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Morphometric study of *Puntius sophore* (Hamilton, 1822) with special reference to body length-weight from Chenab River, Punjab, Pakistan

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Abstract

A total of 231 samples of *Puntius sophore* ranged 3.0-16cm total length with mean 7.54 ± 1.77 and 0.4-31g body weight with mean 7.14 ± 5.03 from the downstream of Qadirabad barrage, Chenab River, Pakistan were analyzed to investigate some morphometric characters in relation to body length-weight of this fish. Standard length, fork length, head length, head width, body depth, body girth, pre-dorsal length, post-dorsal length and length of caudal peduncle are found to be highly correlated with increasing total length and body weight ($r = 0.928$; $p < 0.01$). The slope "b" in the length-weight relationship is 2.63 indicating negative allometric growth. This fish being small in size is heavily targeted by fishermen and local fisher community. This is the first report on any biological aspect of this potentially important small indigenous species from river Chenab. This data will be useful for researchers and fisheries policy makers for future management of this species.

Keywords: *Puntius sophore*, length-weight relationship, Chenab, allometric growth

Introduction

Fishes are regarded as highly important both nutritionally and economically. Knowledge of quantitative aspects of fishes such as Length-weight relationships (LWRs) and length-length relationships (LLRs) are important tools for the fish stock assessment, knowing well-being/fitness of individuals, comparing life histories of separated populations of same fish species present in different regions and proper management of their populations. LWRs are often used for estimating the average weight of a fish from a given length group of that species by establishing a mathematical relationship between them ^[1]. For the comparative growth studies of a fish population LLRs are considered as highly important ^[2].

Pakistan is bestowed with diverse freshwater ichthyofauna. Among cyprinids, *Puntius sophore* (Hamilton, 1822) locally known as 'Chiddu' is one of the most important small indigenous fish species (SIFS) found in almost all rivers, streams, ponds and lakes of Pakistan ^[3-8]. It is a shoaling fish and highly nutritious both in fresh and dried state ^[9]. Small indigenous fish species are a rich source of vitamin A and calcium in the diets of rural households of Bangladesh ^[10]. This fish is a popular food fish item and a major source of proteins and micronutrients in the diet of rural small scale farmer communities of Bangladesh ^[11-12]. Being small in size it is heavily targeted by fishermen communities who used it as bait for their traditional fishing gears. The population of *P. sophore* has been reported to seriously decline from various Indian water bodies including Western Ghats, Harike wetland, Gomti River mainly due to its over exploitation and thus categorized as lower risk to near threatened species ^[13-15].

Data on the biology of this fish is available from several studies ^[16-21]. Most of the data for this species are from Bangladeshi and Indian water bodies. However the data about the basic biological aspects of this species is scarce from Pakistan. Therefore, present study was carried out to assess morphometric relationships of various body parts to the total length and body weight of *P. sophore*. This data will be useful for fish farmers, researchers and fisheries personnel's for the proper management and conservation of this species.

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Materials and Methods

Qadirabad barrage (32019'04 N, 073041'36 E and elevation 210 M) is 45 Km away from district Gujranwala. A total of 231 samples of *P. sophore* were collected mainly from downstream on monthly basis from September 2015 to May 2016. Cast nets having variable mesh sizes were employed for capturing fish. Collected samples were immediately preserved in 10% formalin and shifted to the Laboratory at Fisheries Research & Training Institute Manawan, Lahore for their further study. After tagging, body weights (BW) and total length (TL) of all the fish samples was noted nearest to 0.1g and 0.01cm respectively. For each individual other morphometric characteristics such as Standard Length (SL), Fork Length (FL), Head Length (HL), Head Width (HW), Body Depth (BD), Body Girth (BG), Pre-dorsal Length (Pr.L), Post-dorsal Length (Ps.L) and Length of Caudal Peduncle (LCP) were measured.

The LWRs was estimated by using this equation $W = aL^b$. Logarithmic form of the above given equation was used as: $\log W = \log a + b \log L$ (Where W= Body weight; a= Constant; L= Total length and b= Regression coefficient)

The normality of collected data was checked by using Kolmogorov-Smirnov test. Additionally, data were subjected to regression analysis for estimating 95% Confidence Interval (CI) of a and b, and the coefficient of determination r^2 . All statistical analyses were considered significant at $p < 0.01$.

Results

A total of 231 specimens of *P. sophore* were collected from the downstream of Qadirabad barrage. In regression analysis, the central tendency values such as mean, standard deviation and ranges for all the morphometric characteristics of *P. sophore* were measured. It appeared that the total length of *P. sophore* fishes ranges from 3.0-16.0 cm and body weight ranges from 0.4-31g. The mean values (\pm S.D) for total length

and body weight were 7.54 ± 1.77 and 7.14 ± 5.03 respectively. The mean values (\pm S.D) for other morphometric characteristics such as standard length; fork length; head length, width; body depth, girth; pre and post dorsal length and length of caudal peduncle were 5.99 ± 1.47 ; 6.13 ± 1.53 ; 1.7 ± 0.37 , 1.48 ± 0.41 ; 2.39 ± 0.60 , 2.59 ± 0.63 ; 3.21 ± 1.23 , 2.1 ± 0.65 and 1.18 ± 0.35 respectively (Table 1).

Table 1: Central tendency values including Mean \pm S.D and range of various body measurements of *Puntius sophore*.

Body Measurement	Mean \pm S.D	Range
Total Length (TL)	7.54 \pm 1.77	3.0-16.0
Body Weight (BW)	7.14 \pm 5.03	0.4-31
Standard Length (SL)	5.99 \pm 1.47	2.2-13.9
Fork Length (FL)	6.13 \pm 1.53	2.0-14.3
Head Length (HL)	1.7 \pm 0.37	0.5-3.2
Head Width (HW)	1.48 \pm 0.41	0.5-2.9
Body Depth (BD)	2.39 \pm 0.60	0.7-3.6
Body Girth (BG)	2.59 \pm 0.63	1.2-4.0
Pre-dorsal Length (Pr.L)	3.21 \pm 1.23	1.0-18.0
Post-dorsal Length (Ps.L)	2.1 \pm 0.65	0.2-5.6
Length of Caudal Peduncle (L.C.P)	1.18 \pm 0.35	0.1-2.4

SD= Standard deviation

When total length was taken on x-axis and other morphometrics of *P. sophore* on y-axis then LWR is found to be highly significantly correlated ($r = 0.928$; $p < 0.01$) with slope value 2.639 (95% CI of 2.501-2.777). Other significant correlations were found in standard length-total length (SL-TL), fork length-total length (FL-TL), head length-total length (HL-TL), head width-total length (HW-TL), body depth-total length (BD-TL), body girth-total length (BG-TL), pre-dorsal length-total length (Pr.L-TL), post-dorsal length-total length (Ps.L-TL) and length of caudal peduncle-total length (LCP-TL) (Table 2). Among these characters maximum correlation was observed in SL-TL ($r = 0.960$) and minimum in Pr.L-TL ($r = 0.511$).

Table 2: Descriptive statistics and regression parameters of total length (cm) with different morphometric characteristics of *P. sophore*.

Equation	a	b	95% CI of a	95% CI of b	r	r^2
BW = a + b TL	-1276	2.639	- 13.83 to -11.70	2.501 to 2.777	0.928**	0.862
SL = a + b TL	-0.025	0.798	-0.259 to 0.209	0.768 to 0.828	0.960**	0.922
FL = a + b TL	-0.045	0.819	-0.329 to 0.238	0.782 to 0.855	0.946**	0.894
HL = a + b TL	0.266	0.191	0.169 to 0.363	0.179 to 0.204	0.894**	0.800
HW = a + b TL	-6.092	0.196	-0.126 to 0.126	0.180 to 0.212	0.843**	0.711
BD = a + b TL	0.155	0.297	-0.020 to 0.330	0.274 to 0.319	0.863**	0.744
BG = a + b TL	0.180	0.320	0.018 to 0.342	0.299 to 0.341	0.894**	0.799
Pr.L = a + b TL	0.508	0.358	-0.098 to 1.115	0.280 to 0.436	0.511**	0.262
Ps.L = a + b TL	-0.429	0.335	-0.580 to -0.278	0.316 to 0.355	0.913**	0.834
LCP = a + b TL	-0.007	0.158	-0.129 to 0.115	0.142 to 0.174	0.794**	0.631

a= intercept; b= regression coefficient; CI= confidence interval; r= coefficient correlation. **Correlation is significant at the 0.01 level (2-tailed).

By keeping body weight on x-axis and other morphological characteristics on y-axis, it was observed that there exists a significant correlation among them (Table 3). Among these, the maximum value of correlation was observed for standard

length-body weight (SL-BW) ($r = 0.916$; 95% CI of 0.252-0.283) and minimum for pre-dorsal length-body weight (Pr.L-BW) ($r = 0.479$; 95% CI of 0.090-0.146).

Table 3: Descriptive statistics and regression parameters of body weight (g) with different morphometric characteristics of *P. sophore*.

Equation	a	b	95% CI of a	95% CI of b	r	r^2
SL = a + b BW	4.082	0.268	3.949 to 4.216	0.252 to 0.283	0.916**	0.839
FL = a + b BW	4.186	0.272	4.032 to 4.341	0.255 to 0.290	0.894**	0.800
HL = a + b BW	1.264	0.063	1.216 to 1.311	0.057 to 0.068	0.831**	0.691
HW = a + b BW	1.004	0.066	0.949 to 1.058	0.060 to 0.072	0.811**	0.658
BD = a + b BW	1.675	0.100	1.598 to 1.751	0.092 to 0.109	0.831**	0.691
BG = a + b BW	1.822	0.108	1.749 to 1.895	0.100 to 0.117	0.860**	0.739
Pr.L = a + b BW	2.366	0.118	2.121 to 2.612	0.090 to 0.146	0.479**	0.992
Ps.L = a + b BW	1.313	0.110	1.237 to 1.389	0.102 to 0.119	0.855**	0.731
LCP = a + b BW	0.805	0.053	0.754 to 0.857	0.047 to 0.059	0.759**	0.576

a= intercept; b= regression coefficient; CI= confidence interval; r= coefficient correlation. **Correlation is significant at the 0.01 level (2-tailed).

The highest value for coefficient of determination (r^2) was found for pre-dorsal length-body weight ($r^2=0.992$) and lowest for pre-dorsal length-total length ($r^2=0.262$). The b values for all the studied relationships were found less than 3. This shows negative allometric growth of various body parts of this fish in relation to their total length and body weight. The change in 'b' value ($b=3$ isometric growth, $b<3$ negative allometric growth and $b>3$ positive allometric growth) not only depends on length-weight of a fish but also on some other factors such as temperature, salinity, food availability, sex, stage of maturity, time of year and even with daily changes as compared to 'a' value which is more constant.

Discussion

In the present study, 231 samples of *P. sophore* belonging to different size classes were collected. The total length ranges from 3 to 16 cm and body weight from 0.4 to 31g. The value of the growth coefficient (b) was 2.639. This value is significantly smaller than 3 showing that weight of the fish is less than a cube of its length and thus does not follow the cube law showing negative allometric growth. Similar results to present study were reported for this fish species collected from Padma River, Bangladesh [16]. The maximum size and weight reported for this fish was 10.6 cm and 17 g which is much smaller than present study. Their value of b was 0.48 showing negative allometric growth of this fish. The LWR of *P. sophore* collected from Indus river, Pakistan showed positive allometric growth ($b= 3.18$) for this fish [22]. Their results are contrasting to our study. The maximum total length and body weight reported for this fish was 8.5 cm and

9 g which is much lesser than present results. *P. chola* collected from a freshwater reservoir of Pakistan showed negative allometric growth ($b= 2.80$) [23]. *P. ticto* also showed negative allometric growth ($b= 2.95$) from Ganga river, Bangladesh [24]. The results of their studies are also similar to our findings.

The maximum recorded length and weight of *P. sophore* from the Kolkata fish market, India was 11.10 cm and 21.1 g and significant correlation between length-weight ($r= 0.934$) was reported [19]. Similar results were found for the LWR ($r=0.928$ when $p<0.01$) in the present study ($r=0.928$ when $p<0.01$). In some Bangladeshi water bodies isometric growth ($b= 2.95$) of *P. sophore* was reported with a maximum recorded total length of 10.66 cm [17]. The LWR was reported highly significant ($r= 0.945$) also supporting the results of the present study.

In contrast to the present study, some other researchers reported positive allometric growth of *P. sophore* collected from different water bodies [19, 22, 25]. The values for regression slope (b) for different species of *Puntius* genus are presented in (Table 4). The total length estimated for this fish in the present study was found higher, when compared to the previously conducted studies in some other localities. The total length and weight of *P. sophore* collected from Chalan beel, Bangladesh range from 3.62-9.02 cm and 0.70-13.20 g respectively [18]. The recorded maximum length and weight of this fish is much smaller compared to the present study. *P. binotatus* showed positive allometric growth of Fish farm, Malaysia, similar to the present study.

Table 4: Regression coefficient for length-weight relationships of some *Puntius* species from different locations.

Fish species	Slope (b)	Locations	References
<i>P. sophore</i>	0.48	Padma river, Bangladesh	16
<i>P. sophore</i>	2.98	Bangladeshi waters	17
<i>P. sophore</i>	3.39	Chalan beel, Bangladesh	18
<i>P. sophore</i>	3.24	Kolkata Fish markets, India	19
<i>P. sophore</i>	3.18	Indus river, Pakistan	22
<i>P. chola</i>	2.80	Freshwater reservoir, Pakistan	23
<i>P. ticto</i>	2.95	Ganga river, Bangladesh	24
<i>P. sophore</i>	3.05	Mathabhanga river, Bangladesh	25
<i>P. binotatus</i>	3.35	Fish Farm, Malaysia	26
<i>P. sophore</i>	2.63	Chenab river, Pakistan	Present study

The size of *P. sophore* ranges from 5.3-9.6 cm and standard deviation 7.73 ± 1.19 [27]. The results of this study reported allometric growth of this fish. Also, all morphometric characters showed high degree of interdependence supporting the results of the present study.

Conclusion

This is the first report on the morphometrics and length-weight relationships of *P. sophore* from river Chenab, Pakistan. Present study reported negative allometric growth of this fish and all morphometric characters showed high degree of interdependence. The results of this study will be useful for the researchers, fisheries conservationists and policy makers. Also, suggesting an imperative need to study other biological aspects of this one of the most potentially important small indigenous species.

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