

International Journal of Fauna and Biological Studies

Available online at www.faunajournal.com

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International
Journal of
Fauna And
Biological
Studies

ISSN 2347-2677

IJFBS 2016; 3(4): 19-23

Received: 05-05-2016

Accepted: 06-06-2016

Bhatt Nakul A

Research scholar, Department of
Aquaculture, College of
Fisheries, MPUAT, Udaipur.

Sharma B.K

Professor, Department of
Harvest and Post harvest
technology, College of Fisheries,
MPUAT, Udaipur.

Shwetanshumala

Research scholar, Department of
Aquaculture, College of
Fisheries, MPUAT, Udaipur.

Shah Tarang

Research scholar, Department of
Aquaculture, College of
Fisheries, MPUAT, Udaipur.

Length-weight relationship and condition factor of *Catla catla* in Lake Pichhola, Udaipur, Rajasthan

Bhatt Nakul A, Sharma B.K, Shwetanshumala, Shah Tarang

Abstract

A research into length-weight relationship and condition factor (K) of *Catla catla* was carried out in Lake Pichhola, Udaipur district during the period from November (2015) to March (2016). The *Catla catla* attained more weight per unit of length in early age (1-2 years) in the lake Pichhola thus, showing a linear growth. The correlation coefficient was positive and highly significant ($r = 0.886^{**}$ to 0.580^{**}) in length groups B (61-70 cm) and D (81-90 cm). The values of condition factor 'K' varied between 1.307 to 2.145. The nearness of the K values to 1.0, in length group B, C and D indicates the environment suitability of the lake Pichhola for good growth of fish. Further, the high value of condition factor (K) in group A (2.145) 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.

Keywords: Length- weight relation, Condition factor, *Catla catla*, Lake Pichhola

Introduction

The relationship between body length and weight is of great importance in fishery biology (Sparre *et al.* 1989^[17]; Gulland 1983^[7]). Length-weight relationships are usually calculated through liner regression on log-transformed data (Frota *et al.* 2004^[6]). 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 and research of age and growth of fishes there is lack of such information except few notable studies by Ujjania (2003)^[18], Johal and Tondan (1987)^[11], Durve (1976)^[4], Sarang (2012)^[16], and Ingle (2014)^[9]. The main objective of this paper is to provide the LWR for catla fish from the lake Pichhola. A secondary objective is to analyze the sample size and types of length measure in the estimation of LWR parameter. In contrast to this, the present work was attempted to know the length-weight relationship and condition factor of catla. 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. 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. The Lake Pichhola 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, cat fishes and rohu-catla hybrid in varied quantities. Thus, study of length and weight relationship and condition factor of *Catla catla* in Rajasthan waters is an interesting and useful study.

2. Materials and Methods

The field study was performed at the landing center of Lake Pichhola, situated at 73°31'55" E latitude and 24°34'8" N longitude. The lake Pichhola is drained by upper Berach River.

Correspondence:

Bhatt Nakul A

Research scholar, Department of
Aquaculture, College of
Fisheries, MPUAT, Udaipur.

The upper berach Basin, of the present study is a part of the Gangatic river system which is, one of the major river basin of the country. (Dangi, P., 2010 [2])

2.1 Selection of water body: Lake Pichhola, Udaipur

2.2 Selection of species: *Catla catla* (Catla)

2.3 Body measurement of fish

As per requirement of the study, morphometric data of selected fish such as total length (TL), and body weight (WT) of fish were noted. These data are helpful for further analysis of length weight relationship and condition factor.

2.4 Collection of fish scale

Total 200 fishes were examined and scales taken over the period of 5 months from the fish landing centre of Lake Pichhola. For this purpose randomly selected fishes were used to measure total length (cm) of each fish from the tip of the snout (mouth closed) to the extended tip of the caudal fin using a measuring tape. Body weight was measured to the nearest gram using a top loading single pan weighing balance for all the fish samples collected. At the same time, 5-6 scales were collected from the lateral side below the first spine of the dorsal fin. Intact scales were picked up using coarse forceps and preserved in tough paper envelopes.

2.5 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.

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

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

Where,

W and L = are the variables

a = Coefficient related to body form or intercept.

b = Exponent or slope (n)

r = Correlation coefficient

2.6 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].

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

$$K = \dots\dots\dots$$

L³

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: 41 - 50 cm, B: 61 – 70 cm, C: 71 – 80 cm and D: 81 – 90 cm. respectively, the fishes were grouped into four weight (W) groups i.e. A: 1000-3000 gm, B: 3010-6000 gm, C: 6010-

8000 gm and D: 8010-11000 gm. It is seen from (Table 1) that Catla from lake Pichhola was primarily dominated by length group C (64%) while the other length groups viz., B, D and A were in the same sequential order, with 23%, 11% and 2% dominance, respectively. Similarly, from (Table 1) it is seen that catla of weight group C (6010-8000 gm) dominated the catch with 43.5 percent. Whereas, it is followed by group B (3010-6000 gm), group D (8010-11000gm) and group A (1000-3000 gm) with a percent contributions of 38.5, 16 and 2 percent respectively. The statistical relationship of total body-length with bodyweight of *Catla catla* indicated a positive significant correlation for all the length groups (Table 2). It may be noted here that the highest positive correlation ($r = 0.886^{**}$ and 0.770^{**}) were found in length-group B and C respectively followed by length-groups A ($r = 0.760^{**}$) and D ($r = 0.580^{**}$). These results also depict that *Catla catla* deviated from Cube law at all the length-groups. The exponent 'n' values for total body-length and body-weight ranged between 1.769 (A) and 4.790 (B). For other length groups i.e. C and D, the exponent values (n) were near 2 i.e. 2.862 and 2.878 respectively. The values of 'a' constant for different length-groups ranged between a minimum of -5.085 in length group B and the highest in the length-group A (0.342) whereas the values of 'a' were -1.551 in group C and -1.535 in group D (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 *Catla catla*.

3.2 Condition Factor/Ponderal Index (K)

The mean value of condition factor (K) for the four length groups of *Catla catla* are shown in Table 3. The 'K' value of *Catla catla* ranged between 1.307 and 2.145. The minimum being recorded from the length-group B and the highest from the length group A, subsequently followed by those of C and D groups in the order of 1.391 and 1.444 respectively.

The results pertaining to length and weight frequency distribution of *Catla catla* indicates that there was dominance of length group C (71-80 cm) with 64% frequency followed by group B (23%) whereas, weight group C (6010-8000gm) dominated the catch with a frequency of 43.5% followed by group B (38.5%). 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 [5] and Koutrakis and Tsikliras, 2003 [13]). Rajkumar (2005) [15] 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. 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). Desai and Shrivastava (1990) [3] 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. Rajkumar (2005) [15], 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 *Catla catla* clearly indicate that in the length-groups B (61-70 cm) and C (71-80cm) of the species, the relationship between total body length and body weight were highly and positively with $r = 0.886$ and $r = 0.770$ 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 Catla. 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 *Catla catla* from lake Pichhola are comparable to those reported earlier by Ujjania (2003) [18] particularly for length group C (71-80 cm) and A (41-50 cm). Ujjania (2003)[18] 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 1.307 to 2.145 for *Catla catla* (Table 3). The nearness of the 'K' values to 1.0, in length group B, C and D i.e. 1.307, 1.391 and 1.444 respectively clearly indicates the suitability of food and environment in the lake Pichhola for good growth of fish in these length groups. 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]. All the results from above studies support the presently made lower observations of 'K' value in *Catla catla* in greater length group in Lake Pichhola.

Table 1: Length and Weight Frequency distribution of *Catla catla* from Lake Pichhola

Group	Length			Weight		
	(cm)	No. of observation	Frequency (%)	(gm)	No. of observation	Frequency (%)
A	41-50	4	2	1000-3000	4	2
B	61-70	46	23	3010-6000	77	38.5
C	71-80	128	64	6010-8000	87	43.5
D	81-90	22	11	8010-11000	32	16

Table 2: Correlation of body weight (g) with total body length (cm) of *Catla catla* from Lake Pichhola

No	Group	Mean L±SD	Mean W±SD	'a' Value	'n' Value	'r' Value
1	A	41.3±1.816	1500±165.200	0.342	1.769	0.760**
2	B	61.9±2.239	3100±853.4	-5.085	4.790	0.886**
3	C	71.1±2.714	5000±926.029	-1.551	2.862	0.770**
4	D	81.1±1.367	7700±755.361	-1.535	2.878	0.580**

** Significant at 1% level of significance

Table 3: Condition factor of *Catla catla* from Lake Pichhola

No.	Length group (cm)	Condition factor (K)
1	41-50 (A)	2.145
2	61-70 (B)	1.307
3	71-80 (C)	1.391
4	81-90 (D)	1.444

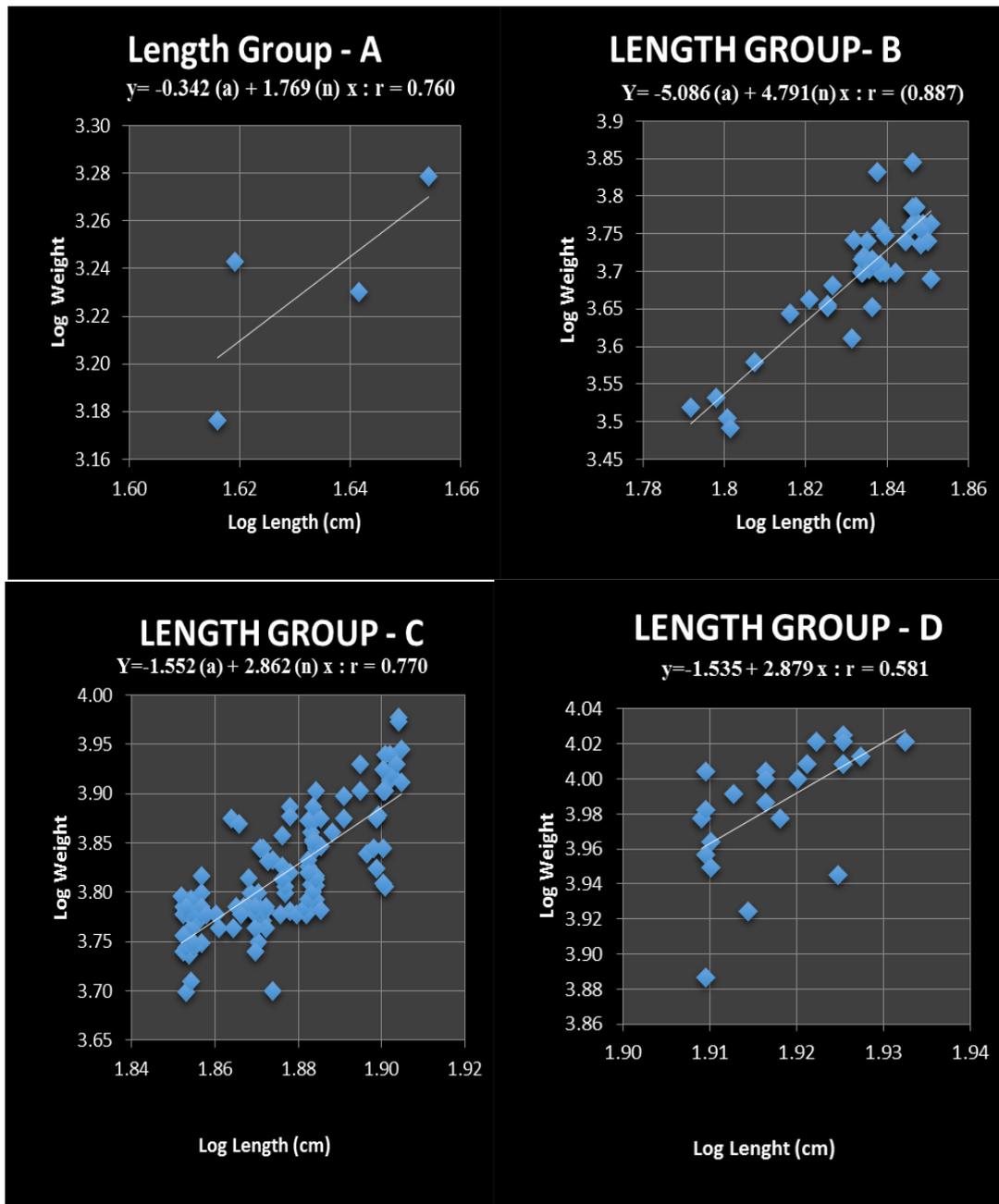


Fig 1: Relationship between log length (cm)-L and weight (gm)-W in different groups of *Catla catla* from Lake Pichhola

4. Acknowledgements

Author are highly thankful to Dean, College of Fisheries, Maharana pratap University Agriculture and Technology, Udaipur for providing all the facilities required to perform proposed research work. We accord our humble thanks to Dr. Vimal Sharma, Ex. Dean, Dr. L. L. Sharma, Ex. Dean College of Fisheries, and Dr. N. C. Ujjania (Prof. Aquatic Biology, Surat, Gujarat) for their help, cooperation, valuable suggestion during the course of this experiment.

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