

Morphometric analysis of fish, *Labeo rohita* in Lucknow, Uttar Pradesh, India

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Abstract

A study on morphometric characters of Indian Major Carp- *Labeo rohita* was conducted and the fish were collected from the fish markets of Lucknow. *Labeo rohita*, commonly known as rohu is a species of fish that belongs to the family Cyprinidae and the order Cypriniformes. It is a warm water teleost and primarily feeds as a column feeder herbivore. Ten morphometric characters, length-weight relationship of *Labeo rohita* were studied. The morphometric measurements like total length, standard length, head length, snout length, body depth, eye diameter, pre-dorsal length, pre-pelvic length, pre-pectoral length and caudal length and body weight were recorded. The descriptive statistical parameters and correlation coefficient were analysed with independent and dependent variables. The morphometric character showed gradual increase in the body length and weight. A positive correlation has been observed between total length and other morphometric characters like standard length, head length, snout length, body depth, eye diameter, pre-dorsal length, pre-pectoral length, pre-pelvic length, caudal length. The value of 'b' of the length-weight equations is 3.949 which suggest that fish possess positive allometric growth.

Keywords: Morphometric characters; Total length; Body weight; Fins

1. Introduction

Morphometric study is the basic fundamental tool to know the development of organisms, growth, variations and structure of population characteristics of a fish [17]. Morphometry is the study of geometrical form of organisms which shows differences in growth and maturity patterns which are sensitive to environmental changes. The morphometric analyses of fishes are very important for the study of biology of fishes and it helps in determining the relationship between various parts of the body. A change in the relative growth of the various parts of body in fishes occurs at different stages of life cycle and notably at sexual maturity [4]. With the increase in total length, growth of other body parts shows proportionally positive increase. Therefore, morphometric measurements and the statistical relationship among them are necessarily for taxonomic study and growth variability in fishes [24]. The study of the morphometric traits is one of the most commonly used and cost-effective method and it is essential for the identification of fish species and their habitat.

The morphometric relationship between various body parts of fish can be used to show possible differences between separate unit stocks of the same species [16]. To determine the length-weight relationship, length measurements are used in fishes because it can be obtained under a large range of circumstances than weight measurements [19]. Fishes adapt themselves by making necessary morphometric changes as they are very sensitive to environmental changes [11]. Fishes indicate greater variation in morphological characters both within and between populations as compared to other vertebrates [5].

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Fishes are cold blooded, aquatic, marine or freshwater and jaw bearing vertebrates. They are characterized by the presence of streamlined bodies, covered with scales. In fish's gills are present for respiration and paired fins for swimming. They belong to superclass Pisces. Fishes are very important source of dietary animal protein.

Common name of *Labeo rohita* is rohu and it belongs to family Cyprinidae, order Cypriniformes. It's a warm-water teleost and column feeder herbivore. It can be identified by depressed snout, thick lips. *Labeo rohita* are mainly found in the rivers of northern and central India and in the last years it is also found in neighbouring countries such as Myanmar, Nepal, Bangladesh and Pakistan and in some of the rivers of Peninsular India [6, 9]. It mainly lives in clean water and respire by means of gills. It is a bottom feeder but it comes to water surface, to take air into the air bladder. Fertilisation takes place externally in water.

Body colour of rohu is greying or blackish on the back and silvery on the sides of the body and also on the belly. The maximum reported age of *Labeo rohita* is 10 years [15] and maximum length of 200cm can be attained and the maximum weight of 45 kg [8].

Body of rohu is divisible into head, trunk and tail. Snout is depressed and short. Mouth is sub terminal. At the corners of mouth thread like small, sensory maxillary barbels are present. Pair of small nostrils are present on the snout dorsally. Eyes on head are without eyelids but they are protected by a transparent protective membrane. Behind the eyes a large bony gill cover or operculum is found in rohu.

The aim of the present study was to find out the morphometric characters of Indian Carp- *Labeo rohita* collected from different fish markets in Lucknow, Uttar Pradesh. The specimens of various sizes were collected for morphometric study of *Labeo rohita*. Mean, range, range difference, standard deviation, correlation coefficient and regression equation between total length verses all other morphometric characters of *Labeo rohita* were analysed.

2. Material and methods

2.1. Study Area

The sufficient numbers of fish specimens of *Labeo rohita* were collected from fish markets of Lucknow like Naveen Fish Market in Dubagga, Kaiserbagh Fish Market and Telibagh Fish Market.

2.2. Fish Sample Collection

The specimens of variable sizes were collected from the fish markets and were brought to the laboratory in fresh form and preserved in 10% formalin. The body component measurements were taken by using scale and body weight of fishes were measured after removing water using blotting paper on a balance. Readings of all morphometric characters were obtained for each fish collected. All morphometric characters were measured in centimeter and weight in gram. Specimens of *Labeo rohita* were identified up to species level by Srivastava [23]. The growth rate of different morphological parts of body of *Labeo rohita* in relation to its total length was studied.

2.3. Morphometric Characters

The morphometric measurements such as total length, standard length, head length, snout length, eye diameter, pre-dorsal length, pre-pectoral, pre-pelvic length, body depth, caudal length was measured in centimeters (Table 1 and Fig 1).

2.4. Statistical Analysis

Statistical analyses such as mean, range, range difference, standard deviation, regression equation and correlation coefficient have been calculated. The computer software Microsoft Office Excel was used for all the statistical values, mean, range, standard deviation, correlation coefficient, regression analysis and charts. The regression equation has been used for morphometric measurements by the formula:

$$Y = a + bX$$

Where 'Y' is the dependent variable such as standard length, body depth, head length, etc. 'a' is a constant value to be determined and 'b' is the regression coefficient and 'X' is the independent variable such as total length.

The length-weight relationship was determined by the equation of $W = aL^b$ [18] where W is total weight (expressed in g), L is total length (expressed in cm), a is intercept i.e., coefficient related to the body, and b is slope. The growth pattern is isometric when the value of $b = 3$ and positive allometric, when the value of b is more the 3 and negative allometric when the value of b is less than 3 [1].

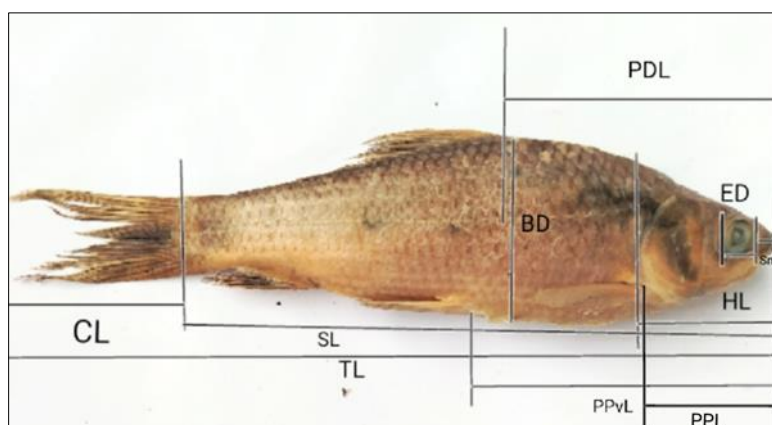


Figure 1 Morphological parameters of *Labeo rohita* [TL (Total length), SL Standard Length), HL (Head Length), SnL (Snout length), ED (Eye diameter), PDL (Pre-dorsal length), PPvL (Pre-pelvic length), PPL (pre- pectoral length), BD (Body depth), CL (Caudal length)]

Table 1 Morphometric parameters of *Labeo rohita*

| S.no. | Parameters | Description |
|-------|---------------------------|--|
| 1 | Total Length (L) | It is a measurement of body length from the tip of the snout to the end of the caudal fin. |
| 2. | Standard Length (SL) | Length from the tip of the snout to the fork of the tail. |
| 3. | Head Length (HL) | Length of from snout to the posterior part of operculum. |
| 4. | Snout length (SnL) | Length is measured from the tip of the snout to the most anterior part. |
| 5. | Eye diameter (ED) | Maximum length of eye orbit from one margin to other. |
| 6. | Pre-dorsal length (PDL) | Length from snout to the origin of the dorsal fin. |
| 7. | Pre-pectoral Length (PPL) | Length from snout to the origin of pectoral fin. |
| 8 | Pre-pelvic length (PPvL) | Length from snout to the origin of pelvic fin. |
| 9. | Body depth (BD) | Maximum vertical distance between dorsal and ventral margin of the fish body. |
| 10. | Caudal length (CL) | Total length- Standard Length |

3. Results and discussion

A total of 25 specimens ranging from 16-30cm in total length and 75g-155g in were taken for the study of morphometric characteristics. Ten morphometric characters were studied during the present course of study. Different morphometric characters which are expressed in the percentage of total length of fish have been taken for statistical analysis like mean, standard deviation, range, range difference, correlation coefficient and regression equation (Table-2 and Fig. 2-5).

The minimum and maximum total length was 16cm and 30cm. On the basis of above observations, it can be concluded that there is a positive correlation between all the parameters. Linear relationship has been observed between all the independent and dependent characters (Fig. 1-4). The independent variable such as total length was taken on x-axis whereas dependent variable such as standard length, snout length, head length, etc. on y-axis and it was observed that

significant correlation exist in standard length- total length (SL-TL), head length- total length (HL-TL), eye diameter-total length (ED-TL), pre-dorsal fin length- total length (PPL-TL), pre-pelvic fin length-total length (PPvL-TL), Body depth-total length (BD-TL) and caudal length-total length (CL-TL). The correlation coefficient was maximum (0.977) in standard length-total length (SL-TL) and minimum (0.845) in eye diameter-total length (ED-TL).

The values of b of the length-weight equations is 3.949 which suggests that fish possess positive allometric growth. The high correlation coefficient 'r' value (r= 0.842) indicated that the length and weight of *Labeo rohita* were highly correlated. Scientist have reported the value of 'b' for *S. niger* as 3.014, 2.977 and 2.974 in Manasbal lake, Dal Lake and Anchar lake respectively [26].

Table 2 Mean, Standard Deviation, Range, Range difference, Correlation coefficient (r) and Regression equation (Y=a+bX) between different morphometric characters of *Labeo rohita*

| S.no. | Parameters | Mean | S.D. | Range | Range Difference | Correlation coefficient | Regression equation |
|-------|---------------------|-------|-------|----------|------------------|-------------------------|---------------------|
| 1. | Total Length | 23.05 | 9.98 | 30-16 | 14 | - | - |
| 2. | Standard Length | 18.27 | 7.21 | 23-12.3 | 10.7 | 0.977 | Y=1.885+0.710X |
| 3. | Head Length | 5.17 | 2.68 | 7-3.2 | 3.8 | 0.955 | Y=-0.410+0.242X |
| 4. | Snout Length | 1.47 | 0.98 | 2.3-0.8 | 1.5 | 0.970 | Y=-0.749+0.096X |
| 5. | Eye Diameter | 0.68 | 0.35 | 1-0.5 | 0.5 | 0.845 | Y=-0.071+0.032X |
| 6. | Body Depth | 5.51 | 2.26 | 7-3.8 | 3.2 | 0.921 | Y=0.885+0.200X |
| 7. | Pre-dorsal Length | 8.60 | 3.60 | 11.1-6 | 5.1 | 0.965 | Y=0.902+0.334X |
| 8. | Pre-pelvic Length | 8.98 | 3.39 | 11.1-6.2 | 4.9 | 0.958 | Y=1.754+0.313X |
| 9. | Pre-pectoral Length | 4.17 | 2.05 | 6.2-3.1 | 3.1 | 0.907 | Y=-0.657+0.209X |
| 10. | Caudal Length | 4.77 | 2.68 | 7.2-2.8 | 4.4 | 0.902 | Y=-2.023+0.294X |
| 11. | Body weight | 129.8 | 18.67 | 155-75 | 80 | 0.842 | Y=38.729+ 3.949X |

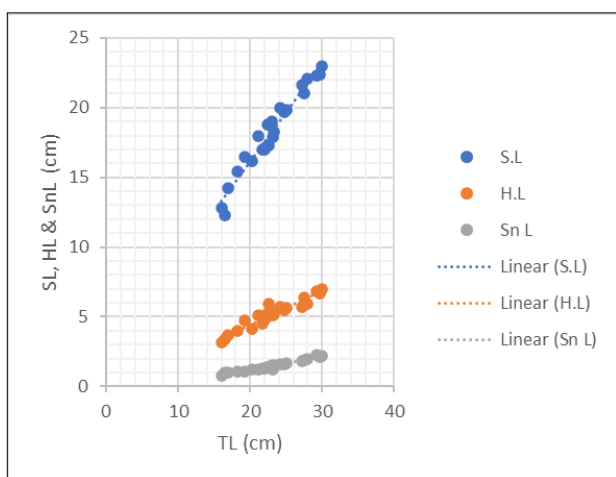


Figure 2 Relationship between Total Length of the fish (TL) with Standard Length (SL), Head Length (HL) and Snout Length (SnL) in *Labeo rohita*.

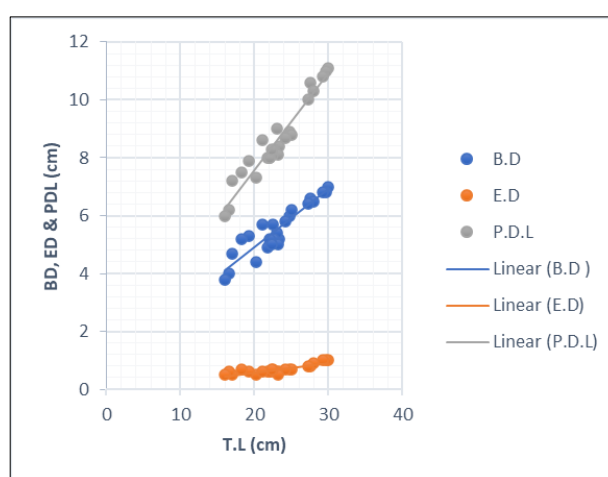


Figure 3 Relationship between Total Length of the fish (TL) with Length of Body Depth (BD), Eye Diameter (ED) and Pre-dorsal length (PDL) in *Labeo rohita*

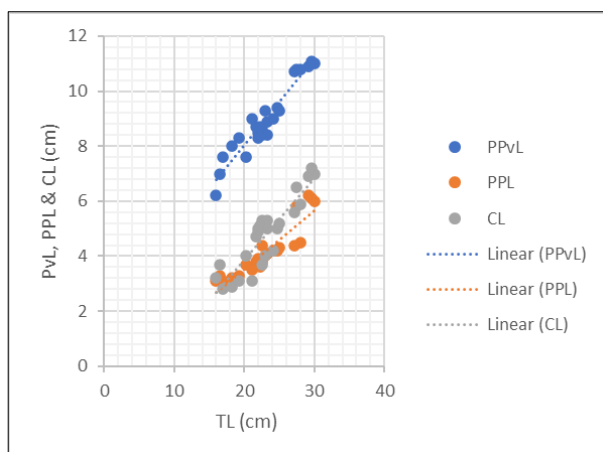


Figure 4 Relationship between Total Length of the fish (TL) with Length of Pre-Pelvic Length (PPvL), Pre-pectoral Length (PPL) and Caudal Length (CL) in *Labeo rohita*

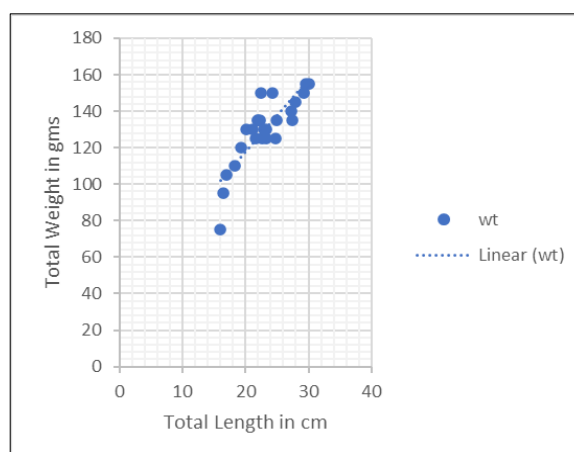


Figure 5 Length-weight relationship of *Labeo rohita*

It has been observed that characters like standard length, snout length, pre-dorsal length in relation to total fish length shows high value of correlation coefficient and characters like head length, pre-pelvic length, body depth show moderate correlation coefficient (Fig.2-5). The characters like eye diameter, pre-pectoral length, caudal length show least correlation coefficient.

Dube and Dubey observed high correlation coefficient between total length and head length, snout length, caudal length, body depth and low value of correlation coefficient between total length and caudal length and eye diameter in *Tor tor* from Narmada River [7]. Johal showed standard length as most correlated part of body in *Tor putitora* from Gobindsagar [13] whereas Nautiyal showed post-dorsal length as the most correlated body part [21]. Bhatt showed that the eye diameter as a least correlated variable and the results are comparable with the present studies [3]. Johal reported that almost all the morphometric characters show high degree correlation coefficient [14].

Fishes adapt themselves by changing necessary morphometric characters as they are very sensitive to environmental conditions. Morphological characters in fishes show high tolerance to changes in environmental conditions, such as abundance of food, temperature and salinity [2, 25]. Fishes adjust themselves according to the environmental condition by adapting different adaptations to improve their sustainability [20]. It is known that different fish populations exhibit differences in their morphometric characters [12].

The high value of parameter b also indicates the overall condition of the fish in terms of appetite and gonad content. The weight of fish increases when they eat food items that are available for their growth and energy [10]. The b values may also vary significantly due to other reasons like sex, growth phase, stomach contents, gonad development, preservation techniques, age and maturity stage [10]. Shingadia stated that the length weight ratio exhibit variation throughout the year, influenced by factors such as food availability and spawning periods [22]. In contrast, the parameter b remains relatively stable throughout the year with minimal fluctuations.

On the basis of range differences, the morphometric characters are divided into genetically controlled characters (narrow range), intermediate (moderate range) and environmentally controlled characters (vast range) [13]. Characters which are genetically controlled show minimum range of variation, characters belonging to intermediate show moderate range of variation and the characters which are environmentally controlled shows maximum range of variation.

During, the present investigation, it has been observed that five characters were genetically controlled, three characters were intermediate and one character was environmentally controlled in percentage of total length.

4. Conclusion

The present study corroborates the relationship of total length with other morphometric characters viz., standard length, snout length, head length, body depth, eye diameter, pre-dorsal length, pre-pelvic length, pre-pectoral length, caudal length of *Labeo rohita*. The results concluded that the total length and other morphometric parameters of *Labeo rohita* were significantly correlated. The positive correlation coefficient indicated that proportional positive increase in the morphometric parameters in comparison with the total length. Linear relationship has been observed between all the independent and dependent variables. The study of morphometric characters is important for identification of specimens and for experimental studies.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare that they have no conflicts of interest.

Statement of ethical approval

The present research work does not contain any studies performed on live animal's subjects by any of the authors.

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