

LENGTH-WEIGHT RELATIONSHIP AND RELATIVE CONDITION FACTOR OF *LABEO ROHITA* AND *CATLA CATLA* (HAMILTON, 1822) IN SARODA RESERVOIR, KAWARDHA, CHHATTISGARH

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ABSTRACT

The length- weight relationship and condition factor was estimated for 400 samples of combined sex of *Labeo rohita* and *Catla catla* separately. The sampled *Labeo rohita* and *Catla catla* fish ranged from 20.1-70.0 cm and 30-90 cm respectively. *Labeo rohita* categorized as L1 to L5 and *Catla catla* L1 to L4 according to length frequency. The weight of *Labeo rohita* and *Catla catla* ranged from 300-10,000 g and 800-22,200 g respectively. The value of regression co-efficient (b) obtained for length-weight relationship for *Labeo rohita* was 3.03 and for *Catla catla* was 3.17. The regression coefficient value showed positive allometry growth for the entire sample of *Labeo rohita* and *Catla catla*. The mean values of relative condition factor (Kn) computed for all the samples of *Labeo rohita* and *Catla catla* which was 1.02 ± 0.01 and 1.005 ± 0.003 . This value of relative condition factor showed that *Labeo rohita* and *Catla catla* of Saroda reservoir were healthy. The highest relative condition factor value was 1.04 for both *Labeo rohita* and *Catla catla* in the month of August and May, June and July respectively. The length-weight relationship of *Labeo rohita* and *Catla catla* calculated as the following equation: $\text{Log } W = -1.73 + 3.03 \text{ Log } L$ (*Labeo rohita*) and $\text{Log } W = -1.77 + 3.17 \text{ Log } L$ (*Catla catla*).

INTRODUCTION

Rohu, one of the Indian major carp, *Labeo rohita* is a geographically widespread species in tropical freshwater of India and adjacent countries with considerable variation in growth parameters (Chondar, 1999). This species thrives well in lakes, ponds, rivers (Talwar and Jhingran, 1991) and is reported from brackish-water system also (Riede, 2004). A column feeder herbivore showing rapid growth in terms of flesh. It is most preferable and prestigious cultivable fish of India. A number of reports are available on biological aspects of *L. rohita* from different water bodies (Varghese, 1997; Salam and Janjua, 1991; Sarkar et al., 2006 and Mir et al., 2013). However, Length – Weight relationship (LWR) studies on *L. rohita* are mostly restricted to cultured environments Khan (1972), Kamal (1971) and (Sarkar et al., 1999). *Labeo rohita* belongs to the family Cyprinidae of the order Cypriniformes. It could be easily identified by bilaterally symmetrical body and thick and fringed lips which are most prominent in mature forms. Length – weight relationship gives information on the condition and growth patterns of fish (Bengal and Tesch, 1978).

Like any other morphometric characters, the LWR can be used as a character for the differentiation of taxonomic units and the relationship changes with the various developmental events in life such as metamorphosis, growth and onset of maturity (Thomas et al., 2003). The LWR can also be used in setting yield equations for estimating the number of fish landed and comparing the population in space and time (Beverton

and Holt, 1957). LWR parameters (a and b) are useful in fisheries science in many ways: to estimate weight of individual fish from its length, to calculate condition indices, to compare life history and morphology of populations belonging to different regions (Petrakis and Stergiou, 1995) and to study ontogenetic allometric changes (Teixeira de Mello et al., 2006). Furthermore, the empirical relationship between the length and weight of the fish enhances the knowledge of the natural history of commercially important fish species, thus making the conservation possible.

Length and weight of Indian major carps in relation to growth parameters have been studied by Jhingran (1952, 1957 and 1959), Sinha (1972), Choudhary et al., (1982), (Johal et al. 1992), (Zafar, et al., 1992), (Ahmed et al., 1996), Jain (2000) and (Saxena et al., 2009). Johal et al. (1983) reported a strong linear relationship between total length and weight of *C. catla* from Govind Sagar. Kartha et al. (1990) in a similar study from the Gandhi Sagar (Madhya Pradesh) reported an isometric growth pattern in *C. catla*. (Rajbanshi et al., 1984) observed an isometric growth pattern at juvenile stage of the *C. mrigala* from a water body in the southern Rajasthan. (Sarkar et al., 1998) while performing a similar study on *C. mrigala*, observed that fish spawned in Bundh and a hatchery reared stock indicated an allometric growth from both these environments.

Condition factor and relative condition factor for carps have been estimated by (Chacko et al., 1951), (Chakraborty et al., 1963), (Jhingran et al., 1979), (Choudhari et al., 1982), (Johal et al., 1983), (Rajbanshi et al., 1984) and (Zafar et al., 1992)

and several other researchers from different types of water bodies located in different regions and environments of the country. Chakraborty *et al.* (1963) from Allahabad and Rajbanshi *et al.* (1984) have estimated the relative condition factor of *C. mrigala* from Roopsagar Pond (Southern Rajasthan). And have observed that relative condition factor is mainly dependent on the growth, maturity of gonads and length of fish. Johal, *et al.* (1983) have described the condition factor of *C. mrigala* from Sukhna Lake (Chandigarh) and stated that condition factor increases with increase in length of the fish. Choudhari *et al.* (1982) studied of condition factor for four Indian major carps from the river Brahmaputra and found that value of relative condition factor in *C. catla* was high during August and low during January.

Fish are said to exhibit isometric growth when length increases in equal proportions with body weight for constant specific gravity. The regression co-efficient for isometric growth is 3 and values other than 3 indicate allometric growth condition (Reynold, 1968). Pauly *et al.* (1997) reported the importance of length-weight relationship in the calculation of an equation of growth in length into an equation of growth in weight. The exact relationship between length and weight differs among species of fish according to their inherited body shape, and within a species according to the condition (robustness) of individual fish. Individual fish within the same sample vary considerably, and the average condition of each population varies seasonally and yearly (James *et al.*, 2000). Arsalan *et al.* (2004) stated that it is usually easier to measure length than weight and weight can be predicted later on using the length-weight relationship which helps among other fish given its definite length.

The condition factor (K) and relative condition factor (Kn) are the important biological parameters which indicate the suitability of a specific water body for growth of fish LeCren (1951). The condition factor is an index of species average size while relative condition factor is the ratio between observed weight and calculated weight of the fish. The values of these factors depend on physiological features like maturity, spawning, environmental factors and food availability in a water body. The present study aims to provide information on the length-weight relationship and relative condition factor of *Labeo rohita catla* found in Saroda reservoir, Kawardha, Chhattisgarh.

MATERIALS AND METHODS

Study Area

The present study was carried out at Saroda reservoir, Kawardha (Chhattisgarh) India. It is located at 21°58'38"N. Saroda is a small type of reservoir located on Sakri river and having an area of 232 ha.

Sample Collection

Fish samples were collected by using gillnets of different mesh size. The samples were transported to the laboratory after preserving it with 5% formalin.

Laboratory analysis

The collected specimens were washed and mopped on filter paper to remove excess water from their body surfaces. Length

of fishes was measured to the nearest cm and weight up to 0.1g by using a scale and electronic weighing balance respectively. The size of fishes were ranging between 20.1 - 70 (cm) which was categorized into 5 category viz. 21 - 30 cm (L1), 31 - 40 cm (L2), 41 - 50 cm (L3), 51 - 60 cm (L4), 61 - 70 cm (L5) in total length and 300 - 10,000 g in weight respectively.

Length-weight relationship and condition factor

All length - weight relationships were calculated using the least square fitted method to log transformed data using the function $W = a \times L^b$

Where,

W = Total weight of the fish in grams

L = Total length in cm

a = coefficient related to body form

b = an exponent indicating isometric growth.

The parameters a and b was estimated by linear regression on transformed equation:

$$\log W = \log a + b \log L \quad (\text{LeCren, 1951})$$

The Ponderal index (Kn) or relative condition factor value was calculated for different length groups of 10 cm interval. The formula $Kn = W/aL^n$ (LeCren, 1951) were used for calculation of relative condition factor.

RESULTS

Length-weight relationship

The length-weight relationship for *Labeo rohita* get determined by equation $\log W = \log a + b \log L$ as suggested by LeCren (1951). When empirical values of lengths were plotted against their respective weight on an arithmetic scale, smooth curves were obtained (Fig. 2). The relationship between observed and calculated weight were presented in Fig. 3. The data of length-weight of *Labeo rohita* is presented in (Table 1).

The regression coefficients, when calculated using the methods of least squares for samples of *Labeo rohita* size ranged between 20.1 - 70.0 cm gave the following equation:

$$\log W = -1.73 + 3.03 \log L$$

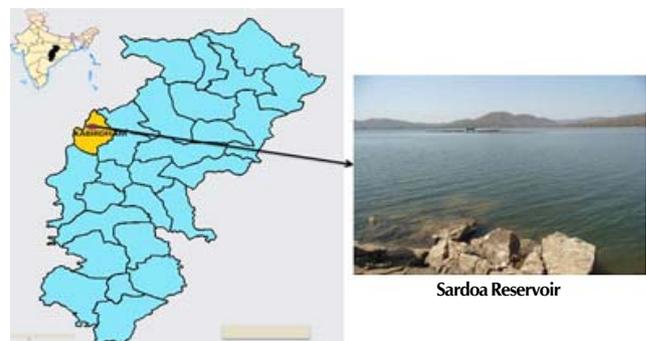


Figure 1: Study area (Saroda Reservoir)

Table 1: Data on length and weight of a *Labeo rohita* and *Catla catla* from Saroda reservoir, kawardha, Chhattisgarh

Length groups	Number of Fishes		Mean length(cm)		Mean Weight (g)	
	<i>Labeo rohita</i>	<i>Catla catla</i>	<i>Labeo rohita</i>	<i>Catla catla</i>	<i>Labeo rohita</i>	<i>Catla catla</i>
L1	28	90	25.88 ± 0.79	35.57 ± 0.30	445 ± 26.63	1371.22 ± 30.33
L2	26	67	35.32 ± 0.58	45.13 ± 0.33	848.8 ± 32.666	2914.47 ± 87.00
L3	8	46	45.00 ± 0.49	55.17 ± 0.45	1416.67 ± 54.94	6460.43 ± 222.05
L4	18	28	55.86 ± 0.71	64.67 ± 0.54	3800 ± 434.44	11512.5 ± 312.16
L5	20	33	65.27 ± 0.61	76.27 ± 0.42	7811.36 ± 408.54	15857.58 ± 136.05
L6	-	90	-	85.61 ± 0.49	-	1371.22 ± 30.33

Table 3: Relative condition factor (Kn) values for combined sexes of *Labeo rohita* from Saroda

Length group(cm)	Observed weight (W)	Calculated weight (aL ^b)	Ponderal IndexKn (W/aL ^b)
L1	445	440.889	1.009
L2	848.8	836.53	1.014
L3	1416.67	1402.7	1.009
L4	3800	3520.62	1.079
L5	7811.36	7728.82	1.010
Mean Kn = 1.02 ± 0.01			

Table 4: Relative condition factor (Kn) values of *Catla catla* from Saroda reservoir, kawardha, Chhattisgarh

Length group (cm)	Observed weight (W)	Calculated weight (aL ^b)	Relative condition factor Kn (W/aL ^b)
L1	1371.22	1356.11	1.01
L2	2914.47	2891.79	1.00
L3	6460.43	6439.93	1.00
L4	11512.5	11239.42	1.02
L5	15857.58	15803.70	1.00
L6	19002.78	18835.13	1.00
Mean Kn = 1.005 ± 0.003			

Table 5: Month wise Relative condition factor (Kn) values for *Labeo rohita* and *Catla catla* from Saroda reservoir, kawardha, Chhattisgarh

Month	Number of Fishes		Observed weight (W)		Calculated weight (aL ^b)		Kn (W/aL ^b)	
	Rohu	Catla	Rohu	Catla	Rohu	Catla	Rohu	Catla
January	9	27	450	1201.11	445.01	1181.88	1.01	1.01
February	10	19	655	1321.15	651.83	1302.19	1	1.01
March	10	29	663	3154.13	658.83	3139.07	1	1
April	7	28	1185.71	7147.42	1168.86	7008.64	1.01	1.02
May	6	23	1200	11484.78	1195.87	10971.69	1	1.04
June	9	24	4333.33	12902.08	4192.99	12374.61	1.03	1.04
July	9	35	4345.34	19788.57	4191.99	18848.34	1.03	1.04
August	7	40	7142.85	17410	6863.3	16865.91	1.04	1.03
September	7	17	7148.85	11697.06	6936.3	11357.07	1.03	1.02
October	9	21	4343.3	7033.33	4194.99	6919.11	1.03	1.01
November	7	18	1171.42	1217.77	1168.93	1203.35	1	1.01
December	10	19	440	1333.15	436.48	1309.15	1	1.01
Mean Kn = 1.015 ± 0.0045 (<i>Labeo rohita</i>)								
Mean Kn = 1.02 ± 0.004 (<i>Catla catla</i>)								

As observed from the above equations values for all specimens were practically identical and followed the cube law (b = 3). The agreement between the empirical weight and computed weight from regression can be termed as ideal growth (positive allometry). The minimum calculated weight were found for length group 21 - 30 cm i.e. 440.889 gram having observed weight 455 gram and maximum calculated weight were found for length group 61 - 70 cm i.e. 7228.82 gram having observed weight 7811.36 gram.

Relative condition factor

The relative condition factor (Kn) for all fish samples was determined from the average lengths and weights of 10 cm

interval of total length groups (Table 2). The relative condition factor (Kn) was determined for all samples in case of sexes combined only Kn values were ranging from 1.009 – 1.079 with mean was 1.02 ± 0.01. The Kn value increased with weight and this value of Kn showed ideal or good growth of all samples in all size groups of fish. In case of month wise the minimum relative condition factor found was 1.00 in the month of february, march, may, november and december. The maximum relative condition factor found was 1.04 in the month of august followed by 1.03 in the month of june, july, september and august (Table. 3).

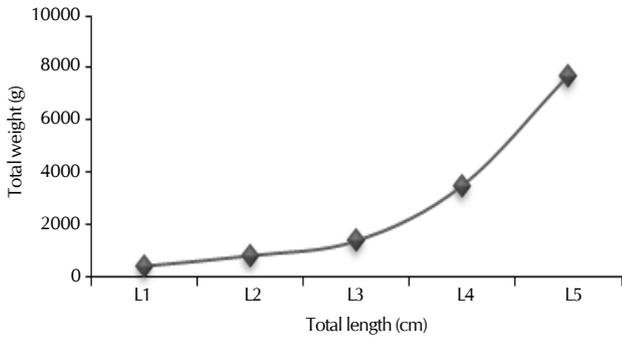


Figure 2: Length - weight relationship of *Labeo rohita* from Saroda reservoir, Kawardha, Chhattisgarh

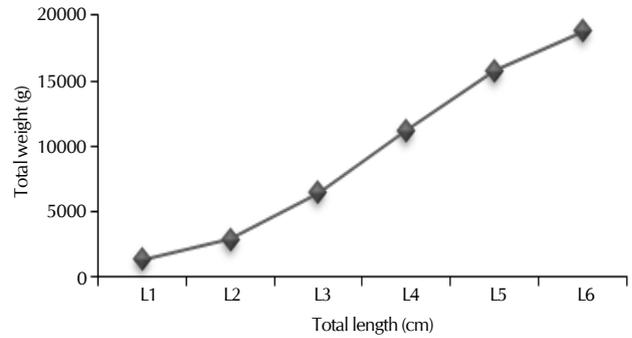


Figure 3: Length - weight relationship of *Catla catla* from Saroda reservoir, Kawardha, Chhattisgarh

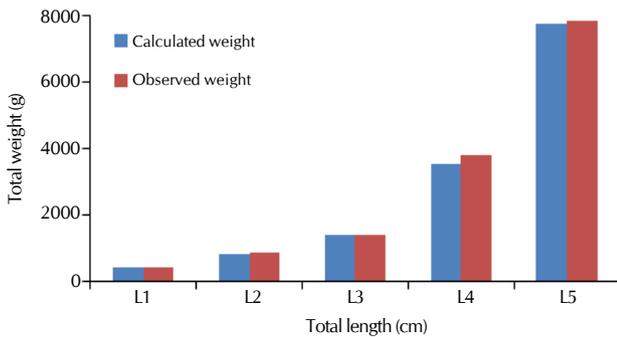


Figure 4: Observed and calculated weight in different mean length groups of *Labeo rohita* from Saroda reservoir, Kawardha, Chhattisgarh

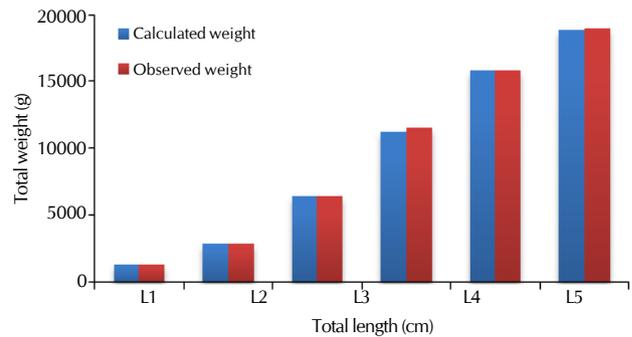


Figure 5: Observed and calculated weight in different mean length groups of *Catla catla* from Saroda reservoir, Kawardha, Chhattisgarh

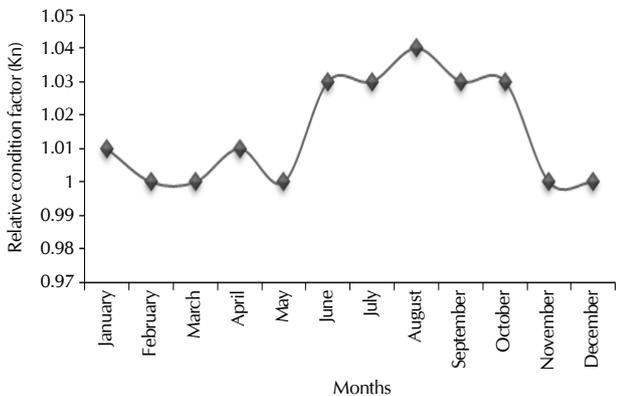


Figure 6: Month wise relative condition factor of *Labeo rohita* from Saroda reservoir, Kawardha, Chhattisgarh

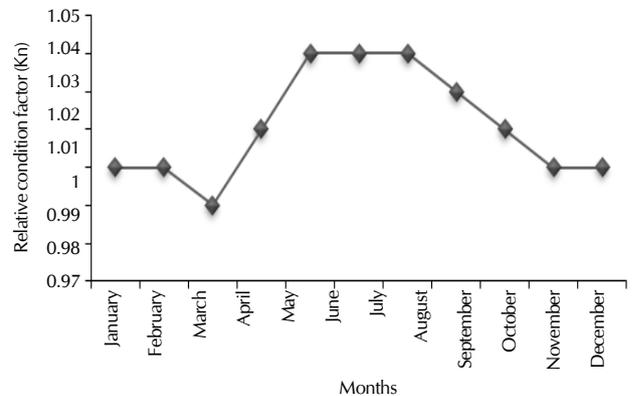


Figure 7: Month wise relative condition factor of *Catla catla* from Saroda reservoir, Kawardha, Chhattisgarh

DISCUSSION

The value of regression co-efficient (b) obtained for the length-weight relationship was 3.03 which showed positive allometry growth in *Labeo rohita*. Positive allometry growth in *Labeo rohita* show healthy environment such as optimum levels of dissolved oxygen, pH, temperature, hardness, proper circulation of water, availability of required amount of food materials etc. Several workers reported high value of 'b' in freshwater fish, notable among them are like Jhingran and Khan (1979) who reported a value of 3.22 in *Cirrhina mrigala* and Natrajan and Jhingran, (1963) observed a value of 3.23

in *Catla catla*. Working on different populations of *Labeo rohita*, (Khan and Hussain, 1941) reported the values of 3.17 river. Chatterji *et al.* (1977) noted the value of 3.17 in *Labeo bata* and Sinha (1972) estimated a value of 3.02 in *P. sarana*. All these findings support the present finding regarding the value of regression coefficient (b) for *Labeo rohita*.

The relative condition factor or ponderal index determines the condition of environment where organism lives. In Saroda reservoir we found suitable environment for *Labeo rohita* because in result the value of relative condition factor increasing with increase in length and weight. The fluctuation

in the value of 'K' and 'Kn' in fish has been mainly assigned to dependency on many factors such as feeding intensity, fish size and availability of fish (LeCren, 1951). Ujjania *et al.* (2012) found almost the same value of Kn *i.e.* 1.00 for Indian major carps which is also get observed in this study. The mean relative condition factor was found to be 1.015 ± 0.0045 which shows better growth of fishes and it indicate that the water body is very much suitable for that particular organism. Maximum relative condition factor was observed in the month of august *viz.* 1.04 followed by june, july, septmber and October *viz.* 1.03. In these months the weight of organism get increased very fast may be due to increase in the weight of gonads or the increase in availability of food or both the reasons may be responsible for increase in body weight of organisms in these months.

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