim. Ecol. 7: 333-349.

Beverton, M.A. and S.J. Holt. 1957. On the Dynamics of Exploited Fish Populations. U.K. Ministry of Agri. and Fisheries; Fisheries Investigation Series. 2 (19): 1-583.

Dasgupta, M. 1991. Length-weight relationship and condition factor (K-value) of *Tor putitora* (Ham.) from Garo Hills, Meghalaya. Indian J. Fisheries, 38 (1): 35-38.

Javed, M. 1984. Effect of artificial feed on the growth of *Labeo rohita*. M.Sc. Thesis, Univ. Agri., Faisalabad.

Kartha, K.N. and K.S. Rao. 1990. Length-weight and length-maximum girth relationship of *Catla catla* (Ham.) in commercial landings of Gandhi Sagar Reservoir. Fishery Technol. 27 (2): 155-156.

LeCren, E.D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch *(Perca flufiatilis)*. J. Anim. Ecol. 20: 201-219.

Martin, W.R. 1949. The mechanics of environmental control of body form in fishes. Univ. of Toronto Studies, Biological Series 58 (Publication of the Ontario Fisheries Research Laboratory 70).

Nautiyal, P. 1985. Length-weight relationship and relative condition factor of the Garhwal Himalayan Mahseer with reference to its fishery. Indian J. Anim. Sci. 55: 65-70.

Qayyum, A. and S.Z. Qasim. 1964. Studies on the biology of some freshwater fishes *Ophicephalis punctatus* (Bloch) J. Bombay Natural History Soc. 61: 74-98.

Shrivastava, Sharad, A. Swarup and A.K. Pandey. 1981. Growth rate of different body parameters in *Labeo rohita*. Indian J. Zool. 9 (1): 27-30.

Snedecor, G.W. 1955. Statistical Methods. Iowa State College Press, Ames, USA.