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Studies on length-weight relationship (LWR) and condition factor of *Labeo rohita* and *Cirrhinus mrigala* in sutiapat reservoir, Kabirdham, Chhattisgarh, India

Ritesh Chandrvanshi, Rakesh Uraon, Niranjan Sarang and HK Vardia

Abstract
This study aimed to estimate the length-weight relationship and characterized the condition factor of *Labeo rohita* and *Cirrhinus mrigala* is one of the most abundant and economically important species in sutiapat reservoir. The Sutiapat reservoir is a medium irrigation reservoir which is located in the Kabirdham district of Chhattisgarh. The present study describes the length-weight relationship and condition factor of *L. rohita* and *C. mrigala* to determine the growth pattern. The fish sampled range between total length 38.30 cm to 62.00 cm and total weight 850.00 gm to 3000.00 gm for *L. rohita* and *C. mrigala* from 36.50 cm. to 48.00 cm. in total length and 800.00 gm to 1250.00 gm in total weight. The correlation coefficient 'r' was found to be significant and observed to be 0.96 and 0.94 in *L. rohita* and *C. mrigala* respectively. The experimental fish ranged the length-weight relationship was calculated based on a sample collected during the study period revealed a strong linear relationship between total length and weight. The value of exponent was observed to be 3.11 for *C. mrigala* that revealed positive allometric growth and 3.04 for *L. rohita* that revealed isometric growth. The mean values of computed condition factor for all specimen of *L. rohita* was 2.12 and *C. mrigala* was 1.91 which indicated that good health condition of the L. rohita and C. mrigala in Sutiapat reservoir situated in kabirdham district in Chhattisgarh.

Keywords: Length-weight relationships, *Labeo rohita*, *Cirrhinus mrigala*, allometric, isometric growth and Sutiapat reservoir

1. Introduction
The length-weight relationship and condition factor are one of the important aspects of fishery management as well as conservation point of view [1-3]. The length and weight of fishes may differ from time to time even the same water body due to a fluctuation of water quality and fish stocks [4]. Studies on length-weight relationship and condition factor have widely riveted the attention of fishery biologists and mainly associated with the assessment of growth rate in the fishes[5]. In view of practical utility this relationship assessing the weight to know the length of fishes or vice versa, growth rate, size at first sexual maturity, spawning season and gonads development of fishes [6-11]. In general, fishes normally do not retain the same shape or body outline throughout their life span and the specific gravity of the tissues may not be the same in capture and culture fisheries [12]. A number of authors have been described length-weight relation and condition factor of different fishes in different locations. A study reported a significant linear relationship between length and weight of *Cirrhinus mrigala* from the river Ganga [13]. Alike isometric growth was observed in *Catla catla* from Gandhi Sagar, Madhya Pradesh [14]. Similarly, the juvenile of *Cirrhinus mrigala* showed isometric growth pattern from the water body in southern Rajasthan [15]. The condition factor rise with increasing the length of *Cirrhinus mrigala* from Sukhna Lake, Chandigarh [16]. The growths of fishes from some different localities are not following the cube Law, where length of the fishes is observed to be higher when compared to weight, hence showed allometric growth. It has also been observed by a number of authors that length-weight relationship in carps does not follow the cube law and value of 'b' is always more than 3 as in *Puntius sarana* from Loni reservoir, Madhya Pradesh [17], *Aristichthys nobilis* from Pakistan [18] and in Indian major carps from Mahi Bajaj Sagar, Rajasthan [19]. The relative conditions factor of the fishes is primarily reliant upon the maturity of gonads, growth and length of *Cirrhinus mrigala* from Allahabad, Uttar

Pradesh [20], *Labeo boga* [21], *Puntius stigma* [22], *Hilsa Ilisha* [23] and *Botia lohachata* [24] from different water bodies in Bangladesh.

In general, Kabirdham district of Chhattisgarh has a number of reservoirs and out of which Sutiapat is one of the important reservoir in terms of economy and livelihood of the local people.

A review of the literature shows that there is no LWR data on these important fish species for that reservoir. Considering those factors, this study has been undertaken to evaluate their LWR and condition factors, by which their sustainable use could be practice.

2. Materials and methods

The Sutiapat reservoir is a medium irrigation reservoir which is located in the Kabirdham district of Chhattisgarh which is about 20 km from district headquarters in Lohara block. The dam is located at latitude 21048'30" and longitude 81002'50" on Silhati, at local tributary of Mahanadi river basin (Table 1).

A total of 350 specimens of *Labeo rohita* and *Cirrhinus marigala* representing all size groups were collected from the landing centre and used to measure total length (cm), standard length (cm) and body weight (gm) of each fish from the commercial fish catch of Sutiapat reservoir during the April to October, 2107.

Table 1: Morphometric Features of Sutiapat Reservoir, Kabirdham, Chhattisgarh

S. No.	Particular	
	Locations: Latitude Longitude	 $21^0$48'30" $81^0$02'50"
1.	Water catchment area	130.75 sq. Km.
2.	Purpose	Irrigation
3.	Average rainfall (inch)	1046 mm.
4.	Maximum depth (m)	28.0 m.
5.	Mean depth (m)	14.0 m.
6.	Length of dam (m)	450 m.
7.	Nature of dam	Earthen Dam
8.	Project	Bhainsbod
9.	Block and district	Sahaspur Lohara, Kabirdham
10.	State	Chhattisgarh

The cube law[12] is widely used to defined length-weight relation of fishes and can be expressed as: $W = aL^b$

Where: W = Weight of fish (gm), L = Total length of Fish (cm) and b = exponent/ regression coefficient

This straight linear relationship was fitted to the logarithmic form: $Ln\ W = Ln\ a + b\ Ln\ L$

Where: a = constant/intercept, b = slope, Ln W = dependent variable (y), Ln L = independent variable (x).

Various workers have investigated body changes by means of condition factor (K) or ponderal index of fishes in different length groups following the equation: $K = (W \times 100) / L^3$

Where: K = Coefficient of condition, W = Whole body weight (gm), L^3 = Standard length (cm).

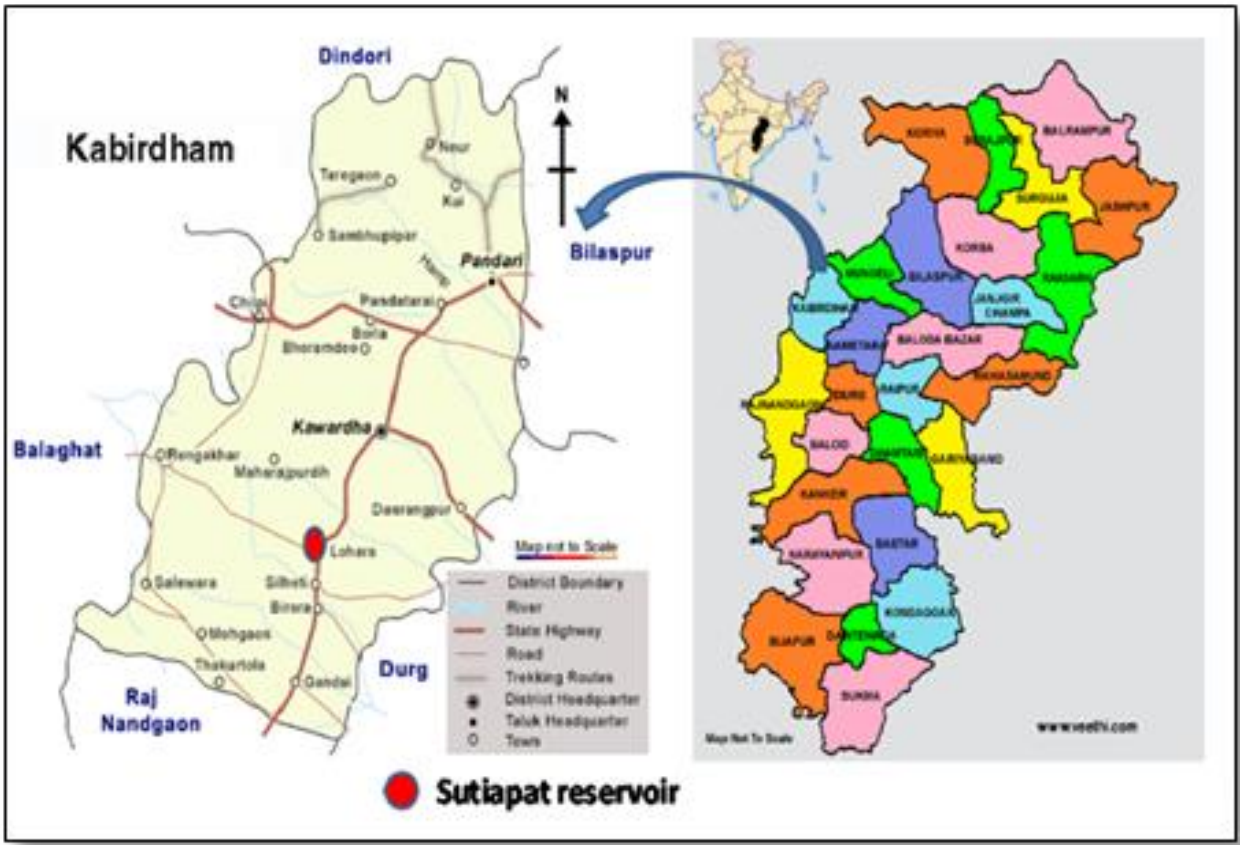

Fig 1: Site map of study area

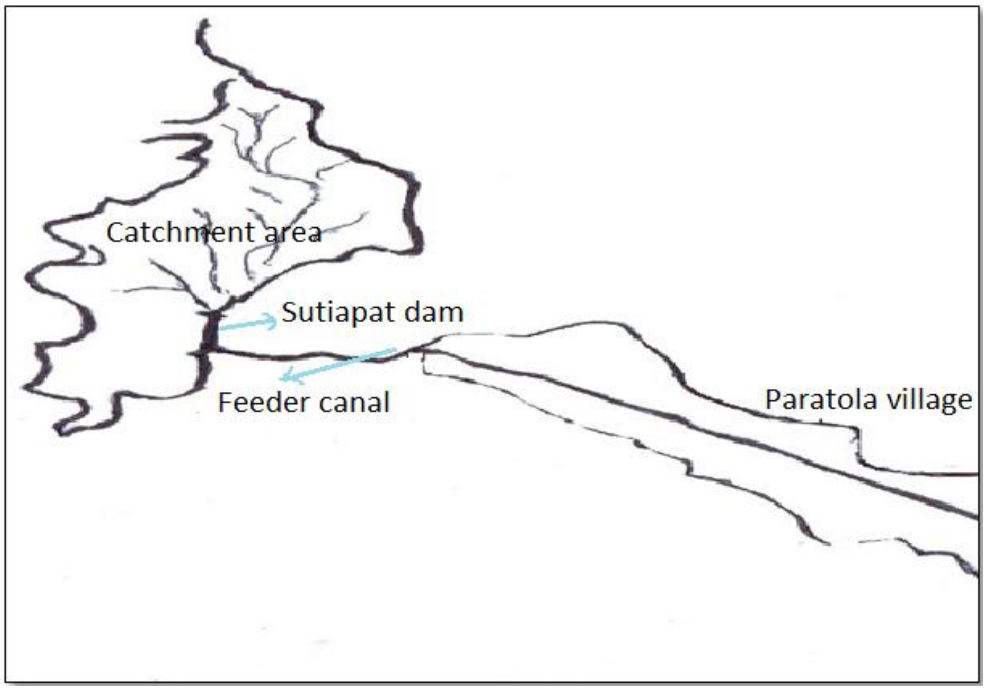

Fig 2: Index map of reservoir

3. Results and Discussion

The fish sampled range between total length 38.30 cm to 62.00 cm and total weight 850.00 gm to 3000.00 gm for *Labeo rohita* and *Cirrhinus mrigala* between 36.50 cm. to 48.00 cm. in total length and 800.00 gm to 1250.00 gm in total weight (Table 2). The coefficient of correlation was 0.96 for *Labeo rohita* and 0.94 for *Cirrhinus mrigala* showing a high degree of correlation. A logarithmic graph drawn from the length and weight data showed a straight linear relationship of both species in that reservoir (Figure 3&4). Condition factor from *Labeo rohita* (2.12) and *Cirrhinus mrigala* (1.91) showed a steady rise during the study period. The observation of *Labeo rohita* and *Cirrhinus mrigala* of Sutiapat reservoir in Chhattisgarh clearly designate that the relationship between weight and length were significant ($p < 0.05$). The regression coefficient (b) was observed 3.046 for *Labeo rohita* and 3.110 for *Cirrhinus mrigala* (Table 2) and advises that the isometric growth ($b = 3.0$) in *Labeo rohita* and positive allometric growth ($b > 3.0$) in *Cirrhinus mrigala*. These outcomes support from earlier studies of fish from different water bodies in different localities [25-27]. A similar study conducted on Indian major carps from Mahi Bajaj Sagar, Rajasthan and observed that significant linear relationship between length and weight of all species and showed positive allometric growth [19]. Alike significant result is showed regarding length-weight of *Catla catla* in Chhirpani Reservoir, Chhattisgarh [28]. Significant linear relation and positive allometric growth are witnessed in fishery of *Catla catla* from Harike wetland, Punjab [29]. The morphometric relationship of Indian major carps were established and reported that the negative allometric growth for *Catla catla*, positive allometric growth for *Labeo rohita* and isometric growth for *Cirrhinus mrigala* in Jaisamand Lake, Udaipur [30]. General equation straight linear curve drawn between total length and weight was similar as *Labeo calbasu* in Rana Partap Sagar, Rajasthan [31] and Indian major carps in river Brahmaputra [32]. The significantly positive allometric growth (3.32) was observed in *Aristichthys nobilis* in Pakistan [18]. Desai described the length-weight relationship of *Cirrhinus mrigala* from Rihand reservoir, Uttar Pradesh and concluded that the deviation in the length-weight relationship on the basis of cube law was applied for fishes [33]. Similarly, *Labeo calbasu* from Jawahar Sagar Dam of Southern Rajasthan [34] and *Pseudambassis ranga* from Wetland of East Kolkata [35] did not follow the cube law precisely because of the value of regression coefficient (b) lower than 3.

The mean values of computed condition factor (K) for all specimen of *Labeo rohita* was 2.12 and *Cirrhinus mrigala* was 1.91. The falling trends of 'K' value by means of an increase of length are conveyed to be a good sign of length by the side of sexual maturity starts [36].

Table 2: Descriptive statistics and estimated parameters of LWR for *Labeo rohita* and *Cirrhinus mrigala*, Sutiapat Reservoir, Kabirdham, Chhattisgarh, India

Species	Sample size (n)	Total Length range (cm)		Total Weight range (gm)		Regression parameters		R^2
		Minimum	Maximum	Minimum	Maximum	a ± SE	b± SE	
Labeo rohita	75	38.30	62.00	850.00	3000.00	-4.392 ± 0.62	3.046 ± 0.16	0.935
Cirrhinus mrigala	75	36.50	48.00	800.00	1250.00	-2.164 ±0.44	3.110 ± 0.23	0.895

a: Intercept, b: Regression coefficient, SE: Standard Error, R^2: Coefficient of determination

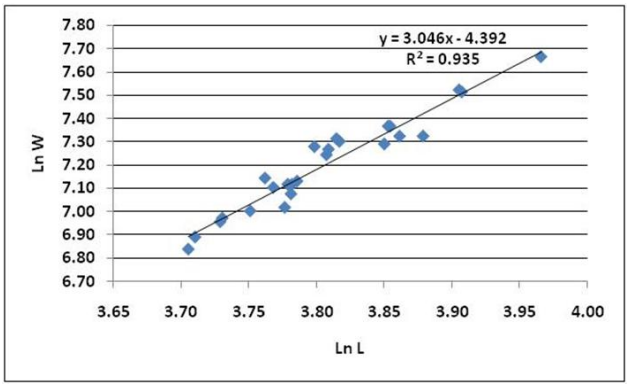

Fig 3: Length-weight relationship of *Labeo rohita* in Sutiapat Reservoir, Chhattisgarh

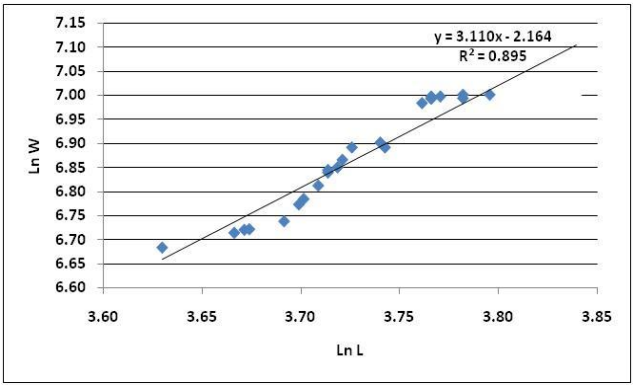

Fig 4: Length-weight relationship of *Cirrhinus mrigala* in Sutiapat Reservoir, Chhattisgarh

4. Conclusion

The study concluded that the significantly higher degree coefficient of correlation between length and weight of fishes and also indicates isometric growth in *Labeo rohita* and positive allometric growth in *Cirrhinus mrigala* from sutiapat reservoir situated in Chhattisgarh. This study provides basic information for fishery managers besides sustainable management in reservoir fisheries.

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