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External Morphological Study of Wild *Labeo calbasu* with Reference to Body Weight' Total Length and Condition Factor from the River Chenab, Punjab, Pakistan

Muhammad Naeem, Asif Hussain Bhatti, Muhammad Fahad Nouman

***Abstract*—**115 samples of *Labeo calbasu* ranged 8.0-17.9cm length with mean11.90±1.96 and 4.9-68.5g weight with mean 22.25±12.54 from the River Chenab, Southern Punjab, Pakistan were analyzed to investigate length-weight relationships (LWR) of fish in relation to condition factor (K). 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 (PcFL), pelvic fin length (PvFL) and anal fin length (AFL) are found to be highly correlated with increasing total length and wet body weight (r > 0.500). Wet body weight has positive (r=0.540) and total length has no correlation (r=0.344) with calculated Condition factor (K). The slope "b" in the relationship is 3.27 and intercepts -2.2258.

Keywords*—Labeo calbasu*, Length-weight relationship, Body weight, condition factor

I. Introduction

In fishery sciences, length weight relationships provide statistics which is cornerstone in research and management and are major tools for precise estimation of biomass and calculation of length frequency samples to total catch [1]. This data is also an essential component of morphological and statistical analysis of fish growth, length and age ecological patterns and such other population structures [2].

Length weight relationships help in conversion of growth in length equations to growth in weight equations particularly in fishes which is a useful parameter for ichthyologists and fish farmers in assessment, culture and stocking of fish [3] - [5]. Length weight relationships are good indicators of fatness and fish condition [6], sexual development potential and comparative study of specific fishes in historical alike regions [7]. The concise relationship between body weight and length is always a unique; different among species of fishes and even fish of same species and this reflects innate, specific, robustness of fish and inherited body shape configuration [8].

Analysis of length weight data has directed toward mathematically described length- weight correlations that are changed to other predictive variable factors from expected weight for length of fish as indications of various morphological and physiological processes [6].

Muhammad Naeem is with the Institute of Pure and Applied Biology, Bahauddin Zakariya University, Multan, 60800, Pakistan (phone: +92-61-9210053; fax: +92-61-9210068; e-mail: dr_naeembzu@yahoo.com).

Asif Hussain Bhatti is with the Institute of Pure and Applied Biology,Bahauddin Zakariya University, Multan, Pakistan (e-mail: asif71@ymail.com).

Muhammad Fahad Nouman is with the Institute of Pure and Applied Biology, Bahauddin Zakariya University, Multan, Pakistan (e-mail: fahadnoumans@gmail.com).

These data has been considered analysis for which results do not warrant publication [9] or considered a low value analysis [10]. However, the recent review of methods and large scale such data analysis promoted fishery research to a valuable consideration [9]. An insufficient literature of length weight analysis exists on major carps of Asian countries so there was need to work and analyze length weight relationships more and easy cultivable fishes; i.e. carps in order to meet the food scarcity challenges provided by rapid urbanization and over population. Among more abundant carps in Asia *Labeo calbasu* is food important teleost inhabiting in diverse range including Pakistan, India, Myanmar, Yamuna, Thailand and Bangladesh. In polyculture Labeo calbasu grows well but in recent years, the natural breeding of *L. calbasu* has become uncertain due to continuous habitat degradation caused by environmental modification and human interventions (overfishing, dam construction, pollution etc.) affecting feeding migration and spawning which decreasing its population size in all Bangladeshi rivers [11].

Generally *L. calbasu* is a bottom feeder. It feeds on vegetable matter, crustaceans, insect larvae etc. *Labeo calbasu* feeds on algae 10%, higher plants 48%, protozoa 12%, crustacean 10%, mollusca 5%, mud and sand 15% [12] so there is no need of much attention in its cultivation. They are also seen in deep pools clear sluggish streams, creeks. It can be reared in ponds and tanks [12],[13].

It feeds on dead and decaying matter at the bottom so it acts as scavenger and improves the sanitation of the tank [12].

River is the major source of major carp species for aquaculture and its contribution has been condensed to (1%) in 2003 as compared to 80% in the early 1980s [14]. On the other hand, the public demand for fish meat has amplified many times; so, fry fish meat production in public hatcheries has increased. 5.36g oil is found form 65 cm of its liver. Its liver oil contains Vitamin "A". This fish is in great demand in the market. It is a good sport on rod and line [15].

The main focus of this study is to analyze length weight relationships of *Labeo calbasu* in relation to condition factor from southern Punjab, Pakistan.

II. Materials and Methods

115 Specimens of *Labeo calbasu* were collected from the River Chenab southern Punjab, Pakistan during the rainy season (July and August 2010). Specimens collected were kept in polythene bags to reduce flesh shock to the lowest level while in transit to the Fisheries Laboratory, IP&AB, BZ University, Multan, Pakistan. Body weights of these fish were measured with the help of an electric balance to the nearest 0.1 g after removing the debris from the surface of body.

Total length (TL) and Standard length (SL) were measured from the terminal part of the snout to the tip of the caudal fin. Head width (HW) was taken as a straight distance between the eyes. Fin length and Fin base values are measured as Dorsal (DFL), pectoral (PcFL), pelvic (PvFL), anal (AFL) 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) and anal fin base (AFB) were measured in the same way systematically.

The length-weight relationship (LWR) of this data was analyzed and estimated by:

$$W = aL^b$$

where W= weight (g), L= total length (cm), a = constant, b= growth exponent. These parameters are then converted to logarithmic form that resulted in linear relationship as

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

Condition factor, K is determined by specific formula from obtained morphometric values. The formula is as under

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

where K= condition factor, W= total body weight (g), L= total length (cm). Comparative determinants resulting from comparison of the slopes of length-weight regressions and 3 by using student's t-test for each fish [16] and these were used to estimate whether fish grew isometrically or in other pattern. This t-test is important in ascertaining seasonal changes correlations in condition factor for the fish and to verify whether the decline in regression ("b value") showed a significant difference of 3.0. This shows the isometric type of growth, where (b=3.0).

TABLE I
CENTRAL TENDENCY VALUES INCLUDING MEAN ± S.D AND RANGE OF VARIOUS BODY MEASUREMENTS OF *LABEO CALBASU*.

Body Measurements	Mean ± S.D	Range
Total length (TL)	11.90±1.96	8.0-17.9
Wet weight (WW)	22.25±12.54	4.9-68.5
Standard length (SL)	9.40±1.60	2.8-13.6
Fork length (FL)	10.61±1.65	7.2-15.3
Head length (HL)	2.33±.37	1.5-3.2
Head length (HL)	2.33±.37	1.5-3.2
Body depth (BD)	3.77±.86	1.2-6.0
Head width (HW)	3.12±.56	2.2-5.0
Body girth (BG)	7.54 ± 1.72	2.4-12.0
Dorsal fin length (DFL)	2.8±.58	1.7-4.5
Dorsal fin base (DFB)	2.63±.49	1.6-4.0
Pectoral fin length (PtFL)	2.24±.42	1.3-3.3
Pelvic fin length (PvFL)	2.11±.42	1.3-3.1
Anal fin length (AFL)	2.04±.37	1.3-2.9
Tail width (TW)	3.71±.93	1.9-6.2
Caudal fin width (CFW)	3.60 - 0.72	1.7-5.7

SD = Standard Deviation

III. RESULTS AND DISCUSSION

In regression analyzed results, central tendency values of measured morphometric values such as mean values (±S.D), ranges and index of morphometery of external body parts of *Labeo calbasu* are given in Table I, which shows *Labeo calbasu* ranged from 8.0-17.9 cm total length with 11.90 mean value and 4.92-68.52g body weight with 22.25 mean value.

When total length was kept on x-axis and other morphometrics on y-axis then Length-weight relationship (LWR) is found to be highly significant correlated ($r = 0.976$; $P < 0.001$) with slope value 3.97 (95% CI of 3.13-3.40) in *Labeo calbasu*.

And other significant correlations exist in Standard length-Total length (SL-TL), Fin length-Total length (FL-TL), Head length- Total length (HL-TL), Head width- Total length (HW-TL), Body girth- Total length (BG-TL), Dorsal fin length-Total length (DFL-TL), Dorsal fin base- Total length (DFB-TL), Pectoral fin length- Total length (PcFL-TL), Pelvic fin length- Total length (PvFL-TL) and Anal fin length- Total length (AFL-TL) ($r>0.762$). Maximum correlation obseved in Fin length- Total length (FL-TL) ($r= 0.984$) while minimum in Standard length- Total length (SL-TL) ($r= 0.762$) (Table II).

By keeping wet body weight on x-axis and other morphometric values on y-axis results come approximately same with slightly different r values as compared to first one. Fin length- Weight (FL-W), Head length- Weight (HL-W), Head width- Weight (HW-W), Body girth- Weight (BG-W), Dorsal fin length- Weight (DFL-W), Dorsal fin base- Weight (DFB-W), Pectoral fin length-Weight. (PcFL-W), Pelvic fin length- Weight (PvFL-W) and Anal fin length- Weight (AFL-W) have significant correlation ($r>0.784$).

Coefficient of determination (r^2) is also very high length weight relationships except correlation of length or weight with condition factor ($r^2 >0.576$).

Length-Weight Relationships were also studied by Yusaf *et al.*, [17] Naeem *et al.*, [18],[19],[28],[29]. The estimated value of b in total length-weight relationship is 3.27 ($p<0.05$) showing positive allometric growth for *Labeo calbasu* same as exhibited for *Mullus barbatus*, *Merluccius merluccius*, and *Scomber scombrus* ($p<0.05$) but contrast to slopes for *Sparus aurata*, *Diplodus annularis* and *Pagellus erythrinus* ($p>0.05$) [20].

While "b" value for relationship studied other than total length-weight relationship is much lower than 3.0 hence shows negative allometric growth.

TABLE II
DESCRIPTIVE STATISTICS AND REGRESSION PARAMETERS OF TOTAL LENGTH (TL, CM) WITH DIFFERENT MORPHOMETRICS FOR *LABEO CALBASU*

Equation	Relationship Parameters a	b	95% CI of a	95% CI Of b	r	r^2
W = a + b TL	-2.2258	3.27	-2.3582 to -2.0669	3.13-3.40	0.976***	0.953
K = a + b TL	-0.2125	0.26	-0.3581 to -0.0669	0.13- 0.40	0.344[ns]	0.119
SL = a + b TL	0.0045	0.90	-0.1477 to 0.1567	0.75- 1.04	0.762***	0.582
FL = a + b TL	0.0226	0.93	-0.0107 to 0.0559	0.90- 0.96	0.984***	0.969
HL = a + b TL	-0.4767	0.78	-0.5977 to -0.3558	0.67– 0.90	0.791***	0.627
HW = a + b TL	-0.5223	0.94	-0.6360 to -0.4086	0.83- 1.05	0.856***	0.733
BG = a + b TL	-0.4542	1.23	-0.6301 to -0.27824	1.06– 1.40	0.813***	0.662
DFL = a + b TL	-0.8044	1.16	-0.8997 to -0.7091	1.07 –1.25	0.925***	0.855
DFB = a + b TL	-0.7441	1.08	-0.8248 to -0.6633	1.06- 1.15	0.936***	0.877
PtFL = a + b TL	-0.8224	1.09	-0.9240 to -0.7207	0.99– 1.18	0.905***	0.820
PvFL = a + b TL	-0.8578	1.09	-0.9766 to -0.7390	0.98– 1.20	0.879***	0.773
AFL = a + b TL	-0.6980	0.93	-0.8270 to -0.5689	0.81– 1.05	0.822***	0.677

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

TABLE III
DESCRIPTIVE STATISTICS AND REGRESSION PARAMETERS OF TOTAL LENGTH (TL, CM) WITH DIFFERENT MORPHOMETRICS FOR *LABEO CALBASU*

Equation	Relationship Parameters a	b	95% CI of a	95% CI Of b	r	r^2
K = a + b W	-0.0871	0.13	-0.1346 to -0.0397	0.08 - 0.16	0.540**	0.292
SL = a + b W	0.6231	0.27	0.5675 to 0.6788	0.22 - 0.30	0.759***	0.576
FL= a + b W	0.6669	0.28	0.6513 to 0.6826	0.26 - 0.28	0.973***	0.948
HL = a + b W	0.0647	0.23	0.0201 to 0.1094	0.19 - 0.26	0.784***	0.616
HW = a + b W	0.1238	0.28	0.0831 to 0.1645	0.25 - 0.31	0.861***	0.741
BG = a + b W	0.3834	0.38	0.3220 to 0.4449	0.32 - 0.42	0.829***	0.688
BD = a + b W	0.0688	0.39	0.0091 to 0.1286	0.34 - 0.43	0.843***	0.711
DFL = a + b W	-0.0117	0.35	-0.0442 to 0.0208	0.32 - 0.37	0.934***	0.873
DFB = a + b W	-0.0084	0.33	-0.0342 to 0.0174	0.30 - 0.34	0.951***	0.905
PtFL = a + b W	-0.0825	0.33	-0.1162 to -0.0488	0.30 - 0.35	0.922***	0.851
PvFL = a + b W	-0.1127	0.33	-0.1527 to -0.0728	0.30 - 0.36	0.897***	0.806
AFL = a + b W	-0.0583	0.28	-0.1046 to -0.0119	0.24 - 0.31	0.827***	0.684

Change of *b* values does not depend only on the shape and fatness of the species, but there are many other various factors which influence the differences in parameters of the LWR among seasons and years, such as temperature, salinity, food (quantity, quality and size), sex, time of year and stage of maturity and "b" value is variable with season, habitats and even with daily changes as compared to "a" value which is more constant as described by Gonçalves *et al.* [21] and Özaydin *et al.* [5], so in the present work the length-weight relationship in fish are considered not to be influenced by none of environmental factors.

Condition factor (K) intended for *Labeo calbasu* varied from 0.79-1.81±0.150, which is lower than *S. melanotheron* (1.40-3.60±2.79), *H. bimaculatus* (1.14-3.13±1.79) and *C. guentheri* (1.13- 2.24±1.67) [22] showing less seasonal variation occurred in k factor of *Labeo calbasu.*

Significant correlation is there in condition factor and wet body weight (r = 0.540) and condition factor remains constant with increase in total length. (r = 0.344) (Table II and III) same as in farmed hybrid (*Catla catla* x *Labeo rohita*) reported by Naeem *et al.* [18] and in *Oreochromis mossambicus* by Naeem *et al.* [23]. Variation of condition factor is possible in special cases described by Charlander *et al.* [24]. Sexual reproductive behavior and condition factor are closely related with reference to specific habitat of fishes reported by Ugwumba [25], Aboaba [26] and Saliu [27].

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