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Length- weight relationship and condition factor of *Labeo rohita* in reservoir Udaisagar (Udaipur, Rajasthan)

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Abstract
The study on "Length- weight relationship and condition factor of *Labeo rohita* in reservoir Udaisagar (Udaipur, Rajasthan)" was carried out during September, 2008 to September. 2009. Commercially important fish *Labeo rohita* of Udaisagar reservoir was selected for the biological study. This study includes the length-weight relationship and condition factor of *Labeo rohita*. The relationship between length and weight of *Labeo rohita* from fish catch was calculated by establishing correlation and regression between the two parameters. The exponent values of total length and weight varied from 0.104 to 0.262 for different length groups of *Labeo rohita*. The higher values of 'n' could be attributed to high rate of weight increase with per unit increase in length. The correlation co-efficient 'r' between total length and weight were found to be significant for all the length groups of *Labeo rohita*. The values of condition factor (K) of *Labeo rohita* was also computed and found that the species performed well. The maximum of 'K' value was found 1.63 in *Labeo rohita* (group B).

Keywords: Indian Major Carp, *Labeo rohita,* Length weight, Condition factor etc.

1. Introduction
Fortunately for meeting the nation's target, the inland fisheries sector offers several opportunities. Out of these, reservoirs alone constitute over three million hectares. Small reservoirs numbering about 19000 accounts for a total water spread area of 14,85,557 hectares and about 180 medium and 56 large reservoir which constitutes 5,24,541 hectares and 11,40,268 hectares, respectively (Sugunan, 1995) [18]. However, these vital resources are yet not fully exhibited to their full potential to contribute the expected level of inland fish production.

Rajasthan is situated between northern latitude 23°3' to 30°12' and eastern longitude 69°30' to 78°17'. Inspite of favourable conditions for high fish growth rate in the state of Rajasthan, fish culture has yet not gained required popularity. One of the most useful aspects of fishery biology is to develop mathematical relationship between length and weight of fish for future use. In case of Indian major carps there exist a linear relationship between length and weight of fish (Jhingran, 1952) [6]; it is also termed as 'cube law' because of three dimensional growths of fish. Hence, from such a relationship, it is possible to determine the weight of fish harvested from water body if their length is known and vice-versa.

The condition factor is an important biological aspect which indicates the well being of a specific fish in a water body. It is an index of species average size and its value depends on the physiological features like maturity, spawning, environmental factors and food availability in a water body. Therefore, the study of condition factor is a mirror for the evaluation of the well being of the fish in relation to its biotic and abiotic environments Ujjania (2003) [20]. In view of the above, the present study on Length- weight relationship and condition factor of *Labeo rohita* in reservoir Udaisagar (Udaipur, Rajasthan) has been designed and conducted.

2. Materials and methods
The present study was carried out during Sept. 2008 to Sept. 2009 with a view to investigate the biology of *Labeo rohita* of Udaisagar reservoir. The details of morphometric features of Udaisagar reservoir are given in (Table-3) For this purpose, laboratory studies were conducted in the College of Fisheries, Udaipur while field studies were conducted at Udaisagar reservoir.

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A. Sample Collection

In order to study the biology of commercially important fish *Labeo rohita*, samples of fish were collected from the commercial catches and sample netting during fishing year 2008-2009 at landing centre of Udaisagar reservoir.

A. Length-weight relationship

About 500 specimens, of *Labeo rohita*, were collected during the fishing year 2008-2009 from Udaisagar reservoir for the length-weight relationship. The total length and weight of fish samples were measured in centimetre and gram, respectively. The samples collected for *Labeo rohita* were divided into four length groups i.e. 40.0-50.0, 50.0-60.0, 60.0-70.0 and 70.0-80.0 cm and named as A, B, C and D, respectively. After grouping, the relationship (correlation and regression) between body weight and total body length for each group was calculated using following formula of Le Cren (1951) [12]:

$W = aL^n$

Where,

W = Weight of the fish in g
L = Total length in cm
a & n = Constants

B. Condition factor or ponderal index (K):

The condition factor or ponderal index (K) was determined using length and weight data of fish samples. The condition factor was calculated as per the standard method of Le Cren (1951) [12].

$$K = \frac{W \times 100}{L^3}$$

Where,

W = Observed weight of fish in g
L = Total length of fish in cm

C. Statistical analysis

The data collected during the present investigation were processed for statistical analysis. The analysis of correlation coefficient and regression was done as per the method described by Snedecor and Cochran (1981) [17]. The length-weight relationship was established using the linear equation of the form $\text{Log } W = \text{Log } a + b \text{ Log } L$.

3. Results

Biological Studies:

Biological studies in fishes encompass fairly wider aspects of fish body functions and in a research, it is impossible to touch all aspects in details. As such, only the following aspects of the fish biology of *Labeo rohita* have been dealt with below:

(A) Length-weight relationship
(B) Condition factor or ponderal index

(A)Length-weight relationship:

For the purpose, the fishes selected for the study were grouped into 4 length groups i.e., A-40.0 to 50.0 cm, B-50.0 to 60.0 cm, C-60.0 to 70.0 cm and D-70.0 to 80.0 cm. It would be seen from (Table. 1 and Fig.1) that *Labeo rohita* from Udaisagar reservoir was primarily dominated by C length-group (45%) followed by D (32.0%), B (20.0%) and A (3.0%) respectively.

The statistical relationships of body-weight with total body-

length of *Labeo rohita* were calculated for different length-groups. A highly significant correlation was observed between body-weight and total body-length for all the length-groups (Table.1). The highest 'r' value (0.788) was in 'A' length group followed by D (0.665), C (0.513) and B (0.394) length groups.

The exponent 'n' values for body-weight and total body-length ranged between 0.104 and 0.262. These values show the deviation of *Labeo rohita* in its growth from the Cube law. The highest and lowest exponent values (0.262 and 0.104) were observed in length-groups D and B respectively. On the other hand, for other length-groups *viz.,* A and C, it was 0.147 and 0.113 respectively.

The values of 'a' constant was found highest in length-group D (-14.273) followed by length groups A (-5.198), C (-3.701) and B (-2.970). The relationship between log of body weight and log of body length is given in the (Fig. 1).

(B) Condition factor/Ponderal index (K)

The mean values of condition factor (K) for all the length-groups of *Labeo rohita* are shown in (Table.2). The values of condition factor for the different length-groups of *Labeo rohita* ranged between 1.273 and 1.637 the highest values being of 1.637 from the length-group B. In the case of length groups A, C and D, the values of K were 1.575, 1.320 and 1.273 respectively.

4. Discussion

Length weight relationship for any fish species gives its performance and well being in relation to habitat and helps in monitoring the status of fish stock for obtaining optimum yield. The length-weight relationship of Indian major carps has been discussed by Jhingran (1959) [7], Chakrabarty and Sing (1963) [1], Natarajan and Jhingran (1963) [13], Srivastava and Singh (1964) [18], Kamal (1969 [11], Choudhary *et al.* (1982) [2], Johal and Tandon (1987) [8], Johal and Kingra (1992a) [9] from different localities of India.

Studies on length-weight relationship have widely attracted the attention of fishery biologists. However, on Rajasthan waters such reservoirs are comparatively meagre. In the present study on length-weight relationship and exponent values for the carp, *Labeo rohita* from Udaisagar reservoir, Udaipur Rajasthan have been computed.

The observations on *Labeo rohita* clearly indicate that in all the fishes morphometric parameters of the species showed the relationship between total body length and body weight were highly significant (Tables.1 - 2 and Fig.1). The results have shown in the Tables 1and 2 and Fig.1 point out a highly significant relationship between total body length and body weight of the fish. Coefficient of correlation (r) in respect of various parameters (Table.1 and 2) further indicated that relationship for morphometrical parameters were highly significant.

In the present study, the exponent value 'n' was found to be deviated from 'cube law' i.e. the values was 0.262. Such deviations from 'cube law' were also observed by earlier workers. Desai and Shrivastava (1990) [11] observed an exponent value of 2.9143 for *Cirrhinus mrigala* from Rihand reservoir. Johal and Kingra (1992b) [10] reported exponent values varying between 2.752 to 3.545 in three Indian major carps. Pandey and Sharma (1998) [14] reported exponent values for *Cirrhinus mrigala*, *Labeo rohita* and *Catla catla* as 1.7932, 2.2502 and 2.5274 respectively, and indicated that

these carps did not follow the 'cube law' in sodic soil pond conditions in U.P. India.

In Rajasthan Jain (2000) [5] reported a high variations in 'cube law' for *Catla catla, Labeo rohita* and *Cirrhinus mrigala* from Siliserh reservoir, and observed that availability of living space and food could strongly influence the values of exponent. Panicker (2000) [15] also observed the exponent value in several species of fishes from Chulliar reservoir and reported that in the case of *Catla catla* and *Labeo rohita* the values of 'n' were 3.353 and 3.113, respectively. It was further stated that the shifting of exponent value to higher than 3 indicates a favourable environment for fish in the reservoir for their good growth and well being.

Ujjania (2003) [20] attempted to workout length weight relationship in three Indian major carps namely, *Catla catla, Labeo rohita* and *Cirrhinus mrigala* and reported a highly positive significant relationship between standard body length and body weight. He also reported the variations in the exponent value (n) of *Catla catla* at different length-weight groups from 3.160 to 3.805, 2.734 to 4.452 and 3.013 to 4.004 from Mahi Bajaj Sagar, Surwania dam and Aasan pond, respectively from southern Rajasthan. Further, the same author reported the exponent value 'n' to vary from 2.770 to 4.574, 2.853 to 4.056 and 2.685 to 4.455 in Three length-groups of rohu from the above stated three reservoirs in respective order.

From above discussion it may be seen that the exponent values obtained in the present study in respect of *Labeo rohita* of Udaisagar reservoir are comparable to those reported by Johal and Kingra (1992a) [9], Pandey and Sharma (1998) [14], Jain (2000) [5], and Ujjania (2003) [20] and Rajkumar 2005.

Condition factor or ponderal index is a physiological indicator of the well being of any fish living in a giving environment. Low values of condition factor or K, as it is normally referred to in a fishery language, is a definite sign of non-allometric fish growth probably owing to the competition for the food and space within the different fish communities in a water body. In the present study, the K values of Rohu varied between 1.273 and 1.637. The nearness of K value to 1.0 in the species clearly indicates the environmental suitability of the reservoir Udaisagar for good growth of fish.

Further, the high value of condition factor (K) in the present study is an indicator of higher increase in weight in relation to length. The higher 'K' value for rohu supported by Choudhary *et al*. (1991) [3]. He reported that the oscillation of 'K' value in the case of *L. calbasu* between 1.15 and 1.26. In this connection, the observation of Jain (2000) [5] in respect of IMC in Seliserh reservoir are comparable and supportive. Ujjania (2003) [20] observed that the condition factors varying from 2.788-3.225 for catla, 2.053-2.339 for rohu and 1.779-1.965 for mrigal. He also reported that such values of 'K' are indicative of the suitability of the water body for good fish growth. All the above studies support the presently made observations in rohu of Udaisagar reservoir.

On the basis of exponent value of length-weight relation, it could be concluded that *Labeo rohita* attains more weight per unit of length in the Udaisagar reservoir. Observed condition factor of *Labeo rohita* reported that the fish was in well condition during the study period.

On the basis of length-weight data, the regression equations of body weight on total body length were calculated.

Length groups (cm)	Equation
40-50	y= -5.198 + 0.147x; r = 0.788
50-60	y= -2.970 + 0.104x; r = 0.394
60-70	y= -3.701 + 0.113x; r = 0.513
70-80	y= -14.273 + 0.262x; r = 0.665

Table 1: Correlation of total body length (cm) with body weight (kg) of *Labeo rohita* at different length groups

S. No.	Length	Group	Total No of Observation	Frequency (%)	Mean L±SD	Mean W ±SD	a' Value	n' value	r' value
1	40-50	A	15	3	45.800±3.278	1.513±0.609	-5.198	0.147	0.788**
2	50-60	B	100	20	55.980±3.134	2.872±0.830	-2.97	0.104	0.394**
3	60-70	C	225	45	65.570±3.220	3.723±0.711	-3.701	0.113	0.513**
4	70-80	D	160	32	74.289±3.354	5.220±1.323	-14.273	0.262	0.665**

** Significant at 1 % Level of significance

Table 2: Condition factor of *Labeo rohita*

S. No.	Length groups (cm)	*Labeo rohita*
1	40-50	1.5752
2	50-60	1.6373
3	60-70	1.3206
4	70-80	1.2731

Table 3: Morphometric features of Udaisagar reservoir

1.	Location	
	Longitude	73°47'0" E
	Latitude	24°33'0" N
2.	Average rainfall	625 mm
3.	Maximum depth (Zm)	15 m
4.	Maximum length (L)	3.75 km
5.	Maximum width (bx)	2.40 km
6.	Water spread area	4.75 sq.km
7.	Catchment area	76 sq.miles
8.	Live storage capacity	975 Mc Ft
9.	Type of dam	Both side face wall with earthen dam
10.	Tehsil	Girwa
11.	Accesses	3 km from Hindustan Zinc Colony, Debari
12.	Year of construction	1565

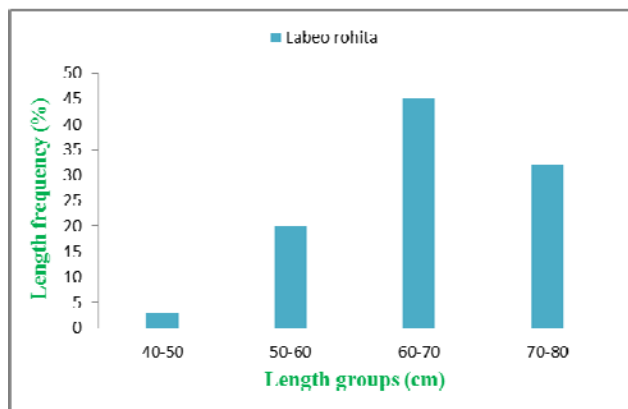**Source:** Irrigation Department, Udaipur (Rajasthan)

Fig 1: Length frequency distribution of *Labeo rohita* of Udaisagar Reservoir

5. Acknowledgement

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