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Length-weight relationship and condition factor of rohu-catla hybrid in Lake Udaisagar, Udaipur, Rajasthan

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Abstract

Rohu-catla hybrid contributes significantly (14.42%) in the total fish landing of lake Udaisagar. The fish attained more weight per unit of length in early age (1-2 years) in the lake thus, showing a linear growth. The correlation coefficient was positive and highly significant ($r = 0.803^{**}$ and 0.748^{**} ; $P < 0.01$) in length groups A (24-29 cm) and C (36-41 cm). The values of condition factor 'K' varied between 1.711 to 2.775. The nearness of the K values to 1.0, in length group C (1.711) and D (1.742) indicates the environment suitability of the lake Udaisagar for good growth of fish. Further, the high value of condition factor (K) in group A (2.775) and B (2.652) indicate higher increase in weight in relation to length. Variations in length-weight relationship between different size-groups could be attributed to the prevailing environmental conditions, available food and space besides, the biological features specific to the species. The later, results into varied growth performance of the fish under study during different age groups.

Keywords: Length- weight relation, Condition factor of rohu-catla hybrid, lake Udaisagar.

1. Introduction

In spite of favourable conditions for high fish growth rate in the state of Rajasthan fish culture has yet not gained required popularity. It is mainly due to inadequate knowledge about growth performance and other related information on culturable fishes especially Indian major carps (IMC), in the specific climate of Southern Rajasthan. In different types of water bodies in this region there is lack of such information except few notable studies by Durve (1976)^[6], Johal and Tondan (1987)^[11], Ujjania (2003)^[22], Sarang (2012)^[20], Bhatt (2014)^[11] and Ingle (2014)^[9]. However, these studies were conducted either on IMC or mahseer. In contrast to this, the present work was attempted to know the length-weight relationship and condition factor of rohu (male) x catla (female) hybrid, popularly known as "Dogla" or "Nadeem". The hybrid has been studied and reported to be better in growth performance than its parent species by some workers. Varghese and Shantharam (1979)^[23] reported better growth of rohu-catla and catla-rohu hybrids over the rohu-mrigal hybrids.

Growth of fish means a change in length or weight or both with increasing age. Growth is generally an increase in size due to conversion of the food matter into the building matter of the body by means of the process of nutrition. Growth of fish is dependent on population density also. Although the relationship between the two is not clearly understood, some effects are clear. Higher densities tend to slow down growth, and low densities tend to hasten it. Growth reflects the adaptive property of the species fast growth resulting in large size affords protection against predators, and is associated with stable food supply. On the other hand, slow growth resulting in small size is an adaptation to meet limited food supplies.

During the life time of a fish, growth characteristics vary at various periods. As far as the linear growth is concerned, it is at a maximum rate during the period preceding the onset of maturity. Once maturity is attained, the growth rate falls. In the event of insufficient food, the growth rate of individuals within a population are so affected that different sizes (lengths) are produced in the same age group.

Weight-length relationships (WLR) are used for estimating the weight corresponding to a given length, and condition factors are used for comparing the 'condition', 'fatness', or 'well-being' (Tesch, 1968)^[21] of fish, based on the assumption that heavier fish of a given length are

in better condition. Both concepts have been used in fisheries research since the beginning of the 20th century. The lake Udaisagar selected for the present study is an old reservoir and is regularly auctioned for fishing by Government of Rajasthan. It is being stocked by the fish contractor with IMC, exotic carps and rohu-catla hybrid in varied quantities. Thus, study of age and growth of this hybrid in Rajasthan waters is an interesting and useful study.

2. Materials and Methods

The field study was performed at the landing center of lake Udaisagar, situated at 73° 47' 0" E Longitude and 24° 33' 0" N latitude, and is 13 km away from the Udaipur city in the East, near Debari village. The lake is having a water spread area of 10.3 sq km fed with Ayad river and is situated on the 'Berach' river system.

2.1 Length-Weight Relationship.

The back calculation technique is useful to determine fish growth in terms of length and weight during each year of life prior to the data collection. The technique is especially useful if no samples were taken prior to a management activity or if only a few fish were sampled afterwards.

The length-weight relationship (LWR) between total length (TL) and body weight (WT) can be determined from logarithm transformed data which were noted on scale envelopes. The parameters 'a', 'n' and 'r' are estimated by linear regression equation. This equation is also referred as the length-weight key.

$$W = a L^b \quad (\text{Biswas, 1993})^{[2]}, \dots\dots\dots (1)$$

$$\log W = \log a + b \log L \quad (\text{LeCren, 1951})^{[14]}, \dots\dots\dots (2)$$

Where,

- W and L = are the variables
- a = Coefficient related to body form or intercept.
- b = Exponent or slope. (n)
- r = Correlation coefficient

2.2 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 Len Cren, (1951).^[14],

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

Where,

W = Observed weight of fish in gm.

L = Total length of fish in cm.

3. Result and Discussion

3.1 Length – weight relationship

To ascertain the length-weight relationship, the fishes selected for the study were grouped into four length (L) groups i.e. A: 24.0 - 29.0 cm, B: 30.0 – 35.0 cm, C: 36.0 – 41.0 cm and D: 42.0 – 47.0 cm. Respectively, the fishes were grouped into four weight (W) groups i.e. A: 300 – 600 gm, B: 601 – 900 gm, C: 901 - 1200 gm and D: 1201 – 1500 gm.

It is seen from (Table 1) that rohu-catla hybrid from lake Udaisagar was primarily dominated by length group B (65.5 %) while the other length groups viz., C, A and D were in the same sequential order, with 27.5, 4.0 and 3 per cent dominance, respectively. Similarly, from (Table 1) it is seen that rohu-catla hybrid of weight group A i.e. 300-600 gm dominated the catch with 62.0 per cent. Whereas, it is followed by group B (601-900 gm), group C (901-1200 gm) and group D (1201-1500 gm) with a per cent contributions of 29.5, 5.0 and 3.5 per cent respectively.

The statistical relationship of total body-length with body-weight of rohu-catla hybrid indicated a positive significant (P < 0.01) correlation for all the length groups (Table 2). It may be noted here that the highest positive correlation (r = 0.803** and 0.748**) were found in length-group A and C respectively followed by length-groups B (r = 0.588**) and D (r = 0.445**). These results also depict that rohu-catla hybrid deviated from Cube law at all the length-groups. The exponent 'n' values for total body-length and body-weight ranged between 1.573 (length group D) and 3.434 (length group C). For other length-groups i.e. A and B, the exponent values (n) were near 2 i.e. 1.808 and 2.018 respectively.

The values of 'a' constant for different length-groups ranged between a minimum of -2.526 in length group C and the highest in the length-group D (0.539) whereas the values of 'a' were -0.034 in group A and -0.361 in group B (Table 2). Fig. 1 shows the graphical representation of relationship and slope between log of total body-length with log of total body weight of rohu-catla hybrid.

3.2 Condition Factor/Ponderal Index (K)

The mean value of condition factor (K) for the four length-groups of rohu-catla hybrid are shown in Table 3. The 'K' value of rohu-catla hybrid ranged between 1.711 and 2.775. The highest being recorded from the length-group A and the minimum from the length group C. Subsequently followed by those of B, and D groups in the order of 2.625 and 1.742 respectively

Table 1: Length and Weight Frequency distribution of rohu-catla hybrid from lake Udaisagar

Groups	Length			Weight		
	(cm)	No. of Observation	Frequency %	(gm)	No. of Observation	Frequency (%)
A	24-29	8	4.0	300-600	124	62.0
B	30-35	131	65.5	601-900	59	29.5
C	36-41	55	27.5	901-1200	10	5.0
D	42-57	6	3.0	1201-1500	7	3.5

Table 2: Correlation of body weight (g) with total body length (cm) of rohu-catla hybrid in different length groups

S.No	Group	Mean L±SD	Mean W±SD	'a' Value	'n' Value	'r' Value
1	A	28.937±1.809	408.125±57.565	-0.034	1.808	0.803**
2	B	33.164±1.676	516.297±89.756	-0.361	2.018	0.588**
3	C	38.021±1.517	804.727±151.014	-2.526	3.434	0.748**
4	D	43.2±1.011	1300±110.679	0.539	1.573	0.445**

** Significant at 1% level of significance

The results pertaining to length and weight frequency distribution of rohu-catla hybrid indicates that there was dominance of length group B (30-35 cm) with 65.5 % frequency followed by group C (27.5%) whereas, weight group A (300-600gm) dominated the catch with a frequency of

62.0 % followed by group B (29.5%). If both the dominating groups of length (B and C) and weight frequency (A and B) are taken together, it indicates that 93.0 % catch measures 30-41cm and 91.5 % catch weigh 300-900 gm.

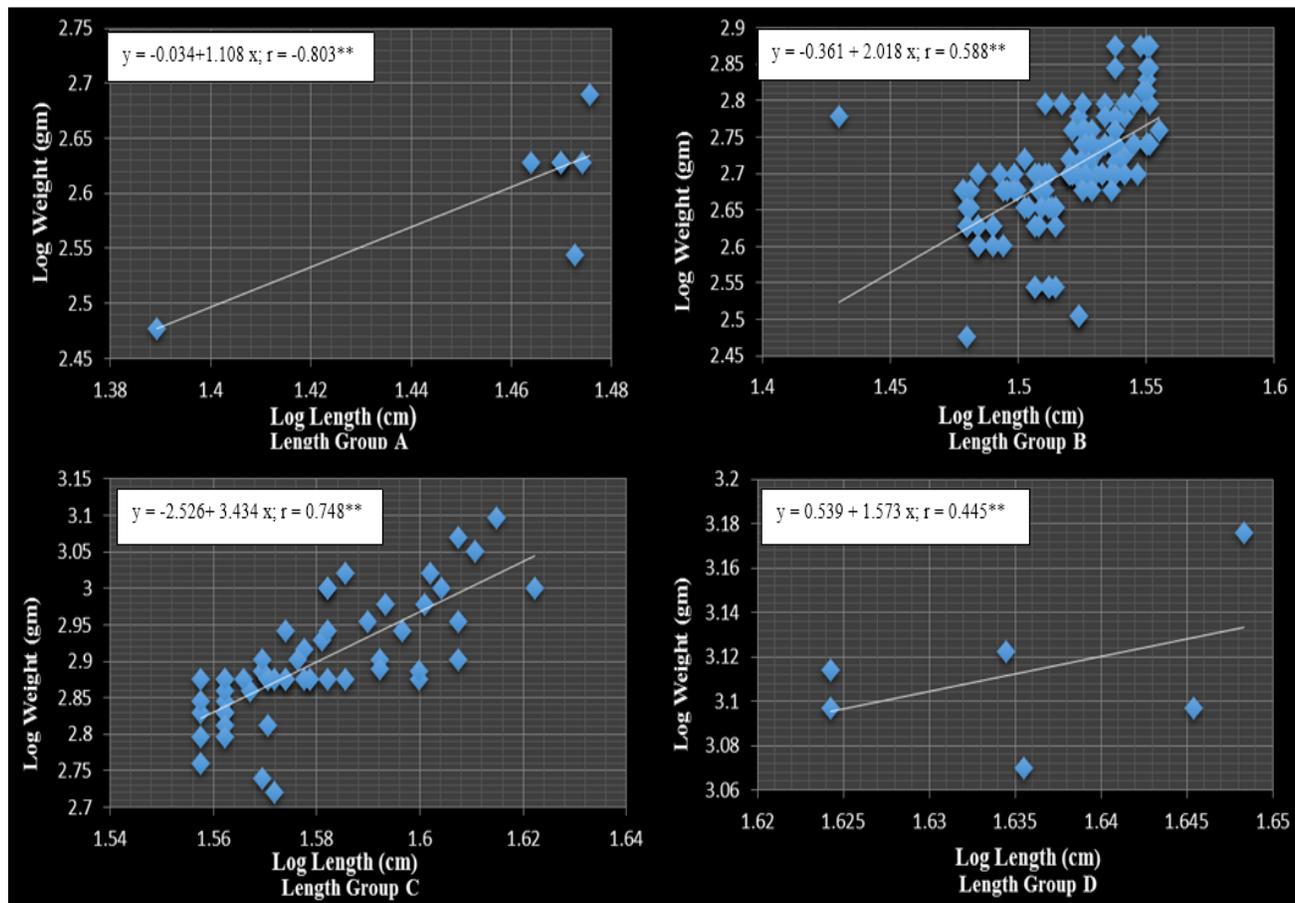


Fig 1: Relationship between log length (cm)-L and weight (gm)-W in different groups of rohu-catla hybrid from lake Udaisagar.

Table 3: Condition factor of rohu-catla hybrid

S. No.	Length groups	Length (cm)	Condition factor (K)
1	A	24-29	2.775
2	B	30-35	2.652
3	C	36-41	1.711
4	D	42-57	1.742

Length-weight relationships provide basic information in fisheries biology and therefore, useful to determine the weight of an individual fish of known length or total weight from length-frequency distribution (Froese, 1998^[7] and Koutrakis and Tsikliras, (2003)^[13]. Jain (2000)^[10] conducted length-weight relationship of *Cirrhinus mrigala* in Silised lake Alwar

and found a dominance of this length group (50-60 cm), (60-70 cm) and (70-80 cm).

Rajkumar (2005)^[16] while studying length and weight relationships of major carps in Daya reservoir observed a dominance of the size group 50 to 60 cm both in *Catla catla* (48.00 %) and *Labeo rohita* (57.8 %).

Parameter 'b' is the exponent of the arithmetic form of the body weight with total body length relationship and the slope of the regression line in the logarithmic. If $b < 3$, then small specimens in the sample under consideration have the same body form and condition as large specimens. If $b > 3$, then large specimens have increased in height or width more than in length, either as the result of a notable ontogenetic change in body shape with size, which is rare, or because most large

specimens in the sample were thicker than small specimens, which is common. Conversely, if $b < 3$, then large specimens have changed their body shape to become more elongated or small specimens were in better nutritional condition at the time of sampling. Carlander (1977) ^[3] demonstrated that values of $b < 2.5$ or > 3.5 are often derived from samples with narrow size ranges.

In the present study, the exponent value 'n' was found to be deviated from 'Cube law' i.e. the values fluctuated from 1.297 to 8.616. Such deviations from 'Cube law' were also observed by earlier workers. Desai and Shrivastava (1990) ^[5] observed an exponent value 'n' of 2.914 for *Cirrhinus mrigala* from Rihand reservoir. Johal and Kingra (1992) ^[12] reported an exponent value varying from 2.752 to 3.545 in three Indian major carps in Rajasthan. Jain (2000) ^[10] reported a high variation of 'Cube law' in catla, rohu, 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 values 'n' in several species of fishes from Chulliar reservoir and reported that in the case of catla and rohu the values of 'n' were 3.353 and 3.113, respectively. According to him, the shifting of exponent value to the higher side of 3 indicates a favourable environment in the reservoir for the growth and well-being of the fish.

Rajkumar (2005) ^[16], observed a variation of 'n' value 2.861 to 3.215 in *Catla catla* and 2.713 to 3.292 in *Labeo rohita* of Daya reservoir, Rajasthan.

In the present study, the observations on morphometric feature of rohu-catla hybrid clearly indicate that in the length-groups A (24-29cm) and C (36-41cm) of the species, the relationship between total body length and body weight were highly and positively significant ($P < 0.01$) with $r = 0.803$ and $r = 0.748$ respectively. (Table 2). However, the results further point out a significant positive relationship between total body-length and body-weight of all the length groups of the rohu-catla hybrid. Such variations in length-weight relationship between different size-groups could be attributed to the prevailing environmental conditions, available food and space besides, the biological features specific to the species.

The exponent values obtained in the present study in respect of rohu-catla hybrid from lake Udaisagar are comparable to those reported earlier by Jain (2000) ^[10] and Ujjania (2003) ^[22] particularly for length group B (30-35cm) and C (36-41cm). However, in group A, B and D there was a negative allometric growth in the rohu -catla hybrid which becomes positively allometric in group C. This connotes the finding of Froese, (2006) ^[7] and Ujjania *et.al.* (2012.)

Jain (2000) ^[10] reported a total-length verses weight relationship in Catla, Rohu, and Mrigala from Siliserh reservoir of Alwar, Rajasthan. He found a positive significant relationship between two parameters $r = 0.896$ in length group 60-70 cm followed by 50-60 cm group ($r = 0.893$) and 70-80 cm ($r = 0.784$). Jain (2000) ^[10] also reported on exponent 'n' values from 2.837 (50-60 cm) to 3.735 (70-80 cm).

Ujjania (2003) ^[20] also attempted to work out length-weight relationship in three Indian major carps namely *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* from Mahi bajaj sagar, Surwania dam and Aasan pond and reported a highly positive significant relationship between standard body-length and body-weight. He reported the variations in the exponent value (n) of *Cirrhinus mrigala* 3.375 (55-65 cm) followed by 2.854 (45-55 cm) and 2.498 (35-45 cm) at different length-groups.

The pooled data indicated the exponent of 3.362 in Mahi Bajaj Sagar.

Condition Factor or Ponderal Index is a physiological indicator of the well-being of any fish living in a given 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 values of 'K' varied from 1.711 to 2.775 for rohu-catla hybrid (Table 3). The nearness of the 'K' values to 1.0, in length group C and D i.e. 1.711 and 1.742 respectively clearly indicates the suitability of food and environment in the lake Udaisagar for good growth of fish in these length groups.

Further, the high value of condition factor 'K' in the present study is an indicator of higher increase in weight in relation to length in the first two length groups i.e. group A (24-29 cm) and group B (30-35 cm). The declining trends of 'K' value with increase of length are reported to be a good indication of length at which sexual maturity starts (Hart, 1946) ^[8]. 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 (Le Cren, 1951) ^[14].

Choudhary *et al.* (1991) ^[4] reported 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) ^[10] in respect of IMC in Seliserh reservoir are comparable and supportive to the results of present study. Jain report a 'K' value of 1.2561, 1.021 and 1.107 in length groups A (50-60 cm), B (60-70 cm), and C (70-80 cm) in *Cirrhinus mrigala*. Ujjania (2003) ^[22] observed the condition factors varying from 1.779-1.965 for mrigala. He also reported that such values of 'K' are indicative of the suitability of the water body for good fish growth. All the results from above studies support the presently made lower observations of 'K' value in rohu-catla hybrid in greater length group in lake Udaisagar.

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