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Length–weight and length-length relationships of a silurid catfish, *Ompok bimaculatus* from Chenab River, Multan, Pakistan

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Abstract: The present work reports the length–weight relationship (LWR) and length-length relationships (LLRs) for *Ompok bimaculatus*, collected from the Chenab River, Multan, Pakistan during May, 2020. Mean (±SE) body weight (W), total length (TL), standard length, fork length, head length and body girth of the studied samples of *O. bimaculatus* were found 28.25±2.51g, 17.70±0.50 cm, 15.54±0.45 cm, 16.37±0.47 cm, 3.29±0.10 cm and 6.73±0.20 cm, respectively. Whereas, mean (±SE) values of dorsal fin length, pectoral fin length, pelvic fin length, anal fin length and caudal fin length were found 2.06±0.06, 2.14±0.07, 1.04±0.03, 9.29±0.27 and 2.16±0.06cm, respectively. All the regressions for LWR and LLRs were found highly significant (P<0.001). LWR ($W = a\ TL^b$) found $W = -2.3916TL^{3.03}$ for *O. bimaculatus* indicating isometric pattern of growth, with coefficient of determination (r^2) value being 0.981. Results of LLRs indicate that all the studied morphometric length parameters represented isometric pattern of growth, except for body girth, pelvic fin length and caudal fin length which showed negative allometric pattern of growth with an increase in TL for wild *O. bimaculatus*. The findings of present work could be helpful to fill the knowledge gap, and for conservationand sustainable management of the investigatedcatfish species.

Keywords: *Ompok bimaculatus*, Catfish, Morphometry, LWR, LLR, Growth pattern

1. INTRODUCTION

The Butter Catfish, *Ompok bimaculatus* (Siluriformes: Siluridae), locally known as Pafta in Pakistan, is widely distributed in inland waters throughout South-East Asian countries (Day, 1981), and recognized for its excellent taste (Pradhan *et al*., 2014). *O. bimaculatus*is also known as 'two-spot glassy catfish 'in global ornamental fish trade (Chawpaknum *et al*., 1990). However, due to indiscriminate fishing and several ecological variations, in its natural habitats, its wild population has declined gradually (Debnath *et al*, 2016).

Today it is essential to build fisheries management on solid stock assessment of the fisheries resources. Length-weight relationships (LWRs) are important morph metrics which have significant implications for fishery management if collected together with other key population parameters (Chen *et al*., 2020), due to the fact that the LWR can be used to estimate the weight corresponding to a given length and so define condition of fish (Froese, 2006). Besides that, LWR could be used for comparing growth among different seasons, gonad stages populations and between sexes (Vicentin *et al*., 2018).

LWR is a biological estimate adopted to assess population structure, which offers data on biomass of the study population, and permits correlations with various environmental conditions (Nascimento *et al*., 2012) and also aids to know life cycle of a fish species (Freitas *et al*., 2014). This quantitative criterion is also vital for conservation strategies of fishery stocks, considering their ecological and status (Fonteles-Filho, 2011).

Studies of LWR, combined with length–length relationships (LLRs), allows to compare the growth of the populations, aiding in proper management (Machado *et al*., 2017).Consequently the LLRs of fish species under various environmental conditions should be known to make the results more reliable when making comparisons between populations (Moutopoulos and Stergiou, 2002).

River Chenab is the second largest river of Pakistan and one of the highly hydrologically managed rivers for irrigation in South Asia. However, this water body is facing numerous environmental problems related to industrialization, agricultural advancements, human population growth and rapid urbanization which are key

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threats to aquatic diversity. *Ompok bimaculatus* have limited number and restricted distribution in this river as compare to carps and other catfishes (Kausar *et al*., 2018).

The present work has been undertaken to estimate the LWR and LLRs for a silurid catfish, *Ompok bimaculatus*, from Chenab River, Multan, southern Punjab, Pakistan.

2. MATERIALS AND METHODS

A total of 51 fish specimens of *Ompok bimaculatus* (Bloch, 1794), for the present study were sampled during summer season (May), 2020, from the Chenab River, near the bridge of Head Muhammad-Wala (30.289630°N, 71.380430°E), Multan, southern Punjab, Pakistan. The collected specimens were transported to laboratory, where their biometric data comprising various body lengths (total length, standard length, fork length, head length, body girth); fin lengths i.e. dorsal fin, pectoral fin, pelvic fin, anal fin and caudal fin; and weight of each fish sample were recorded, with precision of 0.1 cm for length parameters and 0.01 g for weight.

Statistical relationships of LWR and LLRs for *O. Bimaculatus* were evaluated by linear regressionsusing the equation, $logy = log\ a + b\ log\ X$, where *Y* is weight for LWR or various length parameters for LLRs, *X* is total length, *'a'* is intercept and '*b'* is regression coefficient. Outliers were identified graphically by plotting *TL* and *W*, and eventual removed (Froese, 2006) before analysing for LWR and LLRs.The fit of the model to the data was determined by the coefficient of Pearson *r*-square (r^2). The allometric growth patterns for the studied specimens of *O. bimaculatus* were also calculated both for LWR and LLRs. Positive allometric, negative allometric and isometric patterns of growth were designated by $b>1$, $b<1$, $b=1$, respectively (Zelditch *et al*., 2004; Ishtiaq and Naeem, 2016).

3. RESULTS

Body weight (W) and total length (TL) of *Ompok bimaculatus* was ranged 3.19-80.20 g and 8.60-25.30 cm with mean (±SE) values 28.25±2.51 g and 17.70±0.50 cm, respectively. Standard length (SL), fork length (FL), head length (HL) and body girth (BG) of the studied samples of *O. bimaculatus* were found 15.54±0.45, 16.37±0.47, 3.29±0.10 and 6.73±0.20 cm, respectively. Fin lengths (cm) of wild captured *O. bimaculatus* including dorsal fin length (DFL), pectoral fin length (PFL), pelvic fin length (VFL), anal fin length (AFL) and caudal fin length (CFL) were also measured and mean (±SE) values were found 2.06±0.06, 2.14±0.07, 1.04±0.03, 9.29±0.27 and 2.16±0.06cm, respectively. Descriptive statistics of various morphometric length parameters (cm) including fin lengths of wild *O. bimaculatus* are also presented in (**Table 1)**.

Table 1: Descriptive statistics of body weight (g) and various morphometric length parameters (cm) of wild *Ompok bimaculatus*.

Parameter	Min	Max	Mean±SE
Body weight (W)	3.19	80.20	28.25±2.51
Total length (TL)	8.60	25.30	17.70±0.50
Standard length (SL)	7.30	22.00	15.54±0.45
Fork Length (FL)	7.80	23.40	16.37±0.47
Head length (HL)	1.20	5.20	3.29±0.10
Body girth (BG)	3.80	11.00	6.73±0.20
Dorsal fin length DFL)	0.80	3.20	2.06±0.06
Pectoral fin length PFL)	1.20	3.40	2.14±0.07
Pelvic fin length (VFL)	0.50	1.90	1.04±0.03
Anal fin length (AFL)	4.50	13.10	9.29±0.27
Caudal fin length (CFL)	1.20	3.30	2.16±0.06

Results for length-weigh relationship (LWR) were plotted as scatter graphs, andare described as **(Fig 1-2).** The relationship between total length (TL) and body weight (W) of *O. bimaculatus* was found exponential having the general form $Y = aX^b$ **(Fig 1)**.Whereas linear relationship was obtained in logarithm-transformed data of TL and W of *O. bimaculatus* **(Fig 2)**, with regression equation as:

$$Log\ W = -2.3916 + 3.03\ Log\ TL$$

LWR for studied samples of *O. bimaculatus* exhibited strong significant correlation ($P< 0.001$), comprising coefficient of determination (r^2) value being 0.981. Regression coefficient (*b*-value) was found 3.03 (95% CI of $b = 2.91–3.16$), representing isometric pattern of growth in the specimens of wild *O. bimaculatus*, during summer season.

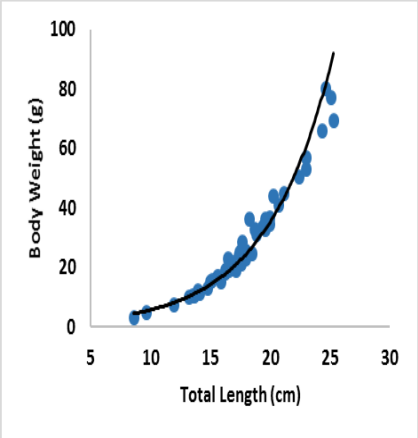

Fig 1: Relationship between total length (cm) and body weight (g) of *Ompok bimaculatus*.

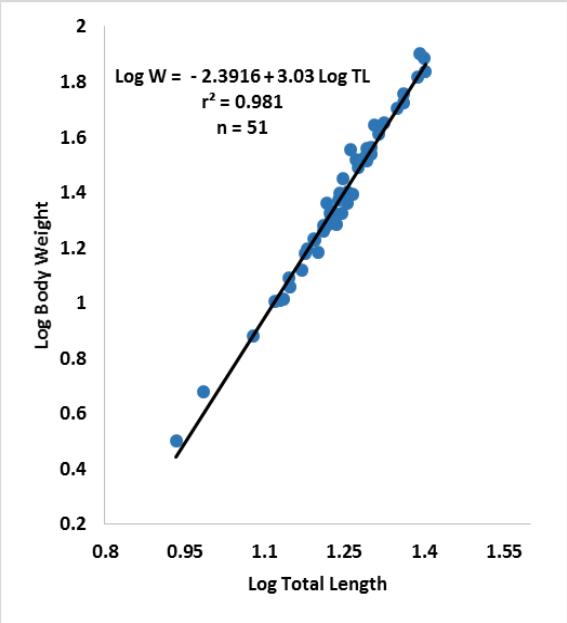

Fig 2: Relationship between total length (cm) and body weight (g) for log transfomed data of *Ompok bimaculatus*.

Results for length–length relationships (LLRs) of wild *O. bimaculatus* including values of *a* and *b* and their associated statistical information are summarized in **Table 2**. Various studied LLRs of wild *O. bimaculatus* indicated strong significant positive correlation at $P < 0.001$, with r^2-value range 0.624–0.997.

4. DISCUSSION

Results of present study demonstrate that all the regressions for LWRs and LLRs were strongly significant ($P < 0.001$) with high r^2 values ranging from 0.862 to 0.997, except for two LLRs, which were as minimum as 0.776 and 0.624. The high values of r^2indicate that the length relationships are linear over the observed range of values. However, less value may indicate the inclusion of inappropriate size in the collected data or juvenile may have different LLRs, as described by Froese (2006). The regression coefficient (*b*) values, in LWRs, ranging from 2.5 to 3.5 are more common (Carlander, 1969; Froese, 2006) for freshwater fish species. The results of LWR represented that assessed regression for *O. bimaculatus* had *b*-value within normal range.

Table 2: Statistics of length- length relationships for wild *Ompok bimaculatus*.

Equation	a	95% CL of a	b	95% CL of b	r^2
SL = *a* + *b* TL	-0.0924	-0.1139 to -0.0709	1.03	1.01–1.05	0.997
W = *a* + *b* TL	-2.3916	-2.5431 to -2.2400	3.03	2.91–3.16	0.981
FL = *a* + *b* TL	-0.0466	-0.0672 to -0.0260	1.01	0.99–1.03	0.997
HL = *a* + *b* TL	-0.7961	-0.8931 to -0.6990	1.05	0.97–1.13	0.937
BG = *a* + *b* TL	-0.2699	-0.3952 to -0.1446	0.88	0.78–0.98	0.862
DFL = *a* + *b* TL	-0.9914	-1.1041 to -0.8788	1.05	0.95–1.14	0.916
PFL = *a* + *b* TL	-0.9004	-1.0166 to -0.7842	0.99	0.89–1.08	0.901
VFL = *a* + *b* TL	-1.0056	-1.2316 to -0.7796	0.82	0.63–1.00	0.624
AFL = *a* + *b* TL	-0.2831	-0.3438 to -0.2223	1.00	0.95–1.05	0.972
CFL = *a* + *b* TL	-0.6685	-0.8222 to -0.5147	0.80	0.68–0.93	0.776

a, intercept; b, regression coefficient or slope; CL, confidence limits; r^2, coefficient of determination

For fishes which maintain the same shape, growth is isometric ($b = 3$), indicate that along ontogenetic growth, there is no change in shape of fish (Froese, 2006), however it is not so in fishes which change their shape as growth advances (Le Cren, 1951). Thus isometric growth in the present study depicts that *O. bimaculatus* maintain the same shape as growth advances, and small sized specimens in the fish sample have the same form as large specimens, also described by Froese (2006).

In LWR, regression coefficient (*b*-value) of *Ompok bimaculatus* computed in present study was 3.03 which was compared favorably with what available in global electronic database of fishes, Fish Base (Froese and Pauly, 2019). The results of the LWR in this study also agreed with those of Mishra *et al.* (2013), who have documented this coefficient ranging from 3.06 to 3.76 in wild captured specimens of *O. bimaculatus*. But Muhammad *et al.* (2017) reported this value 2.87 for *O. bimaculatus*. This variation might be due to difference in size of fish specimens. Size range of *O. bimaculatus*, 89–146 g and 26.6–31.5 cm, documented by Muhammad *et al.* (2017) from the Taunsa Barrage, Indus River, Pakistan also indicates that larger size of *O. bimaculatus* than that of present study is also found in the water bodies of Pakistan. Furthermore,

Sangpradub *et al*. (2014) noted that *b*-value of *O. bimaculatus* is also affected by sample size and season, i.e. found lower in the cool and rainy seasons while higher in hot season than 3.

It is also evident from various studies that regression coefficient (*b*) in LWR varies greatlyfrom species to species. Regression coefficient (*b*) of *Mystus bleekeri* (Siluriformes: Bagridae) has reported 2.62 by Naeem *et al*. (2012) and *b*= 2.85 for wild *Tor putitora* (Cyprinidae) (Naeem *et al*., 2011) showing allometric growth. Oliveira *et al*. (2020) also documented allometric growth with higher value of this coefficient (*b*=3.58) for *Trachelyopterus galeatus* (Siluriformes) from Brazil. Whereas, findings of Ishtiaq and Naeem (2016) denoted isometry (*b* = 3.04) in *Catla catla* (Cyprinidae). Moreover, the difference in *b*-values is also due to the fact that LWRs in fishes can be affected by a number of factors like differences in the length range, sex, gonad maturity, availability of food, degree of stomach fullness and environmental conditions (Tesch, 1971; Bagenal and Tesch, 1978; Froese, 2006); none of which has been considered in the present work.

In LLRs, regression coefficient (*b*-value) being 1 or very close to 1, indicated isometric growth pattern in SL, FL, HL, DFL, PFL and AFL, whereas BG, VFL and CFL represented negative allometry with an increase in TL of the studied specimens of wild *O. bimaculatus*. The findings of LLRs in present work are agreed with the results of Silva *et al*. (2020) who have reported the length-length relationships of the convert standard length to total length for 25 fish species from Xingu River basin, Brazil, with *b*-value ranging from 0.971 to 1.156. Results are also synchronized with the reported studies of Khalid, *et al*. (2020) and Naeem *et al*. (2012) who have stated positive significant correlation in the LLRs forfarmed *Catla catla* and wild *Mystus bleekeri*, respectively.

Present study will contribute knowledge on the population in the region and assist to the ichthyologists for the conservation and future studies.

5. CONCLUSION

The regression equation of length–weight relationship obtained in this work demonstrated that *Ompok bimaculatus* had isometric growth pattern and hence displayed the ideal shape of fish. This indicates that there was dimensional proportionality (in total length and body weight) of *O. bimaculatus* at the same rate, hence this fish species does not change its shape as it grows. Standard length, fork length and head length also grow proportionally at the same rateas total length of *O. bimaculatus* increases. Although the present study provides a baseline information on LWR and LLRs of wild *O. bimaculatus* during summer season, however, further research needs to be conducted on the investigated fish in order to validate and obtain more information about biology, growth pattern, and physiology of this valued catfishin different seasons.

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