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Observation of morphometric characteristics in fish *Clarias batrachus* (Linnaeus, 1758) from Lucknow, Uttar Pradesh

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Abstract

The walking catfish *(Clarias batrachus* Linnaeus, 1758*)* is an omnivorous bottom feeder, incorporating various food sources in its diet, such as insects, insect larvae, crustaceans, and vegetable matter. It is primarily nocturnal. However, it can adapt to pond conditions and readily switch to a more carnivorous diet. During observation, the main focus is to examine the morphometric relationship of *Clarias batrachus* for that total ten morphometric characters were measured for each specimen. Notably, a linear relationship was observed between the total length and other morphometric characters. The results highlight a strong correlation between most morphometric parameters and the total length of the catfish. However, it was found that the anal length does not show a significant correlation with the total length.

Keywords: Morphometric characters; Total length; length measurements, standard length catfish

1. Introduction

Clarias batrachus (Linnaeus, 1758) one of the most widely distributed catfish found throughout the South East Asia, the Indian subcontinent and Africa as well as in parts of Far East locally known as "Magur". It is distributed in Bangladesh and the Indian states of Odisha, West Bengal, and Assam. *Clarias batrachus* belongs to the class Actinopterygii and the order Siluriformes. Catfish, including *Clarias batrachus,* are ray-finned fish and are highly valued in the market for both food and their high price. They are carnivorous freshwater fish with an elongated body. The head is moderately depressed and covered by osseous plates. They have small eyes, a terminal mouth, and four pairs of barbels. The maxillary barbels extend to the middle or end of the pectoral fins, while the mandibular pairs are shorter. The dorsal fin is inserted slightly anterior to the tip of the pectoral fins, and the pectoral spine is strong and serrated on both edges. Its unique ability to survive outside of water for short periods and even move across land has earned it the common name "Walking Catfish." The species has attracted considerable attention from researchers due to its intriguing characteristics, adaptive behaviour, and potential ecological impacts in its native habitats. *Clarias batrachus*, commonly known as the walking catfish, is a species of freshwater fish belonging to the family Clariidae. This fascinating fish is native to the Indian subcontinent and is widely distributed across various freshwater habitats in the region, including Lucknow, Uttar Pradesh.

The walking catfish gets its name from its unique ability to "walk" on land for short distances, using its pectoral fins, which are adapted to function like legs. This remarkable behaviour allows it to move between water bodies, especially during the monsoon season when temporary water bodies form, providing opportunities for the fish to disperse and find new habitats.

As an important member of the Clariidae family, *Clarias batrachus* plays a significant role in the local aquatic ecosystems. It is a highly adaptable and resilient species, capable of surviving in various environmental conditions, from slow-

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moving rivers and ponds to flooded fields and marshes. This adaptability has also contributed to its success as an invasive species in some regions beyond its native range.

The body colour of *Clarias batrachus* is brownish to green-blue, with a black dorsal side that exhibits a greenish luster. The flanks and belly are pale brown or reddish, often with numerous striking pales to white spots. The dorsal and anal fins display striking red margins. The recorded maximum lengths for this species vary according to different sources. According to Bhuiyan (1964), the maximum length recorded is 23 cm. Rahman (1989 and 2005) reported a maximum length of 30.2 cm. Talwar and Jhingran (1991) as well as Huda et. al. (2003) documented a maximum length of 46 cm. Lastly, Shammi and Bhatnagar (2002) recorded a maximum length of 40 cm.

Morphometric measurements play a crucial role in identifying and studying fish species. The morphometric study of *Clarias batrachus* helps in its identification and provides information on its taxonomic status (Ihssen et.al.1981). Identification aims to investigate the relationship between various morphological characters of *Clarias batrachus* and establish mathematical equations that relate to morphometric relationship. The fish morphometric characters represent one of the major keys for determining their systematic and various morphometric parameters (Kova et.al. 1999). These equations can be used for converting one measurement into another.

The genus *Clarias batrachus* belongs to a group of air-breathing catfish found in inland waters. Among the 16 Asian species in the genus, *Clarias batrachus* is one of the most well-studied (Linnaeus,1758). It is widely utilized in aquaculture, appears in the aquarium fish trade, and has been the subject of numerous studies on its behaviour (Ghosh and Pati, 2004).

Clarias batrachus is distributed throughout South and Southeast Asia and is popular for aquaculture within its native range (Hora ,1936; Kottelat, 2001). However, it is also regarded as an invasive species in other Southeast Asian countries. It has been introduced in many parts of the world for aquaculture and as a pet fish (Talwar and Jhingran, 1991).

Fish exhibit greater morphological variation within populations and between species compared to other vertebrates. They are highly sensitive to environmental changes and can quickly adapt by changing their morphometries. Morphometric characters are important for correctly identifying fish species and understanding their habitat and ecological criteria in different aquatic environments (Jayaram, 1999). The complete set of measurements used to describe According to Strauss and Bond (1990), a form is a set of morphometric characters that encompass measurable features such as size, shape, proportions, angles, and other quantitative parameters for analysis.

2. Material and methods

2.1. Study Area

A total of 20 specimens collected from various fish markets, including Khurram Nagar fish market, Tadikhana fish market, Samples were collected by collecting specimens of different sizes from these markets. The collected fish specimens were preserved in a 10% formalin solution and brought to the laboratory for further analysis.

2.2. Morphometric and other analysis of fish body

The identification of the fish species was primarily based on external features such as the mouth, body shape, length, depth, and width. Standard taxonomic keys, such as those provided by Talwar and Jhingran (1991) and Jayaram (1999), were used for the scientific identification of the fish. The morphometric measurements of *Clarias batrachus* were taken using relative units such as centimeters (CM) for length measurements. The morphometric characters that were measured include: Standard length (SL), Total length (TL), Eye diameter (ED), Pre-pectoral length (PPEL), Body depth (BD), Caudal Length (CL), Pre-Anal length (PAL), Anal fin length (AFL), Dorsal fin length (DFL).

- **Total length -** It is the distance between the anterior most extremity of the body (tip of snout or the upper lip and the posterior most boundary body) i.e., the tip of the caudal fin lobe. The Angle of the longest lobe if the caudal fin is forked and has Unequal lobe.
- **Standard Length (SL)-** Length from the tip of the snout to the fork of the tail.
- **Eye length/ Diameter** It is the distance between the front and rear margin of the eye.
- **Pre dorsal** Length-It is the space between the anterior most end of the body and the front end of the dorsal fin base.

- **Pre pectoral Length –** It is the distance between the anterior most end of the body and the front position of the pectoral fin base.
- **Pre anal length -** It's the distance between the anterior most end of the body and the front point of the anal fin base
- **Body depth (BD)** Maximum vertical distance between dorsal and ventral margin of the fish body.
- **Caudal length (CL)** Total length- Standard Length
- **Anal fin length (AFL)** – It is the length of the anal fin, measured from the front base to the posterior tip of the fin.
- **Dorsal fin length (DFL)** – It is the length of the dorsal fin, measured from the front base to the posterior tip of the fin.

2.3. Statistical analysis

The relationship between the total fish length and the morphometric characters was estimated using the following formula Y = a + bX Where: Y = morphological characters, X = total fish length, a, b = constants

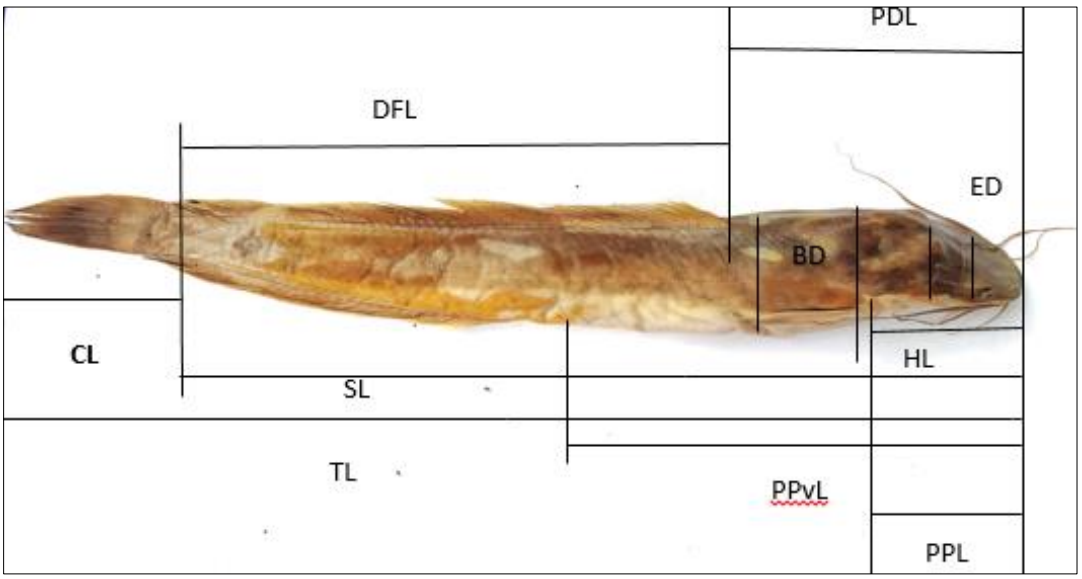

Figure 1 Photograph of *Clarias batrachus*

3. Results and discussion

The mean of total length of the specimens was 21.86 cm, ranging from 14 cm to 32 cm. The mean values for other morphometric characters were as follows: Standard Length (19.67 cm), Caudal Length (3.09 cm), Eye Diameter (0.3 cm), Pre-Dorsal Length (6.9 cm), Pre-Anal Length (10.77 cm), Pre-Pectoral Length (4.71 cm), Dorsal Fin Length (11.53 cm), Anal Fin Length (7.37 cm), and Body Depth (2.95 cm) (Table 1)

The correlation coefficients between total length and the measured morphometric characters were calculated to determine the degree of correlation. The results showed that Standard Length (r = 0.92), Pre-Dorsal Length (r = 0.94), Pre-Pectoral Length (r = 0.94), and Dorsal Fin Length (r = 0.94) had strong positive correlations with total length. This indicates that as the total length of the fish increases, these measurements also increase proportionally.

However, some morphometric characters showed weaker correlations with total length. Caudal Length (r = 0.25), Eye Diameter (r = 0.45), Anal Fin Length (r = 0.85), and Body Depth (r = 0.45) had relatively weaker correlations. These findings suggest that these morphometric characters may be influenced by factors other than total length, such as genetic variations or environmental factors.

Regression equation represents the relationships between total length and the dependent variables. The regression equations can be used to estimate one morphometric measurement based on the knowledge of the total length. For example, the regression equation for Standard Length is Y = 1.35 + 0.90X, where Y represents Standard Length and X represents total length.

The positive correlations and linear relationships observed indicate that changes in total length are consistently reflected across the measured morphometric characters.

Several studies have reported positive correlation between different morphometric characters and standard length in various fish species. Begum et. al. (2008) found a positive correlation between length of *Clarias gariepinus* and standard length. Similar results were observed by Sauliheen Qadri et. al. (2017) in *S. curvifrons*, where standard length showed the highest degree of correlation (0.94%) with total length Amin et. al. (2004) also noted similar observations in catfish *Rita rita,* indicating a significant curvilinear relationship between total length and morphometric characters.

Muhammad Naeem et. al. (2012) reported a high correlation between standard length (SL), dorsal fin length (DFL), Pre pectoral fin length (PPEL) anal fin length (AFL), and increasing total length and wet body weight in *Labeo calbasu*.

In a study conducted by Muhammad Nasir et al. (2017), the researchers examined the correlations between length, weight, and morphometric measurements of farmed male and female *Clarias batrachus* in Pakistan and found significant relationships among the morphometric variables.

Overall, these studies highlight the positive correlations between standard length and various morphometric characters in different fish species, indicating the importance of standard length as a reliable measure in assessing fish growth and size-related characteristics.

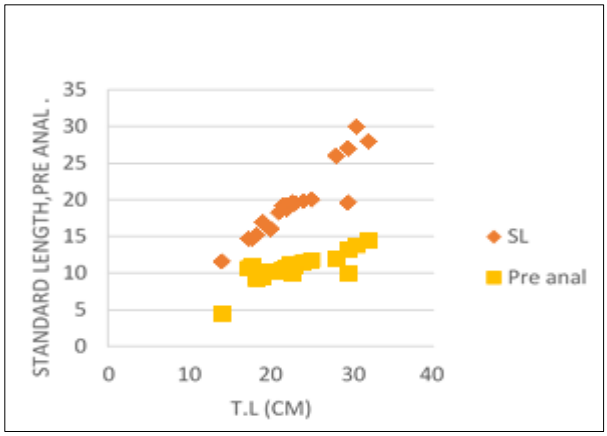

Figure 2 Relationship between Total Length (TL) of fish with Standard length (SL) and Pre anal length (PAL)

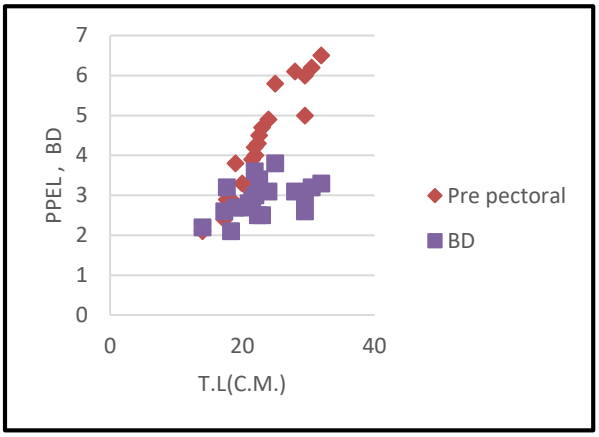

Figure 3 Relationship between Total length (T.L) of fish with pre–Pectoral Length (PPEL) and Body Depth (B.D)

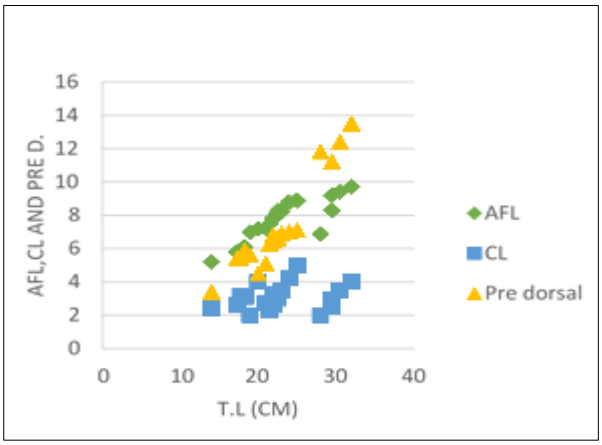

Figure 4 Relationship between Total Length (TL) of the fish with Anal Fin Length (AFL), Caudal Length (CL)& Pre-Dorsal Length (PDL)

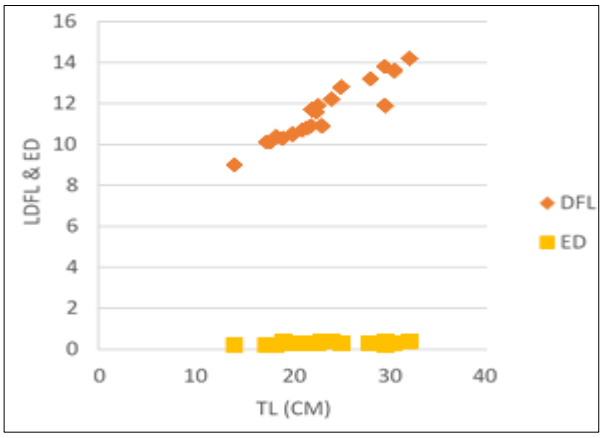

Figure 5 Relationship between total length of fish with dorsal fin length and eye diameter

Table 1 presents the statistical results for the morphometric characters, while Figures, visually represent the relationships between the variables. The figures likely include scatter plots illustrating the linear relationship between the independent variable (total length) and each dependent variable.

Table 1 Mean, Standard Deviation, Range, Correlation coefficient and Regression equation (Y=a+bX) between different morphometric character of *Clarias batrachus*

S.no.	Parameters	Mean	Range	Standard Deviation	Correlation Coefficient	Regression equation
1.	Total Length (TL)	21.86	32-14	5.30		
2.	Standard Length (SL)	19.67	30-11.6	0.63	0.92	Y=1.35+0.90X
3.	Caudal Length (CL)	3.09	5-2	0.21	0.25	Y=2.15+0.041X
4.	Eye Diameter (ED)	0.3	0.4-0.2	0.07	0.45	Y=0.14+0.006X
5.	Pre-Dorsal Length (PDL)	6.9	13.5-3.4	3.32	0.94	Y=5.43+0.56X
6.	Pre-Anal Length (PAL)	10.77	14.4-4.5	0.56	0.79	Y=3.25+0.32X
7.	Pre-Pectoral Length (PPEL)	4.71	6.5-2.1	0.70	0.94	Y=1.54+0.041X
8.	Dorsal Fin Length (DFL)	11.53	14.2-9	0.14	0.94	Y=5.23+0.27X
9.	Anal Fin Length (AFL)	7.37	9.7-5.2	0.35	0.85	Y=2.56+0.22X
10.	Body Depth (BD)	2.95	3.8-2.1	0.28	0.45	Y=1.96+0.04X

4. Conclusion

Present study provides valuable insights into the morphometric characteristics and their correlation in *Clarias batrachus,* a freshwater catfish species. The analysis of morphometric characters in *Clarias batrachus* revealed a minor degree of influence from the surrounding environment. A total of ten characters were examined, and it was observed that these characters were primarily determined by genetic factors. However, there was also a minor influence from the environment on these characters.

The high values of correlation coefficient indicated a strong positive relationship between the morphometric parameters and total length, suggesting that these parameters increase proportionally with total length. This type of study is crucial for effective species management as it can be used to assess the well-being of individuals and identify potential differences between separate populations of the same species.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors have no any conflict of interest for publishing this article.

Statement of ethical approval

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

Statement of informed consent

Informed consent was obtained from all individual participants included in the study

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