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Meristic and Morphometric Characteristics of *Crossocheilus diplochilus* (Heckel, 1838) from the Poonch Valley of Jammu and Kashmir, India

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Abstract: The present study aims to describe the meristic and morphometric characteristics of *Crossocheilus diplochilus* from a tributary of Indus River basin, India. Altogether 41 specimens ranging from 10.0 - 17.0 cm total length (TL) and 12.16 - 41.22 g body weight (BW) were used for the study of the morphometric and meristic characteristics using different local fishing gears. The morphometric characteristics on the head express greater variation in head height (SD=7.46) than those from the body in pre-anal fin length (SD=4.14). The highly correlated body parameter in relation to total length was standard length (r=0.996) and distance from anal fin to caudal fin base was found least correlated (r=0.804) and strong correlations were observed between head length and pre-orbital length (r=0.931) and least correlation between head length and head height (r=0.829). Even though the values of correlation coefficient (r) vary between 0.804 (distance from anal fin to caudal fin base) and 0.996 (standard length), they are all strongly significant (P<0.001). The correlation analysis shows that all morphometric traits change proportionally with increase in the total length. These results generate the baseline data on morphometry of *C. diplochilus* which help in easy identification and will help in the development of a strategy for conservation of the natural stocks of *C. diplochilus* in Indus basin, India.

Key words: Morphometry · *Crossocheilus diplochilus* · Poonch River · Indus Basin

INTRODUCTION

Fishes display vast diversity in morphology, in their habitats and life stages. Unlike other frequently documented vertebrates, fishes are a diverse group [1]. The Labeonini is a subfamily under cyprinidae, the largest family of the order cypriniformes [2]. The Labeonini presently comprises of 40 genera and 400 species and accounts for about 15% of the species diversity of all cyprinid fishes [3]. Labeonins are widely distributed in tropical rivers and streams of Asia and Africa. Most of these species are adapted to rapid flowing water habitats and feed on filamentous algae, diatoms and organic detritus. They are characterized by remarkable diversity of modifications to their lips and associated structures and these structures are highly variable within the subfamily [4]. Diverse morphology of the mouth and related structures differentiates labeonines from other cyprinid fishes and also serves as the main basis to study phylogeny and generic taxonomy. Consequently, several new genera have been successively erected according to special oromandibular morphology [5-7].

Crossocheilus diplochilus, commonly known as Kashmir latia, is a benthopelagic freshwater fish belonging to subfamily Labeonini of family cyprinidae. Its availability is widespread in Indus drainage of Asia including India, Afghanistan and Pakistan. This species prefers lakes and main river banks and does not ascend cold-water tributaries with primarily a lotic species feeding from epilithic growth [8]. This species is listed as Least Concern (LC) in the IUCN Red list of Threatened species [9]. The species is characterized with inferior mouth, two pairs of barbels, diameter of eye 20.5-30.1 percent of head length and lateral line scales 36-38.

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Upper half of body light-brownish or greyish and lower half is somewhat light pink. Fins unspotted; the dorsal and caudal are said to be yellow-greyish in living specimens, the other fins are yellow. Fresh specimen was showing pattern consisting of dark spot on each scale with scale margin light giving the impression of horizontal stripes [8, 10, 11]. More similar species *Bangana diplostoma* is present in Poonch River which differs in having more number of lateral line scales and transverse scales, larger scales size, lack of papillae on both lips with broad cornified sheath and large body size. Earlier reported maximum length of *Crossocheilus diplochilus* was 10.0 cm TL [8].

Morphological irregularity of fish is deliberated to be an important adaptive strategy for populations facing inconsistent environments [12, 13]. Morphological plasticity according to environmental variability is commonly found among many fish species, mainly in freshwater fish species. Morphological variation according to environmental variability has been widely used by ichthyologists to discriminate among species and among populations within a species [14-16]. Effect of environmental factors on fish morphology is also well documented [17]. Information on the morphometric measurements of fishes and the study of statistical relationship among them are essential for taxonomic work [18, 19]. There is no published information available on the morphometric and meristic characters and their relationship in *Crossocheilus diplochilus*. Moreover FishBase have no records of this species till May 2014 [20]. Thus, the aim of the present work was to provide more detailed information on its morphology.

MATERIAL AND METHODS

A total of 41 specimens of *Crossocheilus diplochilus* (Fig. 1) were collected from River Poonch (33°46'22"N; 74°04'42"E), a tributary of Jhelum River in the Poonch region of Jammu and Kashmir, India from September, 2013 to May 2014, by using different local fishing gears. Voucher specimens were preserved in 10% formaldehyde solution. The fish were measured for 7 meristic and 28 morphometric characters. Lengths on the head were counted in percent of head length, while others in percent of total length. The total length of each fish was measured with digital slide calipers up to the nearest 0.1 and weighed with a digital balance up to the nearest 0.1 g. A stereomicroscope was used for the counting of meristic characters. Furthermore, the number of spines (unforked rays) and branched (forked) rays in dorsal, anal and pectoral fins were counted, together with the number of scales on, above and below the lateral line. Identification of fishes was done following Talwar and Jhingran [8] and Jayaram [10]. All data were analyzed for combined sexes in EXCEL 2010 and SPSS 16.0.

RESULT AND DISCUSSION

A total of 41 specimens ranging from 10.00 - 17.00 cm total length (TL) and 12.16 - 41.22 g body weight (BW) were used for the study of morphometric and meristic characteristics. The depiction of morphometric characters is presented in Fig. 2 and definitions and statistical values of morphometric and meristic characters are given in Tables 1 & 2. Further body divisions between total length, head length versus other respective parameter is provided in Table 3. A significant positive correlation (Table 3) was found in all parameters with total length. The most highly correlated body parameter in relation to TL was SL (0.996) and DACB (0.804) was found least correlated. Lengths on the head were counted in percent of head length and shows positive correlation. Highest correlated body parameter in relation to HL was PrOL (0.931) whereas least correlation was observed for HH (0.829). The diagnostic features included elongate and compressed body. Head was flat and compressed.

Fig 1: Lateral view of *Crossocheilus diplochilus*.

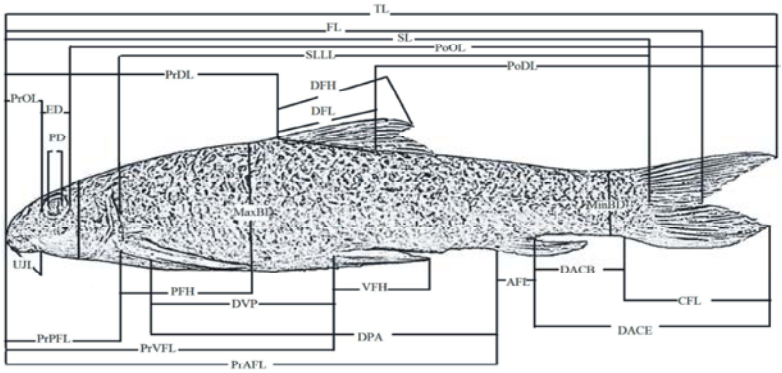

Fig 2: Morphometric characters of *Crossocheilus diplochilus* considered for this study

Table 1: Definition of morphometric measurements, range mean and standard deviation (in parentheses) examined in *Crossocheilus diplochilus* from Poonch valley, Jammu and Kashmir, India

Morphometric characters	Range	Mean	S.D
TL: total length	10.00-17.00	13.75	2.19
FL: fork length	8.85-14.90	12.40	1.97
SL: standard length	7.55-13.50	10.94	1.93
PoDL: post-dorsal length	4.90-9.20	7.21	1.33
PrDL: pre-dorsal length	3.72-5.70	4.82	0.69
HL: head length	1.83-2.50	2.15	0.22
HH: head height	0.90-1.70	1.37	0.24
PoOL: post-orbital length	8.89-15.10	12.24	1.96
PrOL: pre-orbital length	0.84-1.30	1.04	0.15
ED: eye diameter	0.27-0.60	0.46	0.09
PD: pupil diameter	0.17-0.40	0.28	0.05
DFH: dorsal fin height	2.19-3.20	2.64	0.33
DFL: dorsal fin length	1.38-2.12	1.71	0.22
MaxBD: maximum body depth	1.91-2.92	2.41	0.38
MinBD: minimum body depth	0.90-1.70	1.28	0.22
AFL: anal fin length	0.70-1.10	0.88	0.09
PFH: pectoral fin height	1.98-2.64	2.34	0.20
VFH: ventral fin height	1.70-2.41	2.10	0.23
PrVFL: pre-ventral fin length	4.51-6.90	5.79	0.72
PrPFL: pre-pectoral fin length	1.69-2.50	2.16	0.25
PrAFL: pre-anal fin length	7.32-10.40	8.71	0.99
DACE: distance from anal fin to caudal fin end	3.19-5.80	4.50	0.85
CFL: caudal fin length	1.90-3.90	2.86	0.60
DACB: distance from anal fin to caudal fin base	1.20-2.20	1.64	0.29
DPA: distance between pectoral and anal fin	4.89-7.32	6.17	0.87
DVP: distance between ventral and pectoral fin	2.17-3.90	3.14	0.60
UJL: upper jaw length	0.30-0.80	0.57	0.13
SLLL: straight lateral line length	6.32-11.00	9.08	1.41

Table 2: Meristic counts of the *Crossocheilus diplochilus* captured from Poonch valley, Jammu and Kashmir, India

Meristic Characters	Range
NLLS: number of lateral line scales	37-38
LTS: lateral transverse	9-10
PFR: pectoral fin rays	I-13
DFR: dorsal fin rays	III-8
CFR: caudal fin rays	II-17-18
AFR: anal fin rays	II-5
VFR: ventral fin rays	I-8

Table 3: Morphometric characters of *Crossocheilus diplochilus in* accordance with percent total length and head length of fish and correlation of morphometric traits with total length from 10.00 - 17.00 cm

Characters	Mean	S.D	Min.	Max.	R
		In % of total length			
FL	90.17	1.61	87.57	93.18	0.992
SL	79.36	2.11	75.43	82.63	0.996
PoDL	52.21	1.79	49.00	54.48	0.985
PrDL	35.20	1.63	33.33	37.24	0.919
HL	15.84	1.43	13.66	18.30	0.831
HH	9.93	0.47	9.00	10.79	0.829
PoOL	88.99	0.29	88.50	89.78	0.971
PrOL	7.64	0.31	7.24	8.40	0.976
ED	3.36	0.24	2.70	3.59	0.921
PD	2.08	0.18	1.70	2.36	0.923
DFH	19.37	1.36	16.66	21.90	0.859
DFL	12.57	0.85	10.59	13.80	0.878
MaxBD	17.57	1.09	15.10	19.10	0.790
MinBD	9.34	0.51	8.48	10.59	0.876
AFL	6.48	0.45	5.90	7.38	0.925
PFH	17.26	1.60	15.44	20.00	0.926
VFH	15.42	1.12	13.52	17.28	0.925
PrVFL	42.41	2.04	38.23	45.53	0.927
PrPFL	15.86	1.14	13.66	17.65	0.931
PrAFL	63.93	4.14	58.94	73.20	0.898
DACE	32.62	1.71	28.03	35.76	0.948
CFL	20.66	1.55	16.66	23.84	0.979
DACB	11.95	1.04	8.63	13.33	0.804
DPA	45.05	2.22	41.72	48.90	0.896
DVP	22.79	1.60	21.17	26.38	0.980
UJL	4.12	0.43	3.00	4.82	0.840
SLLL	64.51	0.95	62.25	66.02	0.914
		In % of Head length			
HH	63.34	7.46	49.18	78.94	0.829
PrOL	48.52	3.68	42.80	55.00	0.931
ED	21.46	2.93	14.75	26.31	0.921
PD	13.31	1.80	9.28	16.32	0.923

Mouth was sub-terminal with rostral fold covering most or all of upper jaw. Rostral fold crenulated, covered densely with papillae, laterally connected with lower lip at corners of mouth. Upper lip with many tiny papillae arranged in a longitudinal row on upper jaw. Eyes were small and lateral in position. Nostrils were nearer to eye than to tip of snout. Snout rounded and blunt with ethmoid furrow weakly developed. Gill rakers 17 to 21 on first arch.Two pairs of barbels present: rostral and maxillary, both short. Rostral barbels positioned at anterior end of shallow furrow on lateral portion of snout; maxillary barbel's minute, embedded in corners of mouth. Dorsal fin inserted nearer tip of snout than caudal fin base. Pectoral fin reaches vertically to the origin of dorsal fin. Dorsal fin was with 3 simple and 8 branched rays (3, 8), last simple ray longer than head length; outer margin faintly concave. Pectoral fins with 1 simple and 13 branched ray (1, 13) equal to or slightly longer than head length; tip of fin extending slightly beyond three-fourths to pelvic-fin origin. Pelvic fin with 1 simple and 8 branched rays (1, 8), slightly shorter than head length; origin posterior to vertical of third dorsal-fin branched ray; tip of depressed fin surpassing anus, not reaching anal-fin origin. Anal fin was with 2 simple and 5 branched rays (2, 5), origin closer to pelvic-fin insertion than to caudal-fin base; distal margin concave. Anus anterior to anal-fin origin, separated from it by two scales. Caudal fin with 2 simple and 18-19 branched rays (2, 18-19), deeply forked, upper and lower lobes identical in length and shape. Scales were moderately large; lateral line complete, horizontal 37-38 and lateral transverse scales 9-10 (5-6+ 4). Scales on chest and abdomen were relatively small. The maximum total length of *C. diplochilus* caught (17cm) was also higher than that reported by Talwar and Jhingran (10 cm) [8] and Kullander (13 cm) [10]. The correlation analysis (Table 3)

shows that all morphometric traits change proportionally with increase in the total length from 10.0 to 17.0 cm. In present study meristic counts remained constant instead of size difference among the individuals; which means meristic counts are independent of body size. The use of the combined approach, such as morphometry, genetic and other biological indicators (e.g. growth pattern of scales and otoliths), must be considered for more accurate results. Population analyses and stock assessment are required to establish the status of the wild stocks in terms of abundance and distribution, as well as ecological requirements of this important species. These results generate the baseline data on morphometry of C. diplochilus which help in easy identification and will help in the development of a strategy for conservation of the natural stocks of C. diplochilus in Indus basin, India.

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