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Growth and condition of Indian major carp (*Catla catla* Ham., 1822) in perennial small water bodies of south Gujarat (India)

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ABSTRACT

Fish growth is a significant factor in fish production and is directly related to the income of fish farmers. Thus, in the present study, it is aimed to determine the growth status of the Indian major carp (*Catla catla* Ham. 1822) at Keliya reservoir (Gujarat). The morphometric measurements (total length and weight) were taken from 597 fish specimens that were randomly collected from commercial catches between November 2021 and March 2022. During the study, the total length ranged from 25.00 to 46.00 cm (34.41 ±0.16 cm), and the weight ranged from 206.00 to 1525.00 g (528.29 ±8.62 g) of fish was recorded. The length frequency of fish shows that the population was dominated by the length group 30-35 cm (307), followed by the length group 35-40 cm (170), 25-30 cm (75), 40-45 cm (41) and 45-50 cm (4). The total length and weight variables were used to calculate the length-weight relationship and condition factor. The value of the correlation coefficient (r^2) was 0.906, showing a positive relationship between the variables, and the regression coefficient (b, 3.164±0.041 at 0.05 CI, which fulfilled the 'cube law' and indicates positive allometric growth of the studied fish in earthen ponds. The mean value of condition factor (K) for length groups A (25-30 cm), B (30-35 cm), C (35-40 cm), D (40-45 cm), E (45-50 cm) and pooled population were 1.26±0.02, 1.3 ±0.01, 1.25 ±0.01, 1.33 ±0.02, 1.39 ±0.09 and 1.24±0.01 respectively, which indicated that the condition of fish was good. The aquatic environment was conducive for fish survival in the studied water body.

Keywords: Keliya reservoir, Fish growth, Length-weight relationship

Introduction

The relationship between morphological characteristics of fish is imperative from various perspectives, including behaviour, ecology, conservation, evolution, and aquatic resource management (Ujjania et al., 2012; Ujjania et al., 2013; Başusta et al., 2014; Kalhoro et al., 2015). Information on morphometric characteristics (total length and weight) plays a crucial role in fishery biology. It is used to assess the general well-being (Froese et al., 2011), comparative growth studies (Moutopoulos & Stergiou, 2002), biomass (Adarsh & James, 2016), ecosystem modelling (Kulbicki et al., 2005), reproductive history (Kara & Bayhan, 2008), life history (Shah et al., 2013; Ferdaushy & Alam, 2015), and growth and condition of fish (Froese, 2006; Ujjania et al., 2022). Similarly, these reflect the physiological condition of the fish and are influenced by gonadal development, organic reserves, the presence or absence of food in the gut, and food availability, as well as environmental variability in the surrounding water body (Nikolsky, 1969). The length and weight of fish are commonly used in fisheries sciences to estimate the mean weight of a fish stock from the known length of the fish group in a given water body (Gupta & Banerjee, 2015), by establishing a precise mathematical equation between length and weight. Moreover, the statistical relationships among morphometric measurements i.e. length and weight of fishes are significant for fish biologists (Mustafa & Brooks, 2008) and fish taxonomists (Simon et al., 2010) that is helpful too to determine some aspects of fish population dynamics (Adeyemi et al., 2009) like age structure and growth pattern i.e., allometric or isometric (Quist et al., 2012). When the fish growth was isometric, that implies the length and weight are growing to follow the cube law (i.e. value of 'b' equal to 3), while it was allometric that depicted either the length or weight of fish is not followed the cube law (i.e. value of 'b' more than 3). The condition factor (K) is an indirect morphological indicator commonly used by fish growers and biologists to estimate fish growth. It is an index of feeding intensity and growth (Fagade, 1979), revealing information on the biological state of fish, including their well-being (Abowei, 2010). Moreover, it also reveals the conduciveness of the water body for fish growth and survival (LeCren, 1951). It has also been noted that the condition factor helps to evaluate significant changes in body shape among different fish species (Froese, 2006). Studies on the length-weight relationship and condition factor of Indian major carps, including Calta, were carried out by Singh and Kaur (2015), Rajput and Wast (2021), and Ujjania et al. (2023). Significant linear relationship between the total length and weight of catla from Sukhna Lake, Chandigarh (Johal & Tandon, 1983). Although, catla contributing major portion of the fish catch in these small water bodies but such essential information on the length-weight relationship and the condition factor of this fish from various large water bodies of different geographical regions of the world is available but data is scarce on a small perennial aquatic environment, which may be used for comparative growth assessment of fish and useful for fisheries stakeholder including fish biologist and fish farmers. Thus, the present study was conducted to describe the length-weight relationship and condition factor of the Indian major carp (Catla catla, Ham., 1822) from a small, perennial water body in south Gujarat.

Materials and Methods

Keliya reservoir was constructed across the River Kharera, a tributary of the River Kaveri, near the village Keliya, Taluka Vansda, district Navsari of Gujarat state (India). It is a freshwater artificial reservoir with the primary purpose of irrigation and flood control. Additionally, the local people use it for fish culture. The maximum height of the dam wall is 28.10 m, and the maximum length is 814.00 m (Table 1 and Figure 1).

The morphometric data, including length and weight of 597 fish specimens, which were randomly collected from the commercial catches during the fishing year 2021-22 (November 2021 to March 2022). The total length (snot tip to caudal fin end) was measured by measuring the tail, whereas the body weight (WT) of the fish was measured with the help of a single pan balance. The total length and weight of fish are used for further calculations, such as the length–weight relationship and condition factor. The length-weight key and parabolic equation ($W = a\ L^b$) of Froese (2006) and (Log w = log a + b log L) of Pauly (1983) were used for the length-weight relationship from log-transformed data of length and weight (W = weight of fish, L = length of fish, a = intercept and b = exponent). The condition factor (K) was calculated using the following equation ($K = w/L^3$, where w is the weight and L is the length, in meters, and the exponent is 100, as per Fulton (1902). The graphical presentation and statistical analysis were performed using MS Excel 2010.

Table 1. Morphometric details of the studied water body (Keliya reservoir) in south Gujarat

S.N.	Description	Details
1.	State	Gujarat
2.	District	Navasri
3.	Taluka	Vansda
4.	Village	Keliya
5.	River	Kharera tributary of River Kaveri
6.	Name of reservoir	Keliya reservoir
7.	Type of Dam	Earthen dam
8.	Construction year	1983
9.	Latitude	20° 68' 98" to 20° 71' 18" N
10.	Longitude	73° 27' 78" to 73° 29' 73" E
11.	Catchment area	27.58 Sq. km
12.	Area (FRL)	3.18 Sq. km
13.	Depth at FRL	113.40 m
14.	Minimum water level	98.10 m
15.	Maximum water level	115.79 m
16.	Average annual rainfall	1970 mm
17.	Length of Dam	814 m
18.	Height of Dam	28.1 m

Results and Discussion

In the present study, the total length minimum (25.00 cm), maximum (46.00 cm) and mean (934.41 ±0.16 cm), while the weight minimum (206.00 g), maximum (1525.000 g), and mean (528.29 ±8.62 g) of the studied fish were measured (Table 2). The length data of the fish were distributed in different length groups, as described in table 2 and figure 2. which show that length group B was the most dominant (307, 51.4%), followed by length group C (170, 28.5%), A (75, 12.5%), D (41, 6.9%), and E (4, 0.7%). Figure 3 shows a straight line, with a correlation coefficient (r^2) of 0.91. The correlation coefficient depicted a strong, positive, and significant linear relationship between the total length and weight of the studied fish. The value of the growth coefficient (b) was 3.16 ±0.041 at 0.05 CI (Figure 3), which is more than 3.0 and resulted in positive allometric growth of the studied fish in Keliya reservoir. Findings depicted that either the length or weight of fish does not follow the cube law, i.e. weight is slightly more than the required normal weight of the fish. Froese (2006) also reported that the value of 'b' is less than 3.0, and the body shape of the fish specimen is elongated. A similar growth coefficient for Catla catla was reported as 3.2 from Mahi Bajaj Sagar reservoir (Ujjania et al., 2012), 3.22 from Pakistan (Ishtiaq & Naeem, 2016) and 3.2 from Harike wetland, Punjab (Singh & Kaur, 2015), that are in agreement with the findings of the present study. Rajput and Wast (2021) reported very high value of growth coefficient (5.0) for catla in Morvan dam (Madhya Paresh) while negative allometric growth (1.5-2.17) for catla was reported by Sachidanandmurthy et al. (2013) in Mysure Lake and Negi (2013) was reported isometric growth for Indian major carp rohu (3.0) from fishpond Roorkee, Uttarakhand (India).

Table 2. The length, weight and condition factor measurements of catla in the studied water body

Length group (TL, cm)		n	Total length (cm)			Weight (g)					Condition factor (K)			
			Min.	Max.	Mean	SE	Min.	Max.	Mean	SE	Min.	Max.	Mean	SE
25-30	A	75.00	25.00	30.00	28.63	0.14	206.00	403.00	296.84	6.05	0.94	1.64	1.26	0.02
30-35	B	307.00	30.50	35.00	32.92	0.08	222.00	756.00	437.85	4.55	0.76	2.10	1.22	0.01
35-40	C	170.00	35.50	40.00	37.39	0.10	314.00	940.00	654.55	7.43	0.67	1.60	1.25	0.01
40-45	D	41.00	40.50	45.00	42.38	0.21	807.00	1521.00	1014.41	22.95	1.15	1.67	1.33	0.02
45-50	E	4.00	45.50	46.00	45.88	0.13	1185.00	1525.00	1338.00	87.67	1.23	1.57	1.39	0.09
Pooled		597.000	597.00	25.00	46.00	34.41	0.16	206.00	1525.00	528.29	8.62	0.67	2.10	1.24

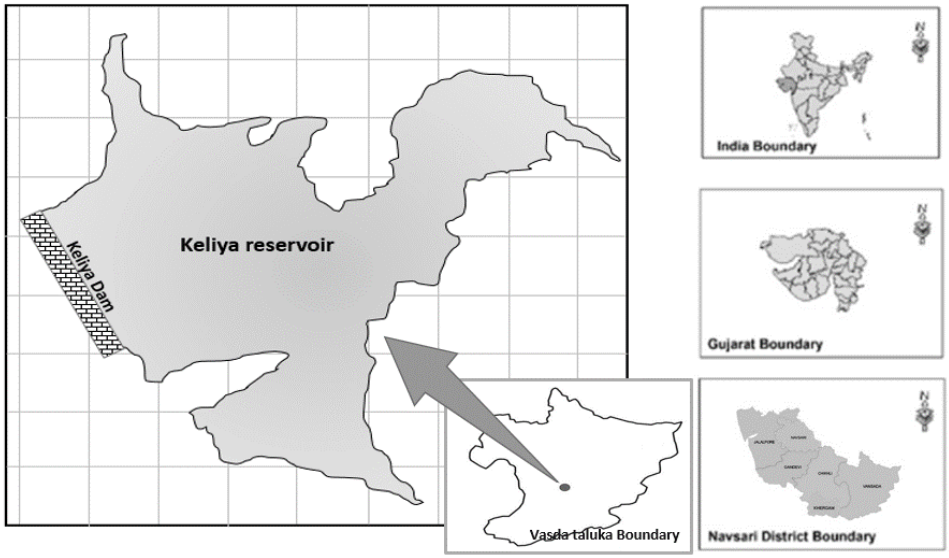

Figure 1. Map of study area (Keliya reservoir, Gujarat)

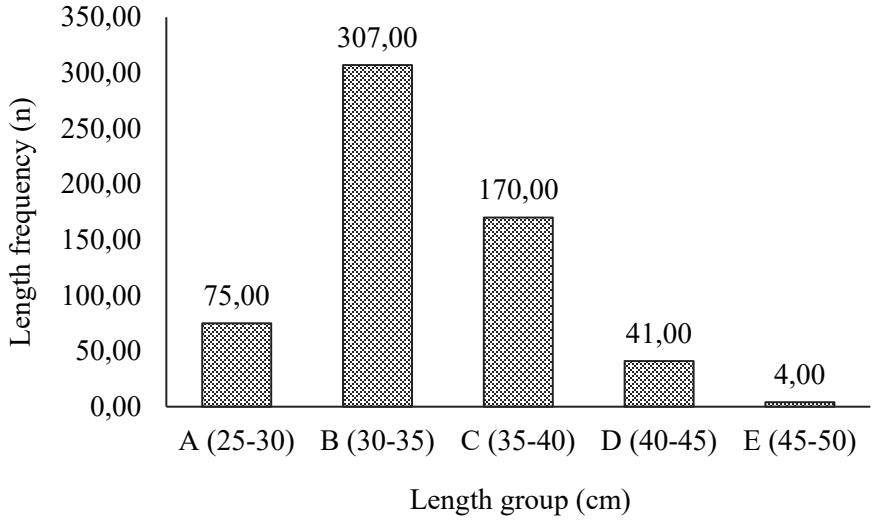

Figure 2. Length frequency distribution of catla in the studied water body

The range and mean of condition factor (K) for length group A (0.94-1.64 and 1.26 ± 0.02), for length group B (0.76-2.10 and 1.22 ±0.01), for length group C (0.67-1.60 and 1.25 ±0.01), for length group D (1.15-1.70 and 1.33 ±0.02), for length group E (1.13-1.57 and 1.39 ±0.09) and 0.67-2.10 and 1.24 ±0.01) for pooled population of studied fish was noted (Table 2). The condition factor (K) for different length groups and the pooled population was noted to be greater than 1.0, indicating the good condition of the fish in the studied aquatic environment. Similar recommendations were also given by Carlander (1977) and Williams (2000). The condition factor decreases with an increase in length (Bakare, 1970; Fagade, 1979) and affects the reproductive cycle in fish (Welcome, 1979). The value of condition factor (>1.0) was reported by Ujjania et al. (2012), Ujjania et al. (2013), Singh et al. (2015), Ishtiaq and Naeem (2016), Balai et al. (2017), Khalid et al. (2020) and Ujjania et al. (2023) for catla, which concluded good condition and conducive environment of the water body.

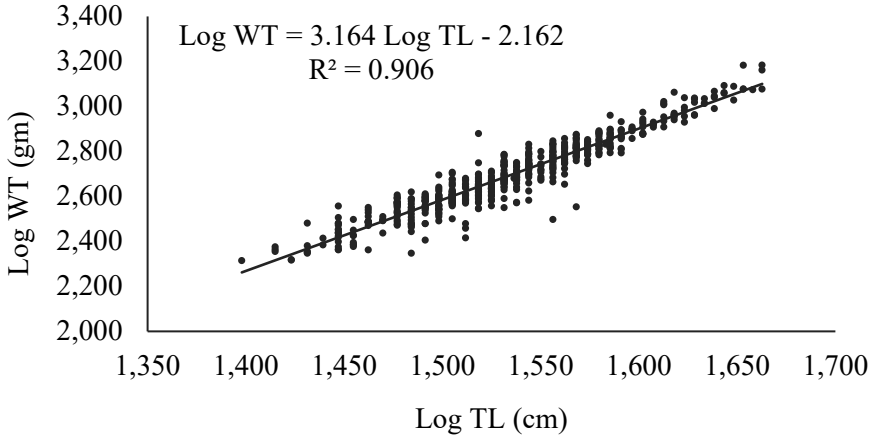

Figure 3. Length-weight relationship of catla

Conclusion

The present study elucidates the length-weight relationship and condition factor of *Catla catla* (Hamilton, 1822) from Keliya Reservoir, a small perennial water body. The findings of the present study suggest that a significant, linear, and positive relationship exists between the length and weight variables. The growth of fish was positive allometric (b = 3.16 ±0.041 at 0.05 CI), and the high value of the condition factor indicates better dwelling conditions and the optimum environmental condition of Keliya reservoir for fish growth and survival. Thus, it is suggested that we explore and manage the water body to enhance fish production quality, potentially. The findings of this study may serve as a baseline for understanding the growth status and condition of catla, which would be helpful for management and conservation practices in fisheries.

Compliance with Ethical Standards

Conflict of interest: The author(s) declare no actual, potential, or perceived conflict of interest for this article.

Ethics committee approval: Ethical approval was not required for this study.

Data availability: The data will be made available upon request.

Funding disclosure: -

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Disclosure: -

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