International Journal of Zoology Studies
ISSN: 2455-7269
Impact Factor: RJIF 5.14
www.zoologyjournals.com
Volume 3; Issue 3; May 2018; Page No. 25-28

Length – weight relationship and condition factor of *Cirrhinus mrigala* (Ham.) fish in Barnoo reservoir (Jabalpur, Madhya Pradesh, India)

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Abstract
The objective of this study was to observe the determine length weight relationship and condition factor of *Cirrhinus mrigala* (Ham.) fish in Barnoo reservoir, Jabalpur (M.P.) for two years study. The present study indicates that the fish did not follow the cube law ($W= a L^n$) because the value of 'n' in a shade lower than three, and is deviated from cube law. The parabolic equation for the statistical relationship between the length and weight was recorded; $W= 0.011542 L^{1.480565}$ and $W= 0.000266 L^{1.68807.}$ The condition factors (K) were also estimated for to determine the wellbeing of fishes and was found satisfactory growth of *Mrigala* fish at Barnoo reservoir. The values of condition factor (K) of *Cirrhinus mrigala* was also computed and found that the species performed well. The maximum of 'K' value was found 1.6103 in the month of December. Observed condition factor of *Cirrhinus mrigala* reported that the fish were in well condition during the study period.

Keywords: *Cirrhinus mrigala*, length-weight relationship, condition-factor, barnoo reservoiur

1. Introduction
Cirrhinus mrigala (Hamilton) is one of the major food fishes of India and adjacent countries (Talwar and Jhingran 1991) [1]. It is also a good game fish. Studies on length weight relationship of fishes in fisheries research have two objectives (i) to determine the type of mathematical relationship between two variables and (ii) to know the wellbeing of the fishes (Annapaswamy *et al*., 2004) [2]. Furthermore the study allow (i) estimation of average weight of the fish for a given length group (ii) conservation of length growth equation to corresponding weight growth equivalents (iii) assessing the wellbeing of fish population (Bolgar and Connolly, 1989) [3]. and determination of condition factor (Mitra,2001) [4]. The present work is an attempt to assess the potential of Barnoo reservoir through the study of length – weight relationship and condition factor of the fish. Both the tools usually employed for fish growth determination. The determination of the weight of a fish directly from length may become necessary some times and prove to be useful (Rose *et al*., 2006) [5].

2. Materials and Methods
2.1 Experimental animal
Experimental animal healthy *Cirrhinus mrigala* (Ham.) were used as an experimental animal and it is was collected from Barnoo reservoir, Jabalpur (M.P.) for two years study.

2.2 Barnoo reservoir: Location and Topography
It is a small irrigation reservoir in Sihora tehsil of Jabalpur district (M.P.), located at 80° 07' 10" E Longitude and 23° 20' 50" N Latitude. The reservoir is about 40 years old and was created by constructing an earthen dam of 322.50m. Long and was completed during the year 1966-67. It was impounded on the rainy river Bernie, with a view to irrigate 2137ha. Land of 15 villages of Sihora block. Total water spread area of the reservoir is 75.6 ha. at FRL, with a catchments area of 32.8 sq. km. the maximum and minimum depth of the reservoir is 72 feet and 22 feet respectively (Mandloi *et al*, 2003) [6]. Barnoo reservoir was adopted for fisheries purpose in 1980. For fishing it had been divided into 10-beats. The water remains only in 2- beats round the year (5-7m) while the remaining dry up in summer. The perennial region of the reservoir have uneven bottom and submerged trees (Ojha, 2004) [7].
Mrigala fishes for the present work were collected during the study period from December 2001 to December 2002 and January 2003 to Oct. 2003 from Barnoo reservoir. Altogether 807 specimen of size ranging from 16.7cm to 53 cm. in total length were collected in different months (table-1-2). Live specimen was collected with the help of fishermen through gill nets, cast net and sometime drag net. Fish specimens were weighed on the pan balance and measured for the length up to the nearest millimeter.

2.3 Statistical Equation
Fishes grow three dimensionally and they normally retain the same shape or outline of the body. So the shape and specific gravity of fish remain constant throughout their life. Length – weight relationship was estimated using the following formula-

$$\mathbf{W= a L^n}$$ (Le Cren, 1953) [8]

Whereas - W= Weight of the fish,
L= Length of the fish,
'A' and 'b' = Constant or it can be linearly represented as-
Log W= Log a + b Log L
The value of the constant 'a' or the proportionately constant

(Mitra, 2001) [4] and the exponent 'b' or the regression slope (Vinchi and Nair, 1974) are calculated by the formula given by Leglar (1952).

Condition factor 'K' was calculated by the formula- $\mathbf{K = \frac{W}{L^3} \times 100}$

3. Results and Discussion

Monthly average growth and average weight of stocked *Mrigala* fishes were observed and noted during two consecutive period of after two month from the stocking. In first year i.e. year Dec. 2001 to Dec. 2002 *Mrigala* attain their weight from 75 gm to 1600 gm with the total length from 16.7 cm to 53 cm (Table-1). In 2nd year i.e. Jan. 2003 to Oct. 2003, *Mrigala* attain their weight from 90 gm to 900 gm, with the total length from 18.5 cm to 44 cm (Table-2).

Length-weight relationship of *Mrigala fish* was calculated. In first year (i.e. Dec. 2001 to Dec. 2002) the calculated values of log 'a' were – 0.011542 and 'n' were 1.480565. In 2nd year (i.e. January 2003 to Oct. 2003) the calculated values of log 'a' 0.000266 and 'n' were 1.68807. The length-weight relationship of Mrigala is given in Table -1 & 2.

The parabolic equation obtained for total length and weight data comes to –

Cirrhinus mrigala (Ist year) - $W = -0.011542\ L^{1.480565}$

Cirrhinus mrigala (IInd year) - $W = -0.000266\ L^{1.68807}$

The correlation co-efficient (r) between log of total length and that of body weight was 0.9738 in first year (Dec. 2001 to Dec. 2002) and 0.9994 in second year (Jan. 03 to Oct. 03). The values of 'K' (condition factor) were given in Table-1 & 2 (Fig. 1 and 2.); against the different size classes for the fish. In first year the primary maximum value of 'K' for Mrigala fish was at 16.7 cm. length which is 1.6103 and minimum value of 'K' was at 30cm length which is 0.9259. In second year the maximum value of'K'for *Mrigala* fish was at 18.5 cm length which was at

18.5 cm length which is 1.4214 and minimum was at 24.5 cm length which is 0.5800. Length – weight relationship of the fishes indicates that it is not follows cube law ($w = a L^3$) because the value of 'n' is a shade higher than 3.

Table 1: Length – weight relationship and condition factor of *Cirrhinus mrigala* (Ham.) in Barnoo reservoir (year- Dec. 2001 to Dec. 2002)

Month of Collection	Number of fish examined	Average length (cm)	Log length Log L	Average weight(gm)	Log weight Log W	Calculated Log 'a'	Calculated Log 'n'	Condition factor (k)
December	26	16.7	1.22272	75	1.87506	-0.011542	1.480565	1.6103
January	25	20.5	1.31175	110	2.04139	-0.011542	1.480565	1.2768
February	30	25.2	1.40140	150	2.17609	-0.011542	1.480565	0.9373
March	31	28.5	1.45484	225	2.352818	-0.011542	1.480565	0.9720
April	28	30.0	1.47712	250	2.39794	-0.011542	1.480565	0.9259
May	27	32.5	1.51188	350	2.54407	-0.011542	1.480565	1.0196
June	25	39.5	1.59660	650	2.81291	-0.011542	1.480565	1.0547
July	35	42.5	1.62839	750	2.87506	-0.011542	1.480565	0.9770
August	38	45.3	1.65610	1000	3.0000	-0.011542	1.480565	1.0757
September	40	49.0	1.69020	1350	3.13033	-0.011542	1.480565	1.1475
October	40	50.5	1.70329	1450	3.16137	-0.011542	1.480565	1.2559
November	45	52.0	1.71600	1550	3.19033	-0.011542	1.480565	1.1024
December	44	53.0	1.72428	1600	3.20412	-0.011542	1.480565	1.0747
	N=434		∑20.09457		∑34.76085			

The value of Correlation co-efficient (observed length and calculated weight) r = 0.9738 (P≤ 0.01).

Table 2: Length – weight relationship and condition factor of *Cirrhinus mrigala* (Ham.) in Barnoo reservoir (Year- Jan. 2003 to Oct. 2003).

Month of Collection	Number of fish examined	Average length (cm)	Log length Log L	Average weight(gm)	Log weight Log W	Calculated Log 'a'	Calculated Log 'n'	Condition factor (k)
January	41	18.5	1.26717	90	1.95424	-0.000266	1.68807	1.4214
February	42	24.5	1.38917	125	2.09691	-0.000266	1.68807	0.5800
March	41	28.0	1.44716	200	2.30103	-0.000266	1.68807	0.9111
April	37	29.9	1.47567	250	2.39794	-0.000266	1.68807	0.9352
May	39	30.0	1.47712	320	2.50515	-0.000266	1.68807	1.1852
June	38	32.0	1.50515	425	2.62839	-0.000266	1.68807	1.2970
July	37	35.0	1.54407	575	2.75967	-0.000266	1.68807	1.3411
August	35	40.0	1.60206	700	2.84510	-0.000266	1.68807	1.0938
September	33	41.0	1.61273	825	2.91645	-0.000266	1.68807	1.1970
October	30	44.0	1.64345	900	2.95424	-0.000266	1.68807	1.0565
	N=373		∑14.96375		∑25.35912			

The value of Correlation co-efficient (observed length and calculated weight) r = 0.9994(P≤ 0.01).

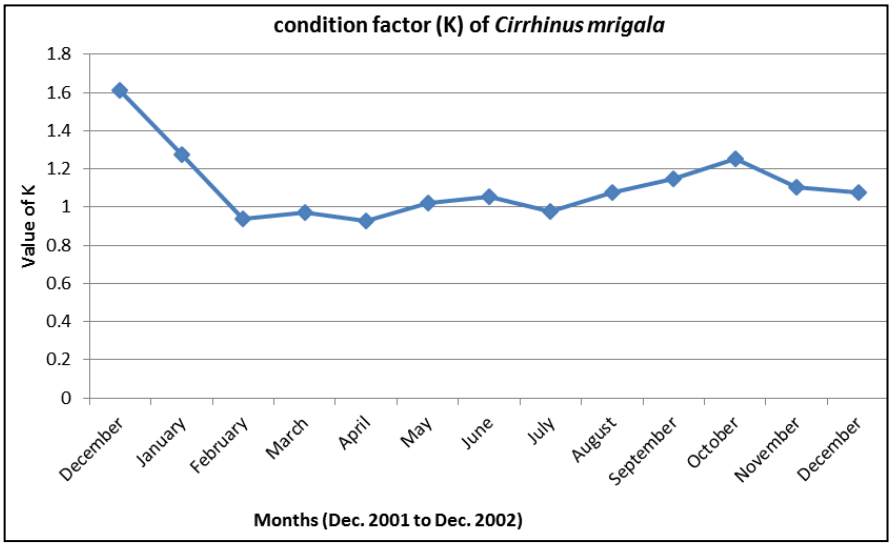

Fig 1: Condition Factor (K) of *Cirrhinus mrigala* (Dec.2001 to Dec. 2002)

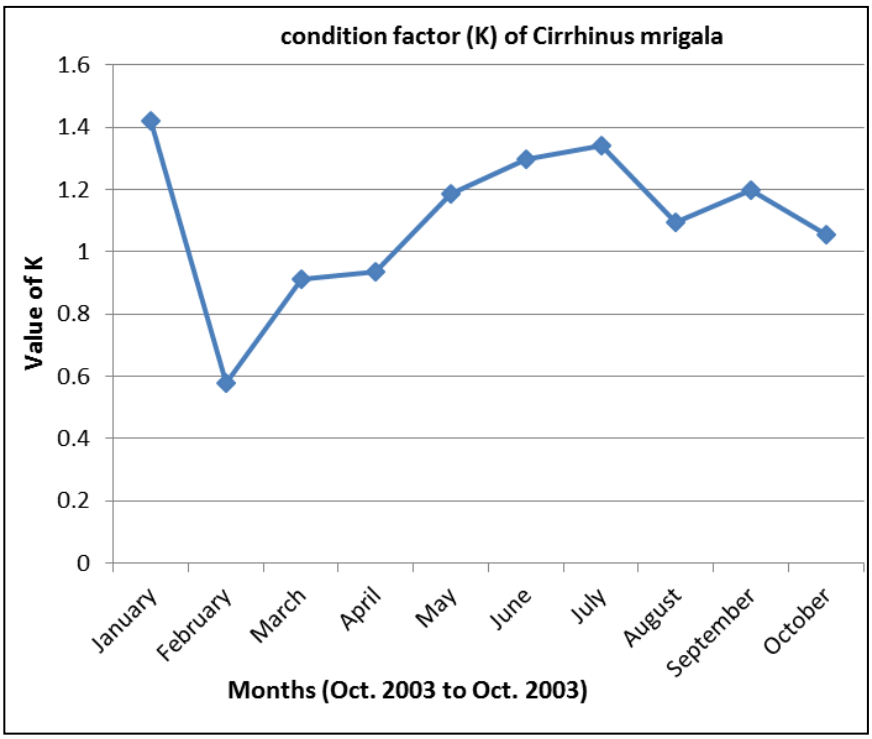

Fig 2: Condition Factor (K) of *Cirrhinus mrigala* (Jan.2003 to Oct. 2003)

Higher values for 'n' have been reported for *Hilsa* of the Ganga River (Mathur, 1964, De, 1980, 1936 and Martin, 1949). [9, 10, 11, 12]. stated that the value of 'n' may vary for fishes inhabiting different localities and even in different sexes and life stages. The value of K >1 points towards good health of the fish and <1 opposite (Le Cren, 1951) [13].

In the present study value of 'K' was estimated and indicating good health of the fish stock. However, amongst fishes of different size groups the 'K' factor fluctuated in a very narrow range in different fish species. De (1980) [8] also observed highest value of 'K' (1.120) amongst fishes in size range of 260 – 479 mm. Pillay (1958 a) [8] stated that curve of 'K' for females showed a steady increase from July onwards reaching the maximum in November thereafter registered a sudden fall. [14].

The determination of 'K' helps in defining the seasonal variation in the condition of the fish in relation to age and sex of the fish. It also helps in finding the differences between the conditions of the same species in different water which might also serve as an index of the productivity of the water mass**.** During the study such rapid change and recovery is generally associated with the attainment of sexual maturity. Pantulu (1961) and Rao (1967) observed a similar change in relative condition factor in *Mystus gulio* and *Labeo fimbriatus*. [15, 16]. Bhatnagar (1963) [18] stated that the monthly variation in 'K' values of *Puntius kolus* indicated the spawning season of the fish [17]. Menon (1950) stated that the 'K' values denoted the beginning of spawning as the downward trend may be due to

increased metabolic strain [18].

Choudhari *et al*. (1982) while working on four Indian major carps of river Bramhputra found that in *Labeo rohita* the 'K' value was high during August and low during January. The high value in June may be due to the presence of mature gonads and subsequent fall in July and August probably due to spawning. Such observation was also seen in the present study in Length-weight relationship of Mrigala fish in Barnoo reservoir i.e. 'K' value was high during April and October and low during December and January months [19]. Gairola *et al*. (1990) showed that the peak 'K' value was smaller (< 8.0 cm), providing evidence of intensive feeding and rapid growth in *P. ticto*.Condition factor is believed to be an indicator of the physiological state involving maturity, spawning, environmental conditions and availability of food. It has also been established that noticeable variation can occur in the 'K' values during the life span of the fish [20].

The length-weight relationship of selected fishes were clearly indicates that the total weight of the fish increases as an exponential function of its total length. Length-weight relationship of any fish is depending upon various environmental factors besides body shape, out line and the contour. Extrinsic factors, such as space, competition for food, enemies and changes in physico-chemical characteristics of water and intrinsic factors such as genetic makeup; reproductive state and endocrine balance etc influence the growth rate of fish. Nikolsky (1963) is of the opinion that growth has its specific characteristics in different age groups. In the present study growth rate was not found similar in all length groups. This can be seen by the slight curvilinear in the calculated values of the weight [21].

During the study of observed fishes the condition factor 'K' follows a pattern of seasonal cycles related to feeding intensity, spawning activity and wellbeing of fishes. Monthly variation in 'K' values synchronies with the feeding intensity of the fish. Thus, the condition factor 'K' in observed fishes was influenced by the maturation cycle and feeding activity of the fish. The value of co-efficient of correlation (r) estimated for the observed species of fishes was found always less than one, which indicated that the relationship between length and weight of the fishes was highly significant in Barnoo reservoir.

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