

An Analysis of Girth Lengths to Morphometric Measures of *Labeo Bata* (Hamilton 1822)



Biology

KEYWORDS : Length-weight relationship, Weight-girth relationship, minor carp, fishery management

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ABSTRACT

The fish *Labeo bata* (Hamilton 1822) was studied to understand the relationship of different girth lengths with other morphometric measures, especially Total Length (TL), Standard Length and Weight (WT). A total of 51 fish samples of different lengths and weights were studied. Three differently located girth lengths (GT1, GT2 and GT3) exhibited positive correlation with morphometric measures considered. However, the girth length behind the dorsal fin (GT3) of the fish showed strong linear positive correlation ($r^2=0.902$) with weight of the fish and it also depicted similar isometric growth result obtained from its length weight relationship. In relationships of $WT = GL^n$ (here, $GL=GT3$) and $WT = TL^n$, the 'n' values were almost equal to 2.9. Hence, the equation of $WT = GL^n$ with $GL=GT3$, can be used to obtain the weight of *L. bata*.

Introduction

Body and girth lengths of fish are important morphological parameters for biological, ecological and fisheries assessment studies. In particular, both length and girth are related to other biological parameters, such as condition and swimming capability (Wootton, 1999). Moreover, both parameters determine whether a gape-limited predator can ingest a particular fish, thus defining predator-prey relationships and the ecological position of fishes within the food webs in which they are embedded (e.g. Hambright, 1991; Pauly, 2000). Data of length-girth relationships can be used for management of gillnet fisheries (Jasper and Evenson, 2006) through gear election pattern (Reis and Pawson, 1999; Purbayanto et al., 2000). In this study, we present length-girth relationships for *L. bata*. The fish *L. bata* is one of the most common fishes of Pakistan, Bangladesh and India (Talwar and Jhingran, 1991). It occupies an important place amongst the species in Asian aquaculture. It attains a maximum length of 25-35cm. It is slow moving fish with elongated body. The snout slightly projects beyond the mouth. A pair of small hidden maxillary barbells is found in the labial fold. Lips are without any cartilaginous support. It is basically herbivorous column feeder, sometimes benthopelagic and potamodromous species inhabiting ponds, river etc. It also eats on protozoa, algae and tiny fish (LeCren, 1951).

Materials and Methods

A total of 51 fish samples were collected from four freshwater ponds in Bolpur, Birbhum district, West Bengal. Morphometric measures considered for study are described in Table 1. The girth length measures were taken from three different positions of the body (Figure 1a). Girth length is best measured through tying up a string around the fish at specific positions of the body and then measuring the distance between the end points of the string (Figure 1b). All girth measurements were taken perpendicular to the body length of fish and to the nearest millimetre unit of length.

Table1. Morphometric measures for *L. bata*

Morphometric measures	Abbreviations	Description
Weight	WT	Weight of the fish
Total length	TL	Distance between the anterior most extremity of the body (tip of snout or upper lip) and the posterior most extremity of the body (tip of caudal fin lobe)

Standard length	SL	Distance between the anterior most extremity of the body (tip of snout or upper lip) and the base of caudal fin.
Girth length1	GT1	Behind the gill cover.
Girth length2	GT2	In front of the dorsal fin.
Girth length3	GT3	Behind the dorsal fin.

Considering that the TL, SL and WT are influenced when girth length increases, the model equations of linear regression analysis were followed to evaluate Length-Weight, Length-Girth and Weight-Girth relationships. These equations are

For Length-Weight relationship

$$\log WT = \log C + n \log L$$

For Length-Girth analysis

$$\log L = \log C + n \log GT$$

For Weight-Girth relationship

$$\log WT = \log C + n \log GT$$

Here, 'C' is constant and 'n' is the measure of growth. L= TL or SL; GT = GT1, GT2 or GT3.

ANOVA was followed to find difference among variable and $p < 0.05$ were defined as significantly different.

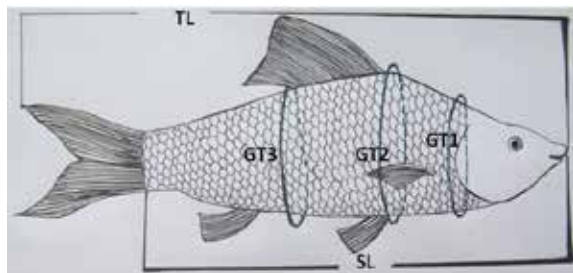


Figure 1a. Different girth lengths i.e. Girth length1 (GT1), Girth length2 (GT2) and Girth length3 (GT3) of *L. bata*

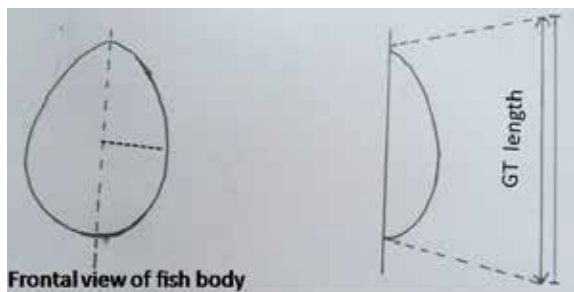


Figure 1b. Girth length of *L. bata*

Results

The length-weight relationship of the fish was computed out and 'n' value was found to be 2.90 with the constant (C) as 4.578.

The average result of GT1, GT2 and GT3 were 2.15, 2.45 and 2.06 respectively. GT2 showed significance differences to GT1 and GT3 (Figure 2). However, all girth lengths were positively correlated to morphometric measures studied.

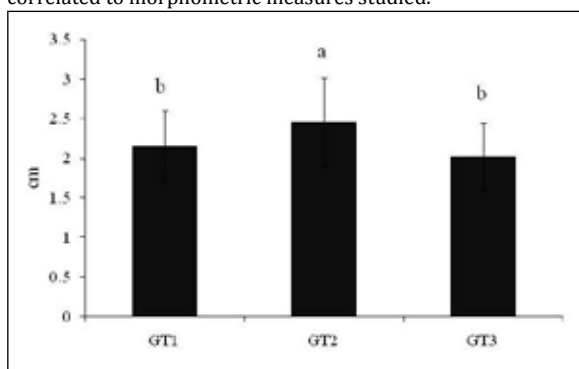


Figure 2. Girth measures from three different body positions (GT1, GT2 and GT3) of the fish *L. bata*. Different letters at the top of the bar are significantly different ($p < 0.05$). All measures are Mean \pm SD.

Model summary

The linear regression model for studied variables showed variability among GT1, GT2 and GT3 in predicting growth measures of the fish. The TL and SL showed a regression coefficient of around 0.7 with GT1, whereas, TL maintained a regression coefficient of around 0.9 with GT2. For GT2, SL and WT also showed linear relationship, but less than TL ($r^2 \approx 0.8$). GT3 showed strong regression coefficient of around 0.9 with TL, SL and WT. All three girth measures showed 'n' above 2.0 against WT. The girth measure GT3 exhibited an 'n' value against WT close to 'n' observed from Length-Weight measures of the fish. The 'n' values from all girth lengths against TL and SL were found very poor in explaining the growth of the fish.

Table 2. Regression equation, regression co-efficient (r^2), growth index 'n' and constant C from TL, WT and SL of *L. bata*

Dependent variable	Independent variable	Equation	r^2	n	C
TL	GT1	TL=cGT1 ⁿ	0.737	0.797	0.829
TL	GT2	TL=cGT2 ⁿ	0.918	0.882	0.752
TL	GT3	TL=cGT3 ⁿ	0.899	0.948	0.807
WT	GT1	WT=cGT1 ⁿ	0.716	2.359	0.437
WT	GT2	WT=cGT2 ⁿ	0.872	2.583	0.872
WT	GT3	WT=cGT3 ⁿ	0.902	2.851	0.902
SL	GT1	SL=cGT1 ⁿ	0.676	0.775	0.676
SL	GT2	SL=cGT2 ⁿ	0.866	0.871	0.866
SL	GT3	SL=cGT3 ⁿ	0.892	0.959	0.892

Discussion

The present study is the first of its kind on girth relationship to body measures of *L. bata*. Except in three cases with GT1, all the regression coefficients (r^2) of the length-girth and weight-girth relationship regressions ranged between 0.80 and 0.98. It was thus established that the girth lengths in front and behind the dorsal fin exhibit a kind of cause-effect relationship at higher degree in *L. bata*. The girth lengths in front of dorsal fin (GT2) with total length and the girth length behind the dorsal fin (GT3) with weight of the fish strongly explain this phenomenon with regression co-efficient of 0.918 and 0.902 respectively. Our study, therefore, describes that (i) linear relation existed between the increasing body girth length at position GT2 with total length and GT3 with body weight and (ii) the 'n' values for these two relationships were estimated as 0.882 and 2.85. According to Carlander (1969) and Froese (2006), 'n' values of around 3.0 could be considered within the normal range of growth of the fish. And hence, from the girth length-weight relationship, the relationship of the weight of the fish with girth length behind the dorsal fin (with $n=2.85$) can be considered an adequate estimate of the girth length-weight relationship. Like many other predictable parameters, weight can be considered as a function of girth length of *L. bata*. The value of regression coefficient 'n' is around 3.0 in the relation of $WT = cGT3^n$, (c is constant). This can be said as isometric, since $n=2.85$ and it corresponds to 'n' value ($n=2.9$) from length-weight relationship from same fish pool. This is supported from both length-weight as well as girth-weight relationships.

There are many other factors, such as age, sex, maturity, food availability, parasitism and fluctuating periods of growth in the summer and winter which may also bring about variations in such relationship (Javaid and Akram, 1972; Salam and Janjua, 1991).

Acknowledgement

Authors are highly indebted to CAS (Phase II) (UGC, New Delhi), Department of Zoology, Visva Bharati University, Santiniketan for providing all material support to complete this work.

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