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ARTICLE

Growth Pattern and Morphological Variation of *Labeo calbasu* Found in Indus River, Sindh-Pakistan

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ABSTRACT

The present work reports the length–weight relationships (LWR) and condition factor relationships for Labeo calbasu collected from Upstream (Matyari) Kotri barrage at, River Indus, Pakistan, because stock assessment helps the fisheries managers to conserve the commercially important fish. Morphological characters of fish as well as Length-weight relationship are an important tool for fishery management. The results of LWR (W= aLb), for L calbasu. Representing negative allometric growth pattern. LWRs and condition factor relationships were found significantly correlated. A total of 200 and 190 specimens from upstream and downstream were collected, respectively. The assessed values of length-weight correlation and condition factor were calculated as Kn=39.663 (LeCren), and K=11.915 (Fulton) for upstream and Kn=44.066 and K=13.872 for downstream. Length-weight was found with a strong correlation of n= 2.892, a=0.0235 with r2=0.934 for upstream population then the downstream population. The results of this work would be beneficial for sustainable management as well as fishery managers.

1. Introduction

Fisheries are one of the very imperative bases of income and socio-economic industry of our country and serves as an important food sector in human nutrition [1]. Labeo calbasu is a freshwater fish species belonging to the family Cyprinidae under the order Cypriniformes. It is a popular best food fish having delicious flavor. Less intramuscular bones and high protein contents is significance of this species. This is known as sport fish and having delicious taste, recently introduced as ornamental fish in the market of Pakistan and abroad [2]. In last few years, the wild inhabitants of this fish species have extremely dropped due to over fishing and other anthropological causes [3,4,5,6]. In Pakistan it has been recounted as Lower Risk near endangered and in Bangladesh as rare species [4,7]. Labeo calbasu supports an important commercial fishery in the Rivers Ganga [8], Yamuna [9], Ghaghra [10] and middle stretch of Ken [11] and Indus River Pakistan. In our country, Labeo calbasu is a one of great commercial important species resembling three other Indian Major Carps such as Catla, Rohu and Mrigal. The Rivers in Pa-

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kistan are challenging several problems intended for severe water pollution, over extraction, intrusion, dams and barrages which cut off the connectivity of the River with its associated ecosystems, climate change, deforestation in catchment areas, etc. In fisheries science, relationships of length weight provide measurements, which are keystone in research and management and are main gears for accurate assessment of biomass and calculation of length frequency samples to total catch [12].

This species occurs mainly inhabits Rivers and Ponds, also in natural Lakes, reservoirs, streams and canals [13,14,15,16,17]. Its favorite habitation is the abysmal pools of Rivers, where it largely remains localized during the winter and summer months, and ascend to adjacent shallower region of the river for breeding during monsoon months [14]. It can be cultured in ponds and tanks [1316]. It can tolerate slightly brackish water also. Fish populations are natural control processes that continually modify with adjust structure, abundance and wide range of factors. Besides some factors as overfishing, species composition, population outbreak, behavior, species switching from small size to large, ecosystem degradation, seasonal fluctuations, pesticide and aquatic pollution, diseases, introduction of exotic species, destruction of breeding grounds and unlawful fishing practices [18]. The maximum reported size for this fish is 90cm [19] but during the last few decades has not been reported. Length weight relationships assist in adaptation 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. Length weight relationships are good indicators of fitness and fish condition [20].

2. Materials and Methods

2.1 Data Collection

In the present study report, Labeo calbasu (200 from upstream and 190 from downstream) was collected from Indus River, Sindh-Pakistan. The specimens were brought to the Department of Freshwater Biology and Fisheries, University of Sindh for species documentation and evaluating growth parameters. Identification of selected fishes was done with the help of related literature, accounts and keys specified [17]. A total of 15 morphological traits (Table.1-2) and 6 meristic traits (Table.3) were measured and calculated.

Morphometric was measured on the fish measuring board while meristic traits were calculated with the help of magnifying lens. The eye diameter was measured by the caliper. The weight of fish was taken by the digital balance machine. The meristic traits were calculated with the help of magnifying lens. The data was analyzed by using SPSS (11.5) software package length weight relationship was calculated as standard [20]. All the parameters were measured for data analysis to calculate the effect at different environments of Indus River, Sindh.

2.2 Statistical Analyses

2.2.1 Length Weight Relationship and Condition Factor

Length weight relationships were calculated using the least square fitted method to Log transformed data using the function as suggested by the Le Cren [20] equation $W= aL^b$. Whereas: W is the total weight of fish in g, L was the length of fish in cm, a was constant condition factor and b was an exponent indicating isometric/allometric growth.

The parameters a and b were estimated by linear regression on transformed equation. The equation 1 could be expressed in the linear form by using logarithms, as given below:

$$\text{Log W} = \text{Log a} + \text{b Log L}$$

The estimates of the constants c and n were obtained empirically by using the formulae, as given below:

$$Log\ = \frac{\Sigma LogW \times (\Sigma logL2) - \Sigma LogL \times \Sigma(LogL \times LogW)}{N(\Sigma LogL2) - (\Sigma(LogL)2)}$$

$$n = \frac{\Sigma LogW - NLogC}{\Sigma LogL}$$

2.2.2Condition factor 'k':

The condition factor of the adult fish was determined the Fulton's Condition Factor (K) was computed by using the formulae, as given below:

$$\text{Condition Factor}\,(k) = \frac{Weight\ (g)}{(\ length)3\ (cm)} \times 100$$

(K= condition factor, W= weight of the fish and L= length of fish). Condition factor (K) was determined for different length groups using length and weight data following the equation given by LeCren[20]:

$$\text{The LeCren Condition Factor}\ Kn = \frac{(w \times 100)}{L3}$$

3. Results

3.1 Length Frequency Distribution

The smallest length was witnessed 7.5cm and the highest

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length was noted 28cm with an average length of 20.892 cm for average of upstream and downstream population.

3.2 Length Weight Relationship

The expected b values in current study for Labeo calbasu from Indus River (Matyari) Sindh Pakistan was a= 0.0235, b= 2.892 and correlation r^2= 0.934 for upstream and a= 0.0458, b= 1.792 and correlation r^2= 0.849 for downstream population (Table 4).

4. Discussion

The achieved parameters of Length-weight relationship specify the evidence about the seasonal changes in their environment and about physical well being of the fish. It is also states the isometric or allometric growth of the fish, this evidence about the growth pattern of the fish is considered to be an essential feature to know the fish population dynamics. The statistical correlation between the length and weight is highly significant tool for the estimation of the weights of the fish of known lengths [21]. The estimated Length weight parameters in current research were compared to Length weight parameters of the other scientist's work (Table 5). The projected results of (a) 0.024 in our study for Labeo calbasu were normally smaller than previous assessed results and the estimated results (b) 2.892 in our study for Labeo calbasu were generally moderate as the previously estimated results from various parts of the world for related species. However the estimated results of (b) value 2.892 in our study for Labeo calbasu were less than 3, which indicates negative allometric rate. While small variances in results may be due to availability of food, condition of maturity and spawning, sex differences [22,23,24].

When we calculated the correlation of traits, with body weight and among other morphological traits, then we found that SnL (0.160) and AFL (0.027) show weak correlation while all other had strong correlation for upstream population (Table 1). While, only ED shows (0.098) weak correlation for downstream population (Table 2). Further, we investigated the correlation of TL with all other traits. It was found that SnL (0. 172) and AFL (0.031) had weak correlation for upstream population. While, all other traits show strong correlation with TL in downstream population, except ED (0.211) as shown in Table 6.

The Condition factor (k) reflects, through its variations, information on the physiological state of the fish in relation to its welfare. The Fultons condition factor k value recorded 11.915 and the Le Cren condition factor (kn) value of labeo calbasu was 39.663 for upstream population. While, the k and kn was recorded 13.872 and 44.066 for downstream population, respectively (Table 4). The fluctuation in the value of k if fish has been mainly assigned to dependency on many factors such as feeding, intensity, fish size and availability of fish.

5. Conclusion

The results indicate that Labeo calbasu showed an almost negative allometric pattern of growth in the present habitat and the condition factor values showed that it is in not good condition or health due to environmental factor. It reveals that present environmental situation of Indus River has great influence on the growth of L.calbasu. These findings may be is useful to the study of fishery biology; conservation biologist, successful development, production and management of fishes and ultimate conservation of this threaten species.

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Appendixes

Table 1. Correlation of various morphological traits of Upstream Population L. calbasu from Indus River, Sindh-Pakistan

	w (gm)	TL (cm)	ED (mm)	SL	HL	FL	Girth	DFL	PFL	VFL	AFL	CFL	SnL	PVD	VAD
w (gm)	1														
TL (cm)	0.841	1.000													
ED (mm)	0.635	0.730	1.000												
SL	0.869	0.965	0.750	1.000											
HL	0.751	0.863	0.700	0.908	1.000										
FL	0.820	0.892	0.664	0.918	0.812	1.000									
Girth	0.767	0.890	0.742	0.915	0.877	0.862	1.000								
DFL	0.762	0.813	0.608	0.837	0.740	0.777	0.772	1.000							
PFL	0.706	0.803	0.559	0.825	0.759	0.764	0.813	0.778	1.000						
VFL	0.749	0.807	0.656	0.823	0.760	0.800	0.825	0.700	0.687	1.000					
AFL	0.027	0.031	-0.146	0.039	0.010	0.037	-0.088	0.056	-0.006	-0.099	1.000				
CFL	0.756	0.857	0.736	0.884	0.848	0.779	0.911	0.763	0.738	0.806	0.000	1.000			
SnL	0.160	0.172	0.143	0.184	0.162	0.196	0.156	0.149	0.127	0.167	-0.123	0.146	1.000		
PVD	0.813	0.910	0.766	0.920	0.835	0.873	0.903	0.789	0.762	0.793	-0.052	0.855	0.142	1.000	
VAD	0.737	0.776	0.673	0.798	0.725	0.776	0.767	0.671	0.605	0.794	-0.086	0.743	0.099	0.794	1

Note: TW=Total weight, TL =Total Length, ED=Eye diameter, SL=Standard Length, HL=Head length, FL=Fork length),Gr= Girth, DFL=Dorsal Fin base, PFL=Pectoral Fin Length, VFL=Ventral Fin Length, AFL=Anal Fin Length, CFL=Caudal Fin Length, SnL=Snout Length, PVD=Pectoral Ventral Distance and VAD=Ventral Anal Distance (1= strong correlation, 0.5= moderate correlation and 0.5<, weak correlation)

Table 2. Correlation of various morphological traits of Downstream Population L. calbasu from Indus River, Sindh-Pakistan

	w	TL (cm)	ED (mm)	SL	HL	FL	Girth	DFL	PFL	VFL	AFL	CFL	SnL	PVD	VAD
w	1														
TL (cm)	0.921	1													
ED (mm)	0.098	0.211	1												
SL	0.935	0.991	0.175	1											
HL	0.826	0.918	0.170	0.919	1										
FL	0.902	0.955	0.172	0.954	0.861	1									
Girth	0.865	0.948	0.177	0.940	0.906	0.923	1								
DFL	0.922	0.980	0.146	0.986	0.895	0.946	0.938	1							
PFL	0.879	0.919	0.004	0.929	0.859	0.893	0.919	0.933	1						
VFL	0.897	0.921	0.124	0.925	0.856	0.899	0.918	0.925	0.880	1					
AFL	0.845	0.884	0.113	0.887	0.813	0.878	0.796	0.865	0.867	0.782	1				
CFL	0.839	0.919	0.171	0.926	0.877	0.862	0.947	0.923	0.880	0.922	0.746	1			
SnL	0.842	0.855	0.090	0.857	0.801	0.887	0.827	0.857	0.787	0.900	0.800	0.802	1		
PVD	0.831	0.921	0.259	0.923	0.839	0.899	0.877	0.912	0.831	0.868	0.784	0.897	0.828	1	
VAD	0.892	0.912	0.185	0.918	0.844	0.888	0.882	0.911	0.826	0.909	0.801	0.895	0.891	0.877	1

Note: TW=Total weight, TL =Total Length, ED=Eye diameter, SL=Standard Length, HL=Head length, FL=Fork length),Gr= Girth, DFL=Dorsal Fin base, PFL=Pectoral Fin Length, VFL=Ventral Fin Length, AFL=Anal Fin Length, CFL=Caudal Fin Length, SnL=Snout Length, PVD=Pectoral Ventral Distance and VAD=Ventral Anal Distance (1= strong correlation, 0.5= moderate correlation and 0.5<, weak correlation)

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Table 3. Meristic traits of Upstream and Downstream Population L. calbasu from Indus River, Sindh-Pakistan

Meristic characters	Upstream population		Downstream population	
	MAX	MINI	MAX	MINI
DFR	17	14	17	14
PFR	19	12	18	10
VFR	11	8	10	7
AFR	9	7	23	26
CFR	26	21	24	18
L.LS	56	46	56	44

Note: In the table DFR = (Dorsal fins rays), PFR= (Pectoral fins rays), VFR= (Ventral fins rays), AFR= (Anal fins rays), CFR=(Caudal fins rays), L.LS=(Lateral line scales).

Table 4. Length-Weight relationship of Labeo calbasu (Upstream and Downstream population)

Groups	Average Length (cm)	Average Weight (gm)	a	b	Fulton's Condition factor (*k*)	Le Cren Condition factor (*kn*)
Upstream Population	20.892	193.57	0.0235	2.892	11.915	39.663
Downstream Population	26.758	305.4743	0.04577	1.7923	13.872	44.066

Table 5. Comparison of estimated results of length weight relationship of Labeo calbasu in present study with species from other parts of the world

Source	Species	*a*	*B*	R^2
Naeem M. *et al.*, (2017)	*L. gonius*	0.729	3.29	0.974
Das B.K et al., (2013)	*L. calbasu*	1.719	1.557	..
N.C. Ujjania *et al.*, (2012)	*L. rohita*	-2.409	3.316	0.976
Shehla et al (unpublished)[25]	*L. gonius*	0.005	2.782	0.879
Present study (Upstream Population)	*L. calbasu*	0.024	2.892	0.934
Present study (Downstream Population)	*L. calbasu*	0.046	1.792	0.849

Table 6. Correlation of morphometric traits with total length (TL) for Upstream and Downstream Population L. calbasu from Indus River, Sindh-Pakistan

S: No	Morphological traits	Correlation Upstream Population	Correlation Downstream Population
1	ED (mm)/TL	0.730	0.211
2	SL (cm)/TL	0.964	0.991
3	HL (cm)/TL	0.862	0.918
4	FL (cm)/TL	0.892	0.955
5	Girth (cm)/TL	0.889	0.948
6	DFL (cm)/TL	0.812	0.980
7	PFL (cm)/TL	0.803	0.919
8	VFL (cm)/TL	0.807	0.921
9	AFL (cm)/TL	0.031	0.884
10	CFL (cm)/TL	0.857	0.919
11	SnL (cm)/TL	0. 172	0.855
12	PVD (cm)/TL	0.910	0.921
13	VAD (cm)/TL	0.776	0.912

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