

Length-weight relationship and condition factor of *Labeo bata* (Hamilton) (Cypriniformes: Cyprinidae) found in Ranikot stream, Sindh-Pakistan

Mughul W.G.^{1#}; Rajput S.^{2#}; Laghari S.²; Hussain I.³; Khan P.²;
Bilal Z.²; Sheikh M.²; Gachal G.S.¹; Laghari M.Y.^{2*}

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Abstract

In the present study the length-weight relationship and condition factor of *L. bata* (*Labeo bata*) had been investigated and elucidated with particular reference to the growth status and condition factor in hill stream of Ranikot at District Jamshoro Sindh-Pakistan. A total of 291 individuals with their sixteen morphometric traits were analyzed for length-weight relationship, correlation and condition factor. The length-weight relationship, morphometrics and condition factor indicated positive allometric growth and high level of interdependence (0.992-0.887) between morphometric traits. The mean total length 20.7+1.21cm and mean weight 13.85+1.42gm were observed. A strong linear relationship ($r=0.975$) was observed between total length and weight variables ($a=0.3338$). The value of regression coefficient ($b=2.684$) suggests isometric growth in *L. bata*. The condition ($K=0.724$) and relative condition factors ($kn=0.751$) were observed <1.0 , that indicated the environmental impact on the fish in hill stream of Ranikot. The findings suggest satisfactory growth and well-being of fish in the surrounding aquatic environment. In further, more hydrological factors might be investigated to know the real impacting factors.

Keywords: Growth, Stream water environment, *Labeo bata*, Fish health.

1-Department of Zoology, University of Sindh, Jamshoro, Sindh, Pakistan

2-Department of Freshwater Biology and Fisheries, University of Sindh, Jamshoro, Sindh, Pakistan

3-Directorate of Fisheries, Gilgit Baltistan, Northern Area, Pakistan

#Equally contributed authors

*Corresponding author's Email: laghariyounis@yahoo.com

Introduction

Labeo bata (Hamilton, 1822), is an important native food fish species for community, that is found throughout the Indian sub-continent, including Bangladesh, Nepal, Myanmar, Pakistan and India (Robins *et al.*, 1991). *Labeo bata* (*L. bata*) is a freshwater benthopelagic. Commonly known as 'Bata' in Bangladesh, 'Bhagan' in India, and 'Bata labeo' in Nepal and Minor carp in Pakistan (Froese and Pauly, 2016). *Labeo bata* is potamodromous cyprinid, inhabiting rivers, canals, ponds and ditches. In spite of some local threats impacting this species, there is no updated information available on its population status in Pakistan. It is one of the richest aquatic proteins and minerals (15.42% of protein and 3.73% of lipid) with high commercial value fish in the market (Ahmed *et al.*, 2012). There is a great demand of *L. bata* in the market because of its high nutritional value and good taste. This fish species is being cultured at large scale based in many countries including Bangladesh, while it had been assessed as endangered earlier in Bangladesh (IUCN Bangladesh, 2015). Where ever, the aquaculture is developed well for conservation and production purposes the fishing is not considered to be a great threat to the species due to the extent of aquaculture (Devi and Boguskaya, 2011). Unfortunately, there is no special developed market for this delicious species in Pakistan due to unawareness and short of stock. While, the species is rare and there is shortage of species in the market. Therefore, it needs utmost

attention of fisheries scientists in Pakistan.

To identify and classify the fish, the use of morphometric measurements and meristics traits is common practice. 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 relationship (LWR) is 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). LWR 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; Özyaydin *et al.*, 2007), evaluation biomass by using length frequency distributions (Petraakis and Stergiou, 1995; Dulčić and Kraljević, 1996) and calculation of fish condition factor (Petraakis and Stergiou, 1995).

In general, Pakistan is rich in natural water resources. These water resources have great potential of fisheries. There are about 193 freshwater fish species in Pakistan (Laghari M.Y., 2018), inhabitant of various water bodies including, lakes, reservoir, stream water or cold water regions.

The mountain stream of Ranikot is situated at 25°45'N - 26°00'N, long 67°45'E - 68°00'E around 30km south west of Sann Railway Station, 124km from Hyderabad Sindh, Pakistan. The site territory goes under Khirther Range which falls under the Sahara-Sindhian area; (Ali and Qaiser, 1986). The small stream goes through the focal point of the post from the west toward the east of Ranikot fort. It flows throughout the median region of the fort. The local community is fully dependant on this water of source for both drinking and agriculture purpose. The water flow and size of stream vary in this valley depend upon the season. This site is ideal for sport fishing as well as for aquaculture purpose. If some positive efforts would be taken in interest then government and local community might earn much more. In the present study, an attempt has been made to investigate the health condition and population status of *L.bata*, my measuring LWR condition factor.

Materials and methods

At total of 291 samples of *L. bata* of different body sizes were collected from small hill stream of Rani Kot at district Jamshoro Sindh Pakistan (Fig. 1). The samples were collected by using hand and drag net for this study. The fish were transported to the laboratory in plastic containers. Weight of fish was weighing by using digital electronic balance. Fresh specimens were used for the study of morphometric and LWR. Fish were properly wiped with blotting paper to ensure removal of moisture. Sixteen

morphometric traits (Fig. 2) were studied using the standard procedures described by (Appa Rao, 1966; Dwivedi and Menezes, 1974). 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 length, respectively. Similarly, head length (HL) was measured as a distance from the most anterior part of snout to the posterior edge of operculum bones. The fin length values were measured as dorsal fin length (DFL), pectoral fin length (PFL), anal fin length (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. In further, the down caudal fin length (DCFL); it begins starting the base of caudal fin along with of down caudal fin, central caudal fin length (CCFL); distance starting the present up of the anal fin the base of the median caudal rays, caudal peduncle length (CPL); distance starting the stop of the anal fin the bottom of the medium anal rays, snout length (SNL); the distance between the top jaw and the anterior margin of the orbit. Girth (GR), a circle dimension for girth turned into taken from the foundation of dorsal fin rays. Upper caudal fin length (UCFL), it begins from the start and until end of caudal balance. Ventral fin length (VFL), length of longest ray from the anterior insertion of the ventral fin and Eye diameter (ED)

was measured as space linking the front and later rims of eye in the longitudinal alignment were measured in the same way systematically.



Figure 1: Map showing collection site area Ranikot Stream, Sindh-Pakistan.

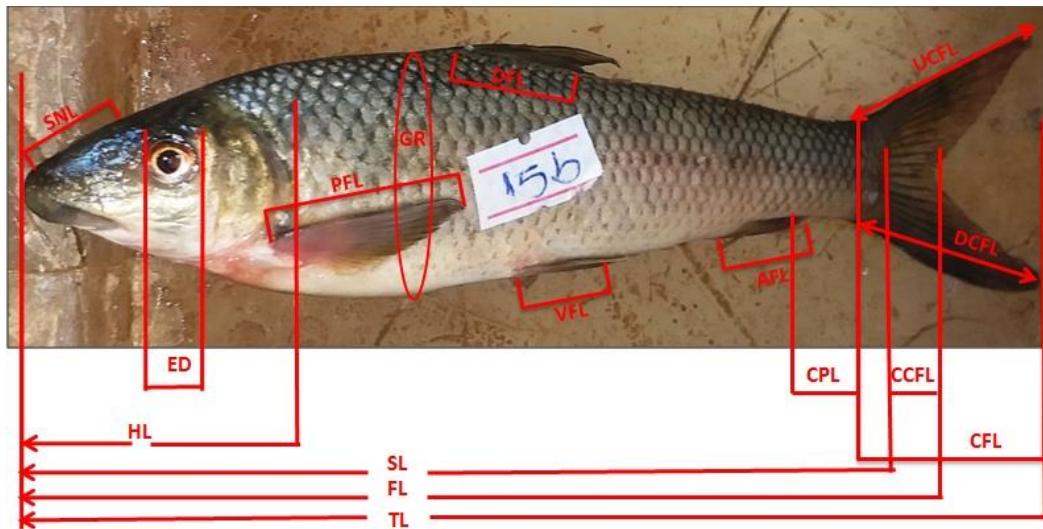


Figure 2: Shows measurement of seventeen morphometric traits of *L. bata* found in Ranikoat stream water, Sindh-Pakistan. TL (Total Length), FL (Fork Length), SL (Standard Length), HL (Head Length); SNL (Snout Length), ED (Eye diameter), CPL (Caudal Peduncle Length), DFL (Dorsal Fin Length), PFL (Pectoral Fin Length), VFL (Ventral Fin Length), AFL (Anal Fin Length), CFL (Caudal fin length), UCFL (Upper part of Caudal Fin Length), DCFL (Down part of Caudal Peduncle Length), CCFL (Mid part of Caudal Fin Length) and ED (Eye diameter).

LWR was calculated using the formula given by Le Cren (1951) as:

$W = a L^b$ (W=weight of fish in grams, L=length of fish in millimeters. 'a' and 'b' are constants). The data on total length and weight were statistically treated by the method of least squares using the equation of Le Cren (1951) given as:

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

The relationship between length and weight for individual trout were used to calculate Fulton's Condition Factor Index (Ricker, 1958), which is estimated using the following equation:

$K = \{w/l^3\} \times 100$, where, L is the length in centimeters (cm) and W is the weight in grams (g).

Relationships between the various body measurements to the total length and head length were calculated. Range, mean, median, standard deviations and correlation of coefficient (r) were estimated for the characters under study.

The relationship between the various morphometric measurements was determined by linear regression formula: $Y = a + b X$

Results and discussion

During the present investigation on the morphometric of *L. bata*, the co-efficient of correlation (r) for various morphometric characters compared against total length ranged from 0.992-0.887 indicating very high degree of relationship among the characters compared, with the lowest value of 0.754 between total length and head length and the highest value of 0.992 between total length and standard length. The LWR of *L. bata* shows round about isometric growth ($b=2.684$) and showed strong correlation ($r=0.975$) as shown in Figure 3 and Table 1.

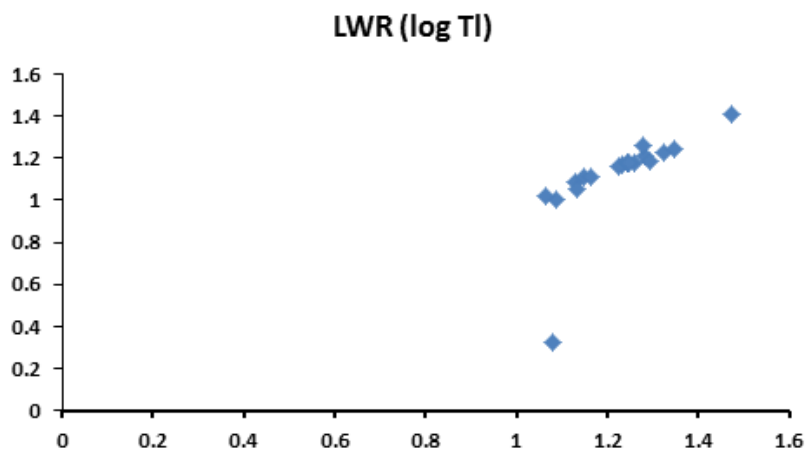


Figure 3: Graph shows the regression of Length weight relationship of *L. bata* found in Ranikoat stream water, Sindh-Pakistan.

The comparison of morphometric characters against head length showed high degree of correlation that ranged between 0.998-0.897 (Table 1). The length-length relationships were found

to be significantly linear in all cases. In further, to analyze the correlation of all other traits with TL was analyzed. All of traits show strong correlation with the TL except HL, PFL, CCFL, UCFL and

ED; those show median correlation with TL. Furthermore, when we calculated slope value ‘b’ of the morphometric characters compared with TL, the FL

(b=1.874) and SL (b=0.743) indicating good growth. While for HL(b=0.243), DFL (b=0.487),PFL (b=0.345) and SL (b=0.387)shows weak growth (Table 1).

Table 1: Morphometry, Length weight relationship, Condition factors and Regression values for various morphometric as function of Total length and Head length of hill stream *L.bata* from Ranikot at district Jamshoro Sindh.

Morphometry	Intercept (a)	Slope (b)	Correlation(r)
TL & WT	0.3338	2.684	0.975
TL & FL	0.3467	1.874	0.887
TL & SL	0.3976	0.743	0.992
TL & HL	0.4867	0.243	0.754
TL & DFL	0.3963	0.487	0.876
TL & PFL	0.4763	0.345	0.783
TL & CPL	0.6745	0.506	0.984
TL & GIR	0.4754	0.724	0.994
TL & SNL	0.3963	0.387	0.854
HL & AFL	0.6321	0.892	0.998
HL & CCFL	0.6432	0.763	0.695
HL & DCFL	0.6543	0.412	0.868
HL & UCFL	0.8435	0.323	0.732
HL & VFL	0.7643	0.755	0.879
HL & ED	0.642	0.637	0.754

Total length (TL); weight (W) Fork length (FL); Standard length (SL); Head length (HL); dorsal fin length (DFL); pectoral fin length (PFL); caudal peduncle length (CPL); girth (GIR); snout length (SNL); Anal fin length (AFL); central caudal fin length (CCFL); down caudal fin length (DCFL); up caudal fin length (UCFL) ventral fin length (VFL) eye diameter (ED).

Among the five traits compared with AFL, CCFL, VFL and ED (b=0.892) show satisfactory growth condition as compared to DCFL (b=0. 412) and UCFL (b=0. 323). Similar report, growth effect of traits, has been reported in various species as Yassar Saker *et al.*(2004) stated that high growth rate of FL (b=0.879) and SL (b=0.862) was observed with TL in *Megalaspis cordyla* from Mumbai coast. Moutopoulos and Stergiou (2002) reported significantly linear relationships among TL, FL and SL in some fish species in Aegean Sea. The significant linear relationships among the length parameters showed

that certain fish species exhibit characteristic morphological features. The statistical analysis of various morphometric characters are presented in Table 2.

The equation obtained for the LWR in the present study was $\text{Log}W = -1.44355 + 2.683412 \text{Log}L$.

The above equation can be represented linearly as:

$$W = 0.036013887 \text{ and } L = 2.683412$$

The co-efficient of correlation (r) for the LWR was estimated at 0.975, indicating a high degree of positive correlation between the two parameters. The value of exponent ‘b’ was calculated as 2.684

which do not differ significantly from 3.0. Length-weight exponent (b) value for most animals fall roughly around 3.0 (Siegfried, 1980; Hopcroft *et al.*, 1998). The variation in 'b' value from 3 is not statistically significant and indicates an isometric growth for the fish. Generally,

the 'b' value in LWR may vary due to combination of one or more factors such as area / season effect, habitat, age, gonadal maturity, fish condition and fish health.

Table 2: Statistical estimates of various morphometric characteristics.

Statically estimation	MAX (CM)	MIN (CM)	MEAN (CM)	STD DEV
TL & WT	29.8	26.7	20.7	1.21
TL & FL	28.7	27.9	20.9	1.23
TL & SL	29.7	22.9	20.7	1.28
TL & HL	25.6	23.7	20.5	1.29
TL & DFL	22.0	22.8	20.7	1.25
TL & PFL	22.9	22.7	21.9	1.20
TL & CPL	27.9	23.8	20.1	1.27
TL & GIR	28.6	26.92	21.5	1.22
TL & SNL	22.1	28.0	20.4	1.24
TL & AFL	23.5	27.6	20.3	1.26
TL & CCFL	21.6	21.8	18.6	1.22
HL & DCFL	24.8	26.3	20.5	1.25
HL & UCFL	29.5	28.4	20.8	1.20
HL & VFL	28.7	27.5	20.4	1.13
HL & ED	24.8	26.5	20.1	1.12

STD. Standard deviation; Min. = Minimum; Max: Maximum

Khan *et al.*(2012)reported isometric growth pattern of *Labeo bata* from river Ganga (b=3.02) and highly significant LWR ($r=0.99$). Naeem *et al.*(2012)also observed similar isometric growth of *Labeo bata* (b= 2.92) from Head Panjnad, Pakistan.Similar results is also published by Dars *et al.* (2010) from Keenjhar Lake, District Thatta, Sindh, Pakistan. While, Das *et al.* (2015)found b=3.06 and b=2.89 of *Labeo bata* for male and female respectively. In similar ecosystem when different growth condition is observed for male and female that might be due to feeding proficiency and loss of energy due to gonad development (Chatterji *et al.*, 1977).There are several reports on the

length-weight relationship around the world (Siglar, 1953; Van Woert, 1957; McAfee, 1966; Kwain, 1981; Pidgeon, 1981; Campos *et al.*, 1997; Zimmerman, 1999; Esmaeli and Ebrahimi, 2006). The 'b' value in the LWR of fish can be used as an indicator of food intake and growth pattern, and may differ according to biotic and abiotic factors such as water temperature, food availability and habitat type, feeding, state of maturity and sex(Hile and Jobs, 1940; Frost, 1945; LeCren, 1951;Wootton, 1990). 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). The

condition factor has least significant relationship with TL, and highly significant with BW (Naeem *et al.*, 2011a, b). 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).

The value of Fulton's condition factor in the present study ranged from 0.92 to 1.34 (average $K=1.14\pm 0.111$), which being very close to unity. That indicates the excellent condition of fish health.

'K' value in condition factor is depending on habitat, food source availability. Condition factor 'K' of fish above 1.0 indicating robustness or well-being, while lowest then 1 indicates poor condition of fish. Similar values of condition factor for rainbow trout have been reported by various authors. Rabe (1967) reported the value of condition factor to be between 0.859 and 1.104 for rainbow trout in Alpine lakes. Cada *et al.* (1987) reported condition factors for rainbow trout collected from southern Appalachian streams that ranged from 0.82 to 1.17. Murphy (1988) obtained an average condition factor value of 1.13 in rainbow trout from Kings River. Ensign *et al.* (1990) reported condition factor for *Rainbow trout* from a southern Appalachian stream within the range from 0.95 to 1.10. Zimmerman (1999) reported average condition factor of *Rainbowtrout* from Portal Lake as 1.09 ± 0.14 .

Labeo 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. Present findings are enough supported for culture of *Labeo bata* in such stream water ecosystem. In further, the growth condition and health status of this region fish will be baseline for the future researcher. It is might me concluded from the results that this region is rich and has great potential for aquaculture especially for culture of *Labeo bata*. Further, aquaculture researchers and fisheries scientists and government departments might pay attention on such huge resource to utilize for national purpose. International community might also cooperate and has research cooperation on such high value able fish for its culture and onward research.

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