



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2017; 5(3): 547-550

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Received: 20-03-2017

Accepted: 21-04-2017

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Morphometric relationship of Indian major carps (*Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*) from Jaisamand Lake, Udaipur (India)

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Abstract

A study on morphometric relationship of Indian major carps (*Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*) was conducted on the fish specimens collected from commercial landing center of Lake Jaisamand. The morphometric measurements (Total length, Standard length, Forked length, Head length, Snout length, Eye diameter, Pre-dorsal length, Pre-pectoral length, Pre-pelvic length, Pre-anal length, Height of dorsal fin, Anal fin length, Body depth, Caudal depth and Caudal length) and body weight were recorded. The descriptive statistical parameters and correlation coefficient (r) were analyzed with independent variable (total length) and dependent variable (other morphometric parameters). The result shows that morphometric parameters are highly correlated to total length except Snout length to total length. The regression coefficient (b) was less than 3.0 with total length and other morphometric that indicate the negative allometric growth of these parameters compared to total length whereas in weight with total length (WT-TL) it shows negative allometric growth (2.600) in *catla*, positive allometric growth (3.160) in *rohu* and isometric growth (3.019) in *mrigal*. The study depicts that growth of fishes is satisfactory and aquatic environment of Jaisamand Lake is conducive for fishes.

Keywords: *Catla*, *rohu*, *mrigal*, growth, morphometric and Jaisamand

1. Introduction

The Indian major carps are the Gangetic origin species and naturally found in river, reservoir, lake, and in cultured ponds [1]. It is most important commercial and cultivable fish species and contributes a major portion to the fresh water fish production of India and also has maximum market demand. In fishes, changes in the relative growth of the various body parts are known to occur at different stages of development and particularly at sexual maturity [2] and growth of the body parts or morphometric characters showed proportional positive increase with increase in length. So, morphometric measurement of fishes and the study of statistical relationship among them are essential for taxonomic study, systematics and growth variability [3]. The population was discriminated on the basis of morphometric variables [4, 5]. Studies of morphological character variation, therefore, vital in order to elucidate patterns observed in phenotypic variation among fish populations [6] and to determine possible differences between separate unit stocks of the same species [7]. There are many well documented studies on morphometric parameters which reported for stock discreteness [8-10].

The present study was taken up to morphometric study of Indian major carps in Jaisamand Lake which will provide the information on growth, survival of fish and conduciveness of aquatic environment for the fishes.

2. Materials and Methods

2.1 Study area

The morphometric data for the present study was collected from the Indian major carps of Jaisamand Lake which is situated on 21.5-24.5° North Latitude and 86-89° East Longitude geographical location at Veerapur village, Udaipur district of Rajasthan (Fig. 1).

2.2 Morphometric measurements

The morphometric measurements, total length, standard length, forked length, head length, snout length, eye diameter, pre-dorsal length, pre-pectoral length, pre-pelvic length, pre-anal length, height of dorsal fin, anal fin length, body depth, caudal depth) and caudal length (Table 1 and Fig. 2) were measured in centimeter and total body weight was in grams from total of

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357 specimens and 119 of each specimen of studied fish species during May 2005 to April 2006. These morphometric measurements were measured with the help of divider, measuring board, measuring tape and single pan balance to follow the method of Lowe McConnel [11].

2.3 Statistical analysis

The relationship of various logarithm transformed morphometric parameters on total length was obtained by least square method with the formula $Y = a + b X$ where 'Y' is the dependent variable (other morphometric parameters like standard length, head length etc.), 'a' is the intercept value, 'b' is the regression coefficient and X is the independent variable (total length).

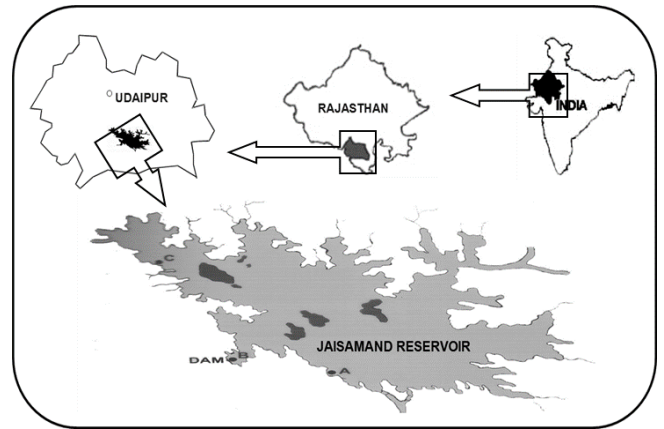


Fig 1: Map of study area

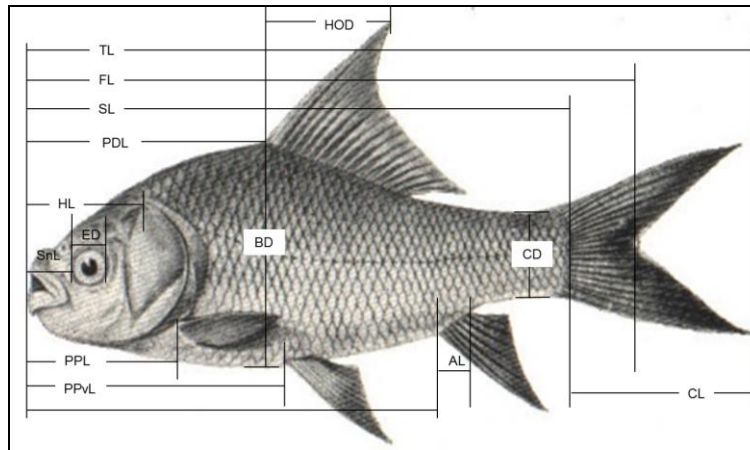


Fig 2: Typical morphological parameters of Indian major carp [TL (Total length), SL (Standard length), FL (Forked length), HL (Head length), SnL (Snout length), ED (Eye diameter), PDL (Pre-dorsal length), PPL (Pre-pectoral length), PPvL (Pre-pelvic length), PAL (Pre-anal length), HOD (Height of dorsal fin), AL (Anal fin length), BD (Body depth), CD (Caudal depth) and CL (Caudal length)]

Table 1: Measured morphometric parameters of Indian major carps

S.N.	Parameters	Code	Description of measured parameters
(i)	Total length	TL	It is a measurement of body length from tip of largest jaw (snout) to the largest part of caudal fin.
(ii)	Standard length	SL	Length from snout to the origin of caudal fin.
(iii)	Forked length	FL	Length from snout to the point of bifurcation of caudal fin.
(iv)	Head length	HL	Length from snout to the posterior most part of operculum.
(v)	Snout length	SnL	Length from snout to the anterior most margin of the eye orbit.
(vi)	Eye diameter	ED	Maximum length of eye orbit from one margin to other.
(vii)	Pre-dorsal length	PDL	Length from snout to the origin of the dorsal fin.
(viii)	Pre-pectoral length	PPL	Length from snout to the origin of pectoral fin.
(ix)	Pre-pelvic length	PPvL	Length from snout to the origin of pelvic fin.
(x)	Pre-anal length	PAL	Length from snout to the origin of anal fin.
(xi)	Height of dorsal fin	HOD	Height of dorsal fin from base of origin of dorsal fin to end of longest fin ray.
(xii)	Anal fin length	AL	Length from origin of 1 st anal fin ray to the origin of the last anal fin ray.
(xiii)	Body depth	BD	Maximum vertical length of body (deepest part of the body).
(xiv)	Caudal depth	CD	Minimum vertical length of the body (minimum depth on caudal peduncle).
(xv)	Caudal length	CL	Total length – Standard length

3. Results and Discussion

The morphometric measurements of catla (*Catla catla*) rohu (*Labeo rohita*) and mrigala (*Cirrhinus mrigala*) presented in the Table 2 which depicts that total length 33.000 to 69.500 (54.113±1.134) cm for catla, 38.000 to 72.000 (51.601±0.754) cm for rohu and 37.300 to 64.000 (51.723±0.541) cm for mrigal whereas total weight 700.00 to 5700.00 (3197.917±157.814) gm, 500.00 to 4500.00 (1853.333±82.959) gm and 600.00 to 3100.00 (1701.250±52.123) gm were observed for catla, rohu and mrigal respectively.

The total length (Independent variable) was kept on x-axis while other morphometric parameter (dependent variable) on

y-axis and it was observed that significant correlations exist in standard length-total length (SL-TL), fork length-total length (FL-TL), head length-total length (HL-TL), eye diameter-total length (ED-TL), pre dorsal fin length-total length (PDL-TL), pre pectoral fin length-total length (PPL-TL), pre pelvic fin length-total length (PPvL-TL), pre anal fin length-total length (PAL-TL) body depth-total length (BD-TL), height of dorsal fin-total length (HOD-TL), anal fin length-total length (AL-TL), body depth-total length (BD-TL), caudal depth-total length (CD-TL) and caudal length-total length (CL-TL). The correlation coefficient (r) was minimum 0.434, 0.286 and 0.469 in snout length-total length (SnL-TL) whereas it was maximum 0.983, 0.991 and 0.985 in standard length-total

length (SL-TL) for the catla, rohu and mrigal respectively (Table 2). Significant correlation of the morphometric parameters with total length reported in *S. richardsonii* from Uttarkashi district of Uttarakhand [12], in wild species of *Labeo calbasu* from Chenab River, Pakistan [13] and similar findings were also reported in tilapia for two ponds of Vadodara, Gujarat [14] and in *Tor putitora* from Himachal Pradesh [15].

The regression coefficient (b) were also observed and it was minimum 0.464 in ED-TL for catla, 0.422 in SnL-TL for rohu and 0.989 in PPvL-TL for mrigal while it was maximum 2.600, 3.160 and 3.019 for catla, rohu and mrigal respectively in WT-TL. The value of 'b' was shows negative allometric

growth ($b < 3.0$), positive allometric growth ($b > 3.0$) and isometric growth ($b = 3.0$) hence, current study shows that other morphometric parameters with total length shows negative allometric growth for all studied species while weight with total length (WT-TL) observed negative allometric growth (2.600) in catla, positive allometric growth (3.160) in rohu and isometric growth (3.019) in mrigal (Table 2). The relationship between different morphometric parameter and total length was established and negative allometric growth ($b < 3.0$) was reported in *Labeo calbasu* [13], in *Tor putitora* [15] and in *Tor putitora* [16]. Ujjania [17] also reported isometric and positive allometric growth for rohu in large water body and small water body of southern Rajasthan.

Table 2: Morphometric observations of Indian major carps

Parameters		Catla		Rohu		Mrigal	
		Min- Max	Mean± SE	Min- Max	Mean± SE	Min- Max	Mean± SE
Total length	TL	33.000-69.500	54.113±1.134	38.000-72.000	51.601±0.754	37.300-64.000	51.723±0.541
Standard length	SL	26.000-55.600	42.508±0.871	30.000-57.400	40.702±0.608	29.200-51.000	41.564±0.463
Fork length	FL	27.000-61.200	46.827±1.033	20.000-64.900	42.689±0.928	31.000-58.100	46.048±0.567
Head length	HL	8.000-18.700	13.232±0.270	7.400-19.200	10.378±0.230	6.100-13.900	9.802±0.138
Snout length	SnL	3.200-13.400	6.664±0.229	3.200-9.200	5.182±0.111	2.200-9.300	4.651±0.167
Eye diameter	ED	1.200-2.400	1.988±0.025	1.100-2.700	1.514±0.038	1.200-2.300	1.801±0.026
Pre dorsal fin length	PDL	13.400-28.400	21.419±0.471	14.000-30.500	19.267±0.332	13.600-26.700	20.433±0.255
Pre pectoral fin length	PPL	7.400-16.600	12.428±0.258	7.100-22.700	10.690±0.236	6.700-14.400	10.248±0.149
Pre pelvic fin length	PPvL	13.200-32.000	23.227±0.518	16.000-34.600	21.758±0.318	15.200-28.900	22.598±0.244
Pre anal fin length	PAL	21.400-47.500	35.339±0.796	24.000-47.000	32.994±0.513	23.800-43.200	34.948±0.372
Height of dorsal fin	HOD	5.500-12.700	9.958±0.203	6.000-15.100	8.595±0.158	6.600-13.100	8.615±0.104
Anal fin length	AL	2.000-5.400	3.874±0.080	2.100-8.800	3.429±0.100	2.100-6.300	3.409±0.066
Body depth	BD	7.400-28.000	18.574±0.526	9.300-26.100	13.546±0.324	7.500-18.800	13.201±0.204
Caudal depth	CD	3.600-9.900	6.618±0.177	3.100-10.700	5.469±0.137	3.600-10.400	5.694±0.106
Caudal length	CL	6.900-16.900	11.933±0.291	6.900-14.600	10.899±0.172	8.000-13.000	10.158±0.120
Body weight	WT	700.00-5700.00	3197.917±157.81	500.00-4500.00	1853.333±82.95	600.00-3100.00	1701.250±52.12

Table 3: Descriptive statistics and regression parameters (total length on other morphometric parameters) for Indian major carps

Parameters	Catla		Rohu		Mrigal	
	Y=Log(a)+b*X	r	Y=Log(a)+b*X	r	Y=Log(a)+b*X	R
TL						
SL	-0.043+0.964TL	0.983	-0.112+1.005TL	0.991	-0.197+1.059TL	0.985
FL	-0.153+1.051 TL	0.977	-0.396+1.179TL	0.724	-0.226+1.102TL	0.945
HL	-0.503+0.938 TL	0.975	-0.729+1.016TL	0.729	-1.090+1.213TL	0.902
SnL	-0.308+0.642 TL	0.434	-0.017+0.422TL	0.286	-1.974+1.525TL	0.469
ED	-0.503+0.464 TL	0.812	-2.002+1.270TL	0.830	-1.893+1.253TL	0.872
PDL	-0.362+0.976 TL	0.949	-0.633+1.119TL	0.980	-0.674+1.157TL	0.952
PPL	-0.459+0.896 TL	0.927	-1.186+1.291TL	0.941	-1.280+1.335TL	0.937
PPvL	-0.403+1.020 TL	0.965	-0.294+0.953TL	0.702	-0.341+0.989TL	0.972
PAL	-0.250+1.037 TL	0.982	-0.264+1.040TL	0.969	-0.181+1.006TL	0.962
HOD	-0.494+0.860 TL	0.894	-0.932+1.089TL	0.924	-0.737+0.975TL	0.882
AL	-0.931+0.876 TL	0.890	-1.947+1.445TL	0.884	-1.694+1.296TL	0.750
BD	-0.802+1.191 TL	0.902	-1.330+1.434TL	0.951	-0.995+1.233TL	0.826
CD	-1.240+1.186 TL	0.953	-2.021+1.607TL	0.976	-1.012+1.028TL	0.655
CL	-0.948+1.156 TL	0.819	-0.649+0.984TL	0.875	-0.299+0.761TL	0.709
WT	-1.049+2.600 TL	0.981	-2.181+3.160TL	0.967	-1.962+3.019TL	0.946

[TL (Total length), SL (Standard length), FL (Forked length), HL (Head length), SnL (Snout length), ED (Eye diameter), PDL (Pre-dorsal length), PPL (Pre-pectoral length), PPvL (Pre-pelvic length), PAL (Pre-anal length), HOD (Height of dorsal fin), AL (Anal fin length), BD (Body depth), CD (Caudal depth) and CL (Caudal length)]

4. Conclusion

The present study concluded that morphometric parameters and total length of Indian major carps were significantly correlated and positive correlation coefficient indicate the proportional positive increase in morphometric parameters with compare to total length. The values of regression coefficient (b) weight-total length relationship show the negative allometric growth for catla, positive allometric growth for rohu and isometric growth for mrigal in Jaisamand Lake. It is also concluded that Jaisamand Lake having

conductive environment and it is suitable for the growth of Indian major carps.

5. Acknowledgment

Authors are thankful to Staff members, College of Fisheries (MPUAT, Udaipur), RTADCF (Udaipur) and fishermen who are working at Commercial Landing Center (Jaisamand Lake, Udaipur) for their logistic support and laboratory facilities for conducting this research work.

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