

Morphometry of *Cirrhinus reba* (Hamilton) from Sukhna Lake, Chandigarh, India

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Abstract: For morphometric analysis of *Cirrhinus reba* (Ham.), 80 fish specimens were collected during the period from June 2012 to May 2014 from Sukhna Lake, Chandigarh. Out of all 24 morphometric characters studied, three characters showed high positive correlation (above 0.90); eleven characters showed good correlation (0.75-0.90), five characters showed moderate correlation (0.50-0.75) and five characters showed poor correlation (0.25-0.50). On basis of percent range difference, fifteen characters were found to be genetically controlled (Range difference $\leq 10\%$) and nine morphometric characters belonged to intermediate category with range difference ranging between 10.00-14.99. No morphometric character was found to be environmentally controlled.

Keywords: *Cirrhinus reba* (Hamilton), Morphometric characters, Sukhna Lake

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I. Introduction

Morphometric studies are useful for the identification and differentiation of the stocks and the subspecies [1]. The variations in the morphometric characters are generally attributed to the genetic variability in the stocks or this may be because of the influence of the various environmentally controlled parameters. The analysis of the morphometric data also gives an indication about the whether the fish growing in right proportions or not. The analysis of morphometric and meristic characters is a very useful tool for characterizing the strains of the same species, which involves subtle changes in the variation of the shape and size [2]. Different population of a fish species usually exhibit differences in certain morphometric characters and that's why morphometry is such an important tool which is used by the fishery scientists all over the world. Various morphometric measures have been classified into three categories on the basis of range differences [3], which is a modification of the criterion given by Vladykov [4]: Genetically controlled characters (Range difference $<10\%$), intermediate characters (Range difference between 10-15%) and environmentally controlled characters ($>15\%$). Keeping the above factors in mind, studies were undertaken to study the variation in the morphometric characters of an important edible fish, *Cirrhinus reba* (Hamilton) from Sukhna Lake, Chandigarh

II. Materials And Methods

Morphometric measurements are the standard measurements which tend to change with the growth of fish as well or under the influence of varied environmental conditions. For the morphometric studies, 80 specimens of *C. reba* (Hamilton) were studied from the Sukhna Lake, Chandigarh during the period from June 2012 to May 2014. All the morphometric measurements were taken from left side of the body of fish and they are expressed in percentage of total length. Total length has been considered as independent variable while all the other characters have been categorized as dependent variables.

III. Results

The correlation coefficient between the dependent and independent variables has been presented in Tables 1 and 3. A total of twenty four dependent morphometric characters (standard length, head length, head depth, pre-orbital distance, post-orbital distance, eye diameter, intra-orbital distance, inter-orbital distance, pre-dorsal distance, post-dorsal length, pre-anal distance, depth of dorsal fin, length of dorsal fin, length of pectoral fin, length of pelvic fin, length of anal fin, depth of anal fin, length of caudal fin, length of caudal peduncle, minimum body width, distance between pectoral and ventral fins, distance between pelvic and anal fin, maximum body width and length of rostral barbel) were assessed with respect to the total length of fish.

Table 1 Mean, correlation coefficient (r) and regression equation between Total Length (TL) vs. all other morphometric characters of *Cirrhinus reba* (Hamilton) from Sukhna Lake, Chandigarh from June 2012 to May 2014

S. No.	Total Length (TL)	Mean	Correlation coefficient 'r'	Regression Equation Y = a+ b(X)
1.	Standard Length (SL)	13.06	0.985**	-0.862 + 0.864 (X)
2.	Head Length (HL)	3.04	0.890**	0.578 + 0.153 (X)
3.	Head Depth (HD)	2.52	0.667**	0.401 + 0.132 (X)
4.	Pre-Orbital distance (PreOr)	1.10	0.459**	0.492 + 0.038 (X)
5.	Post-Orbital distance (PostOr)	1.39	0.764**	0.175 + 0.076 (X)
6.	Eye Diameter (ED)	0.79	0.467**	0.442 + 0.022 (X)
7.	Intra-Orbital Distance (IoD)	0.35	0.284*	0.216 + 0.009 (X)
8.	Inter-Orbital Distance (IeD)	1.46	0.604**	0.387 + 0.067 (X)
9.	Pre-Dorsal Distance (PreD)	5.62	0.955**	- 0.666 + 0.390 (X)
10.	Post-Dorsal distance (PostD)	5.14	0.830**	-0.134 + 0.328 (X)
11.	Pre-Anal distance (PreA)	9.72	0.963**	- 1.400 + 0.690 (X)
12.	Length of Dorsal Fin (LDF)	3.07	0.749**	1.07 + 0.124 (X)
13.	Depth of Dorsal Fin (DDF)	2.04	0.779**	0.088 + 0.122 (X)
14.	Depth of Anal Fin (DAF)	1.04	0.394**	0.093 + 0.059 (X)
15.	Length of Pectoral Fin (LPecF)	2.49	0.690**	0.784 + 0.106 (X)
16.	Length of Pelvic Fin (LPelF)	2.29	0.816**	0.332 + 0.122 (X)
17.	Length of Anal Fin (LAF)	1.99	0.822**	0.371 + 0.101 (X)
18.	Length of Caudal Peduncle (LCP)	1.99	0.773**	0.299 + 0.142 (X)
19.	Length of Caudal Fin (LCF)	3.27	0.618**	1.063 + 0.137 (X)
20.	Distance between Pectoral and Pelvic fin (DPP)	3.54	0.830**	- 0.424 + 0.246 (X)
21.	Distance between Pelvic and Anal Fin (DPA)	3.73	0.823**	-1.738 + 0.339 (X)
22.	Minimum Body Width (MIN)	1.55	0.834**	-0.064+ 0.101 (X)
23.	Maximum Body Width (MAX)	3.57	0.854**	-0.847 + 0.274 (X)
24.	Length of Rostral Barbel (RB)	0.28	0.335**	0.087 + 0.012 (X)

All other morphometric measurements have been expressed in cm
 ** Significant at p< 0.01 level
 *Significant at p<0.05 level

Table 2. Percentage body proportions vs. Total Length (TL) of *Cirrhinus reba* (Ham.) collected from Sukhna Lake, Chandigarh from June 2012 to May 2014.

S. No.	In % of Total Length (TL)	Mean (%)	Range (%)		Range Difference (%)	S.D. (%)
			Min. (%)	Max. (%)		
1.	Standard Length (SL)	80.96	76.77	86.48	9.71	1.95
2.	Head Length (HL)	18.92	16.00	20.91	4.91	1.05
3.	Head Depth (HD)	15.72	8.14	20.86	12.72	1.97
4.	Pre-Orbital distance (PreOr)	6.87	4.50	9.64	5.14	1.01
5.	Post-Orbital distance (PostOr)	8.68	5.16	10.07	4.91	0.83
6.	Eye Diameter (ED)	4.97	3.51	6.61	3.10	0.63
7.	Intra-Orbital Distance (IoD)	2.24	1.48	3.50	2.02	0.42
8.	Inter-Orbital Distance (IeD)	9.11	5.94	13.28	7.34	1.19
9.	Pre-Dorsal Distance (PreD)	34.83	29.23	39.75	10.52	1.59
10.	Post-Dorsal distance (PostD)	44.65	38.16	51	12.54	2.52
11.	Pre-Anal distance (PreA)	60.20	54.19	66.97	12.78	2.58
12.	Length of Dorsal Fin (LDF)	19.17	15.52	23.44	7.92	1.65
13.	Depth of Dorsal Fin (DDF)	12.72	9.03	17.33	8.30	1.24
14.	Depth of Anal Fin (DAF)	6.50	3.24	17.41	14.17	1.81
15.	Length of Pectoral Fin (LPecF)	15.53	10.96	19.37	8.41	1.55
16.	Length of Pelvic Fin (LPelF)	14.27	9.78	17.68	7.90	1.10
17.	Length of Anal Fin (LAF)	12.42	10.66	15.10	4.44	0.94
18.	Length of Caudal Peduncle (LCP)	12.34	9.28	16.02	6.74	1.48
19.	Length of Caudal Fin (LCF)	20.39	13.51	27.10	13.59	2.26
20.	Distance between Pectoral and Pelvic fin (DPP)	21.93	16.66	27.44	10.78	2.00
21.	Distance between Pelvic and Anal Fin (DPA)	23.29	16.21	28.87	12.66	2.54
22.	Minimum Body Width (MIN)	9.66	7.90	14.13	6.23	0.78
23.	Maximum Body Width (MAX)	22.12	14.46	26.22	11.76	2.15
24.	Length of Rostral Barbel (RB)	1.79	0.62	2.87	2.25	0.46

Max. = Maximum; Min. = Minimum and S.D. = Standard deviation

Table 3. Categorization of various morphometric characters of *Cirrhinus reba* (Ham.) collected from Sukhna Lake, Chandigarh (India) from June 2012 to May 2014 on the basis of correlation coefficient value.

S. No.	High Correlation (>0.90)	Good Correlation (0.75-0.90)	Moderate Correlation (0.50-0.75)	Poor Correlation (0.25-0.50)
1.	Standard Length	Head Length	Head Depth	Eye Diameter
2.	Pre-Dorsal Distance	Post-Orbital Distance	Inter-Orbital Distance	Pre-Orbital Distance
3.	Pre-Anal Distance	Depth of Dorsal Fin	Length of Dorsal Fin	Intra-Orbital Distance
4.	-	Post-Dorsal Distance	Length of Pectoral Fin	Depth of Anal Fin
5.	-	Length of Pelvic Fin	Length of Caudal Fin	Length of Rostral Barbel
6.	-	Length of Anal Fin	-	-
7.	-	Length of Caudal Peduncle	-	-
8.	-	Maximum Body Width	-	-
9.	-	Distance between Pectoral Fin and Pelvic Fin	-	-
10.	-	Distance between Pelvic and Anal Fin	-	-
11.	-	Minimum Body Width	-	-

Table 4. Categorization of various morphometric characters in percentage of Total Length (TL) of *Cirrhinus reba* (Ham.) collected from Sukhna Lake, Chandigarh on the basis of range difference.

S. No.	Genetically controlled characters	Intermediate Characters	Environmentally controlled Characters
1.	Standard Length (SL)	Head Depth (HD)	-
2.	Head Length (HL)	Pre-Anal Distance (PreA)	-
3.	Pre-Orbital Distance (PreOr)	Post-Dorsal Distance (PostD)	-
4.	Post-Orbital Distance (PostOr)	Distance between Pectoral and Pelvic Fin (DPP)	-
5.	Eye Diameter (ED)	Length of Caudal Fin (LCF)	-
6.	Inter-Orbital Distance (IoD)	Pre-Dorsal Distance (PreD)	-
7.	Intra-Orbital Distance (IoD)	Depth of Anal Fin (DAF)	-
8.	Depth of Dorsal Fin (DDF)	Distance between Pelvic and Anal Fin (DPA)	-
9.	Length of Dorsal (LDF)	Maximum Body Width (MAX)	-
10.	Length of Anal Fin (LAF)	-	-
11.	Length of Pectoral Fin (LPecF)	-	-
12.	Length of Pelvic Fin (LPelF)	-	-
13.	Minimum Body Width (MIN)	-	-
14.	Length of Caudal Peduncle (LCP)	-	-
15.	Length of Rostral Barbel (RB)	-	-

Out of all 24 characters studied, three characters showed high positive correlation, eleven characters showed good correlation, five characters showed moderate and five characters showed poor correlation (Tables 1 and 3). Furthermore, intra-orbital distance, depth of anal fin and length of rostral barbel showed least positive correlation (Table 1). On the basis of range difference, fifteen characters were found to be genetically controlled with range difference <10% and nine morphometric characters belonged to intermediate category with range difference varying between 10.00-14.99. Further, no environmentally controlled character was observed.

IV. Discussion

Morphometric characters of fish are an important tool in fishery biology and taxonomic studies [5] and it is one of the vital factors for the proper management of a species. The significance of the statistical relationship of morphometric characters has also been recognized in all taxonomic and systematic studies to solve various problems concerned with the life history of fish and these relationships also give information on the condition and growth patterns of fish [6, 7]. In the present study, most of the morphometric characters of *C. reba* (Hamilton) are genetically controlled characters which shows the restricted distribution of this fish at Sukhna Lake. In another study conducted on *Schizothorax richardsonii* (Gray, 1832) from the Uttarkashi District of Uttarakhand, India, 19 characters were observed to be genetically controlled out of the total 21 characters studied. Only 1 morphometric character was found to be environmentally controlled and 1 was in intermediate category [8]. The restricted zoogeographical distribution was also observed in *Barilius bandelisis* and *Barilius vagra* as majority of the morphometric characters found to show narrow range differences and were genetically controlled [9]. In the present study on *C. reba* (Hamilton), out of all 24 characters studied, three characters showed high positive correlation, eleven characters showed good correlation, five characters showed moderate and five characters showed poor correlation. A high value of correlation coefficient between total length and head length, snout length, height of caudal peduncle, minimum body girth and maximum body girth and low value between total length and eye diameter and length of caudal peduncle was found in a population of *Tor tor* from Narmada River [10]. It is quite clear here that the genetically controlled characters outnumber the intermediate and the environmentally controlled characters thereby suggesting restricted distribution of *Cirrhinus reba* (Hamilton)

V. Conclusion

Cirrhinus reba (Ham) has been found to be having more number of genetically controlled characters as compared to the intermediate and environmentally controlled characters, thereby showing its restricted distribution at Sukhna lake, Chandigarh.

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