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Full Length Research Paper

Some morphometric relationship traits of *Labeo bata* (Hamilton, 1822) from Head Panjnad, Pakistan

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In the present research work, 127 *Labeo bata* having diverse body size ranging from 8.20 to 16.00 cm total length collected from Head Panjnad, Pakistan were used for the analysis of some morphometrics, that is, length-weight and length-length relationships. Condition factor and their relationships to investigate growth external morphometric characters, that is, total length (TL), standard length (SL), fork length (FL), head length (HL), head width (HW), body girth (BG), dorsal fin length (DFL), dorsal fin base (DFB), pectoral fin length (PtFL), pectoral fin base (PtFB), pelvic fin length (PvFL), anal fin length (AFL), caudal fin length (CFL) and caudal fin width (CFW) showed highly significant correlation with both cases, that is, increasing total length and body weight. A significant positive relationship was found between condition factor (K) and body weight, while no significant correlation was found in condition factor and total length.

Key words: Morphometry, length-weight, length-length relationship, condition factor, *Labeo bata*.

INTRODUCTION

In practice, the use of morphometric measurements (body length, body girth, head length, fins length, eye diameter and jaw length) and meristics (fin ray, scale, teeth, gill raker and lateral line pore counts) to identify and classify fish is common. Morphometric measurements are generally presented as a proportion of total, standard and fork length, body weight and condition factor (Naeem et al., 2010, 2011a, b).

In morphometry, length-weight relationships are a valuable and standard result of fish sampling programs. These relationships are considered necessary to estimate various morphological and physiological aspects such as growth rates, length and age structures, and other mechanisms of fish population dynamics (Kolher et al., 1995). Length-weight relationships are considerably important for ichthyologists in many aspects such as renovation of growth-in-length equations to growth-in-weight (Dulčić and Kraljević, 1996; Gonçalves et al., 1997; Morato et al., 2001; Stergiou and Moutopoulos, 2001; Özaydin et al., 2007), evaluation biomass by using length frequency distributions (Petrakis and Stergiou, 1995; Dulčić and Kraljević, 1996) and calculation of fish condition factor (Petrakis and Stergiou, 1995). These morphometric relationship characters have a significant role in fisheries research as it is used for comparing life account and morphological themes of populations of different regions (Gonçalves et al., 1997; Stergiou and Moutopoulos, 2001). So, it is strongly required to determine length-weight relationships of *Labeo bata* (Hamilton, 1822), one of the most common fishes of Pakistan, Bangladesh and India (Talwar and Jhingran, 1991). Keeping in view the importance of this species for human welfare and fisheries research, the value of the length-weight relationship of *L. bata* was calculated, and it was observed that it provided information about the

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Abbreviations: TL, Total length; **SL,** standard length; **FL**, fork length; **HL**, head length; **HW**, head width; **DFL,** dorsal fin length; **DFB,** dorsal fin base; **PtFL,** pectoral fin length; **PvFL,** pelvic fin length; **AFL,** anal fin length; **CFL,** caudal fin length; **CFW,** caudal fin width; **LWR,** length-weight relationship; **BG**, body girth.

Table 1. Determination of external morphology in *L. bata*.

Body measurement	Mean ± S.D	Range
Total length (TL)	12.06 - 1.49	8.2 ± 16
Standard length (SL)	9.53 - 1.19	6.5 ± 12.5
Fork length (FL)	10.50 - 1.62	2.2 ± 13.7
Head length (HL)	2.54 - 0.30	1.8 ± 3.4
Head width (HW)	3.41 - 0.43	2.0 ± 4.7
Body girth (BG)	7.54 - 1.00	5.2 ± 10
Dorsal fin length (DFL)	2.28 - 0.28	1.6 ± 2.9
Dorsal fin base (DFB)	2.07 - 0.28	1.4 ± 2.9
Pectoral fin length (PtFL)	1.90 - 0.26	1.3 ± 2.6
Pelvic fin length (PvFL)	1.79 - 0.25	1.1 ± 2.4
Anal fin length (AFL)	1.79 - 0.30	1 ± 2.5
Caudal fin length (CFL)	2.52 - 0.49	1.2 ± 3.8
Caudal fin width (CFW)	3.60 - 0.72	1.7 ± 5.7

SD = Standard deviation.

growth pattern of this species. Forfisheries research, little information about the relation-ships of this fish species is only provided in South Asia, especially in Pakistan and India.

L. bata is assessed as Least Concern owing to its extensive distribution and lack of major widespread threats. It has low pliability to fishing pressures (Froese et al., 2011), but since it is an important species in Asian aquaculture, harvesting may not be a defined threat to wild populations. However, further research into harvesting levels is recommended.

L. bata is basically a benthopelagic and potamo-dromous species inhabiting rivers and it is a herbivorous column feeder. Because it is herbivores column feeder, *L. bata* is an important commercial and economical species for aquaculture. It is a much sought-after fish with a high value in the market, however, fishing is not considered to be a great threat to the species due to the extent of aquaculture (Devi and Boguskaya, 2011).

The present topic has long been neglected in Pakistan as only a few studies have reported on length-weight and condition factor relationship (Salam et al., 1991; Yousaf et al., 2009; Dars et al., 2010; Naeem et al., 2010, 2011a, b). At present, no published information is available on length-weight relationship and condition factor of *L. bata*, a commercially important fish from Pakistan. This study presents estimates of the length weight relationships for 127 samples of the species *L. bata* with respect to various factors. The results of this length-weight study would be helpful in future for the artificial propagation, stocking of this species in cemented ponds and fulfill humans' nutritional demands.

MATERIALS AND METHODS

In the present study, 127 samples of *L. bata* of different body sizes were collected from Head Panjnad, Pakistan using hand and drag nets depending upon the size of the fish in February, 2011. Then, the fish were transported to the laboratory in plastic containers in very critical conditions. By using electric balance, these were weighed to 0.01 g after removing debris and excess water. Body length precise measurements were made with the help of wooden measuring tray integrated with a millimeter scale and vernier caliper to the close 0.01 cm. For each specimen, length and weight were measured to the nearest 0.1 cm, 0.1 g accuracy. Total length (TL) and standard length (SL) were measured from the tip of snout to the tip of tail and the length from terminal mouth to the hidden base of the caudal fin, respectively. Similarly, head length (HL) was measured as a distance from the most anterior part of snout to the posterior edge of opercular bones and head width was taken as a straight distance between the eyes. Fin length and fin base values were measured as dorsal (DFL), pectoral (PtFL), pelvic (PvFL), anal (AFL) and caudal fin length (CFL) and these were measured as distance from anterior point of junction with body to the most anterior tip of the fin. Dorsal (DFB), pectoral (PtFB), pelvic (PvFB), anal fin base and caudal fin width (CFW) were measured in the same way systematically. These values were used for the calculation of the condition factor (K) by using the formula of Weatherley and Gill (1987) and Wootton (1990):

$$K = 100 \times W/L^3$$

The Length (L)-weight (W) relationship is in exponential form, mathematically shown as:

$$W = aL^b$$

When these are converted into logarithms, then it obeys straight line equation:

$$\log W = \log a + b \log L$$

Where, W is the weight (g), L is length (cm), a is the intercept (constant) and b is the regression coefficient (slope) of the linear regressions. A log-log plot of data was made for length-weight relationship (LWR), outliers were identified and removed and the regressions were redone.

Statistical relationships between total length and body weight of the fish were derived using the linear transformation as proposed by Zar (1984). For each specimen, Fulton's condition factor (*K*) was calculated using the following equations:

$$K = 100 \times W/L^3$$

RESULTS

Central tendency values of various morphometric aspects such as mean values (±STD), ranges and index of morphometry of external body parts of *L. bata* are given in Table 1. In the present work, *L. bata* ranged from from 8.20 to 16.00 cm in total length. The length-weight relationship was found to be highly significantly correlated ($r = 0.946$; $P < 0.001$) with slop value 2.92 (95% CI of b = 2.74 to 3.09). The length-weight had a significant correlation and the exponent *b* was 2.92 (95% CI of b = 2.74 to 3.09). Table 2 shows isometric growth of *L. bata*. FL, SL, HL, HW, DFL, DFB, PtFL, PvFL, AFL, CFL and, CFW showed highly significant, correlation with both cases, that is, increasing size (total length and body weight) (Tables 2 and 3). A significant positive relationship correlation was observed between condition

Table 2. Descriptive statistics and regression parameters of total length (TL, cm) with different morphometrics for *L. bata* (n = 127).

Equation	Relationship parameters		95% CI of a	95% CI of b	r	r^2
	a	b				
W = a + b TL	0.0147	2.92	0.0095 – 0.0228	2.74 - 3.09	0.946***	0.896
K = a + b TL	1.4706	-0.08	0.9491 – 2.2793	-0.26 - 0.09	0.083^{ns}	0.007
SL = a + b TL	0.8634	0.96	0.7595 – 0.9813	0.91 - 1.02	0.957***	0.916
FL = a + b TL	0.7818	1.04	0.4192 – 1.4581	0.79 - 1.29	0.592***	0.350
HL = a + b TL	0.3653	0.78	0.2909 – 0.4586	0.69 – 0.87	0.833***	0.694
HW = a + b TL	0.6891	0.64	0.4800 – 0.9892	0.50 - 0.79	0.615***	0.378
BG = a + b TL	0.8121	0.89	0.6226 – 1.0593	0.79 – 1.00	0.829***	0.687
DFL = a + b TL	0.2971	0.82	0.2324 – 0.3798	0.72 – 0.92	0.826***	0.682
DFB = a + b TL	0.2161	0.91	0.1683 – 0.2773	0.81 - 1.01	0.848***	0.719
PtFL = a + b TL	0.1667	0.98	0.1303 – 0.2133	0.88 – 1.08	0.868***	0.753
PvFL = a + b TL	0.1466	1.00	0.1153 – 0.1862	0.91 – 1.10	0.879***	0.773
AFL = a + b TL	0.1162	1.10	0.0787 – 0.1716	0.94 – 1.25	0.778***	0.605
CFL = a + b TL	0.1399	1.16	0.0815 – 0.2401	0.94 – 1.37	0.686***	0.470
CFW = a + b TL	0.4608	0.82	0.2466 – 0.8610	0.57 – 1.07	0.500***	0.250

Correlation coefficient (r), r^2: coefficient of determination, intercept (a), regression coefficient (b), CI: confidence intervals, standard error (S.E.), ***P < 0.001, $^{n.s}$P > 0.05.

Table 3. Descrptive statistics and regression parameters of body weight (W, g) with different morphometrics for *L. bata* (n = 127).

Equation	Relationship parameters		95% CI of a	95% CI of b	r	r^2
	a	b				
K = a + b W	0.9428	0.08	0.7958 – 1.1169	0.02 - 0.13	0.243**	0.059
SL = a + b W	3.6771	0.31	3.4938 – 3.8699	0.30 – 0.33	0.957***	0.916
FL= a + b TL	3.4850	0.36	2.7454 – 4.4238	0.28 - 0.44	0.630***	0.397
HL = a + b W	1.1455	0.26	1.0544 – 1.2448	0.23 – 0.29	0.861***	0.742
HW = a + b W	1.6893	0.23	1.4777 – 1.9311	0.19 – 0.27	0.679***	0.461
BG = a + b W	2.9275	0.31	2.6829 – 3.1952	0.28 – 0.34	0.887***	0.786
DFL = a + b W	1.0014	0.27	0.9116 – 1.1000	0.24 – 0.30	0.840***	0.705
DFB = a + b W	0.8111	0.31	0.7435 – 0.8849	0.28 – 0.34	0.885***	0.784
PtFL = a + b W	0.7181	0.32	0.6528 – 0.7900	0.29 – 0.35	0.875***	0.766
PvFL = a + b W	0.6598	0.33	0.6005 – 0.7249	0.30 – 0.36	0.881***	0.777
AFL = a + b W	0.5752	0.37	0.4981 – 0.6640	0.32 – 0.42	0.812***	0.660
CFL = a + b W	1.0447	0.29	0.8121 – 1.3440	0.20 – 0.37	0.521***	0.271
CFW = a + b W	1.4431	0.30	1.1368 – 1.8319	0.22 – 0.37	0.555***	0.308

Correlation coefficient (r), r^2: coefficient of determination, intercept (a), regression coefficient (b), CI: confidence intervals, standard error (S.E.), ***P < 0.001, **P < 0.01, $^{n.s}$P > 0.05.

factor data of relative weight (W_r) which is valid than condition factor (k) when calculating the W_r and body weight (Table 3), while no significant correlation was found in condition factor and total length (Table 2).

DISCUSSION

This result of length-weight relationship (LWR) indicated that wild estimation b values are within the normal range (2.5 to 3.5) as reported by Carlander (1969) and Froese (2006). Thus, we considered our results to be an adequate estimation of the LWR. Like other parameters, weight was considered to be a function of length in fish. The form and specific gravity of the fish remains constant during its life span, the value of regression coefficient 'b' would be exactly 3.0 in the relation $W = aL^b$. Growth generally tends to be isometric, since b = 3.0 for isometric growth. Isometric growth (b value close to 3.00) in *L. bata* shows that the small specimens have the same form and

condition like large specimens (Froese, 2006). This value is different from the other closely related species of this genus, *Labeo gonius*, b = 3.46 (positive allometric growth) as reported by Dars et al. (2010) from Keenjhar Lake, District Thatta, Sindh, Pakistan. While the type of growth for other species of *Labeo* genus (sush as *L. gonius*) has been reported to be positive allometric by Dars et al. (2010) in Keenjhar Lake, District Thatta, Sindh, Pakistan. The variation shown in the 'b' value was due to feeding (LeCren, 1951), state of maturity (Frost, 1945) and sex (Hile and Jobs, 1940).

The condition factor (K) may possibly vary with length especially in cases when the average weight of the fish does not increase proportionally to the length of cube (Carlander et al., 1952). According to another study by Naeem et al. (2011a), it was clear that condition factor showed least significant relationship with total length, and highly significant with body weight in *Oreochromis nilotica* (Naeem et al., 2011b).

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

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