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Morphometric characters and meristic Counts of a Fish, *Crossocheilus latius latius* (Hamilton-Buchanan) from Ranjit Sagar Wetland, India

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Abstract
Morphometric characters and meristic count of a fish, *Crossochelius latius latius* (Hamilton-Buchanan) have been studied from Ranjit Sagar Wetland. Monthly sample collection of *Crossochelius latius latius* was conducted for the study of morphometric characters and meristic counts. Eighteen characters have been studied in percentage of total fish length from which thirteen characters were genetically controlled, four characters were intermediate and one character was environmentally controlled. In percentage of head length all characters were genetically controlled. The meristric characters were counted and to draw fin formula of this fish. Some variation in the count of branched and unbranched fin rays have been observed. However positive correlation has been observed between total length and external body parts. Thus, population appeared to be relatively uniform as revealed by morphometric characters, thus considered as isometric growth.

Keywords: Ranjit Sagar Wetland, *Crossocheilus latius latius*, Morphometric characters, meristic count

1. Introduction
Genus *Crossocheilus* comes under the family Cyprinidae, which includes carps and minnows. This fish occur in several types of habitats, often found in fast-flowing rivers with rocky bottoms, streams and reservoirs. This fish is not commercially important due to its small size. It plays an important role in the aquatic food chain as it is preyed by large carnivorous fishes, hence maintains ecological balance. It has suctorial disc which is helpful for clinging to the substratum and to resist the fast current of water. Earlier, under Conservation Assessment and Management Plan report compiled by Molur and Walker (1998) [1], this fish was designated as DD (Data Deficient) but during the present investigations, this fish has been reported from Ranjit Sagar Wetland and its adjoining stream. Only 25 fish specimen have been collected in one year after extensive fishing efforts. Later on IUCN (2010) [2] designated this fish as LC (Least Concerned). By taking the cognizance of above said factors, this fish was employed for population studies. As this is a typical hill stream fish and play an important role to maintain the ecological balance of these streams, hence study on its conservation and management is very essential.

Identification of species is a primary step towards any research work and plays a key role for the behavioral study. Morphometric measurements and meristic counts are considered as easiest and authentic methods for the identification of specimen which is termed as morphological systematic (Nayman, 1965) [3]. Morphological measurements, meristic counts, shape and size provide data useful for taxonomic status (Ihssen *et al.,* 1981) [4]. In general, fish demonstrate greater variances in morphological traits both within and between populations than other vertebrates and are more susceptible to environmentally induced morphological variations.

The cause of variation in the morphometric and meristic characters may range from variability to the intraspecific which is under the influence of environmental parameters (Hubbs, 1921[5]; Vladykov, 1934 [6]; McHugh, 1954 [7]; Allendrof *et al.,* 1987 [8]; Wimberger, 1992) [9]. The morphometric relationships between various body parts of fish can be used to assess the well being of individuals and to determine possible difference between separate unit stocks of the same species (King, 2007) [10]. Fish are very sensitive to environmental changes and quickly

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adapt themselves by changing necessary morphometrics (Hossain *et al.*, 2010) [11]. Information the morphometric measurements of fishes and the study of statistical relationship among them are essential for taxonomic work (Narejo, 2010) [12].

Vladykov (1934) [6] and Tandon *et al.* (1992) [13] are of view that morphometric characters can be successfully employed for ascertaining the genetically controlled and environmentally controlled characters. The various morphometric characters have been categorized on the basis of range difference into genetically (narrow range), intermediate (moderate range) and environmentally (vast range) controlled characters (Johal *et al.*, 1994) [14].

The present study is designed to generate data on morphometric and meristic characters of the fish, *Crossocheilus latius latius* (Hamilton-Buchanan) from Ranjit Sagar Wetland, India.

Study Area

Ranjit Sagar wetland (32^0 26' 33" N and 75^0 43' 43" E) is situated on the Ravi river near Pathankot city, Punjab (India). This Wetland (Fig.1) is located at the boundaries of three states i.e. Punjab, Jammu & Kashmir and Himachal Pradesh and created by impoundment of the waters of Ravi river water and its streams. This is primarily meant for irrigation, power generation, flood control, navigation and water supply. This is one of the great potential fishery resources in India. The Ranjit Sagar Wetland is cold water wetland and occupying largest catchment area (6086 sq.km.) as compared to other wetlands existing in the Punjab state. This wetland is included into the list of wetland of National importance in 2005 by Ministry of Environment and Forests, Govt. of India.
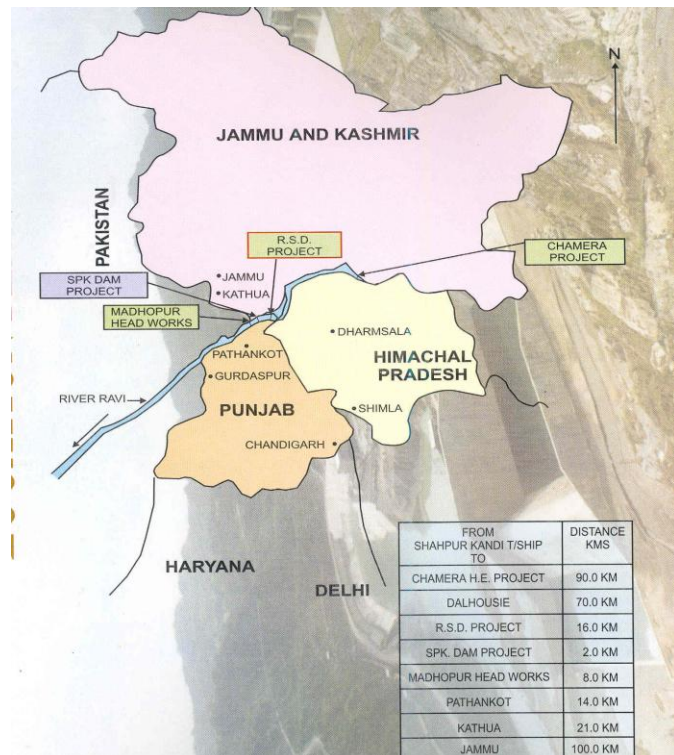

Fig 1: Location Map of Ranjit Sagar Wetland.

2. Materials and Method

A total number of 25 specimens of *Crossocheilus latius latius* (Hamilton-Buchanan) (Fig.2) were collected from Ranjit Sagar Wetland with the help of standard fishing gears like cast and hand nets. The specimens were preserved in 5% formaldehyde solution on the spot. Fishes were brought to the laboratory for further analysis. The meristic counts and morphometric measurements were recorded following Holden and Raitt (1974) [15] and Jayaram (1981) [16]. Statistical calculations such as regression equation and correlation coefficient have been calculated after Snedecor and Cochran (1967) [17].

Fig 2: Photograph of *Crossocheilus latius latius* (Hamilton-Buchanan).

3. Results and Discussion

The samples of the fish namely *Crossocheilus latius latius* (Hamilton-Buchanan) have been collected from Ranjit Sagar Wetland during the present course of work. This fish has been employed for different morphometric characters which are expressed in the percentage of total fish length and head length have been taken for statistical analysis (Table.1). The data generated was employed for futher different statistical analysis like mean, standard deviation, range, range difference, correlation coefficient and regression equation. The values of regression equation and correlation coefficient are based on the original readings. During present course of work, eighteen characters have been studied in percentage of total fish length from which thirteen characters were genetically controlled, four characters were intermediate and one character was environmentally controlled. In percentage of head length all characters were observed to be genetically controlled. The meristric characters were counted and have definite number. The variation in fin rays has been observed and falls under some specific range in all the fishes (Table.2). It has been observed that characters like standard length, head length, predorsal distance and preanal distance in the percentage of total fish length show high values of correlation coefficient indicating that these morphometric characters increase in direct proportion

Table 1: Mean, S.D., Correlation coefficient (r), Range, Range Difference and Regression equation (Y=a+bX) between different morphometric characters of *Crossocheilus latius latius* (Hamilton-Buchanan).

S. No.	In the percentage of total fish length	Mean	S.D.	Range	Range difference	Correlation coefficient	Regression equation
1.	Standard length	8.27	0.86	7-10.1	3.1	0.946	Y=0.784-0.063X
2.	Head length	1.89	0.15	1.7-2.2	0.5	0.936	Y=0.138+0.427X
3.	Head depth	1.16	0.06	1.1-1.3	0.2	0.538	Y=0.032+0.812X
4.	Predorsal distance	3.73	0.37	3.2-4.5	1.3	0.910	Y=0.323+0.296X
5.	Postdorsal distance	3.09	0.39	2.4-3.7	1.3	0.632	Y=0.234+0.597X
6.	Length of dorsal fin	1.54	0.16	1.2-1.8	0.6	0.879	Y=0.134+0.108X
7.	Depth of dorsal fin	2.21	0.24	1.8-2.5	0.7	0.857	Y=0.201+0.073X
8.	Length of anal fin	0.75	0.05	0.7-0.8	0.1	0.483	Y=0.019+0.551X
9.	Depth of anal fin	1.43	0.11	1.2-1.6	0.4	0.737	Y=0.078+0.595X
10.	Preanal distance	6.55	0.66	5.8-7.5	1.7	0.902	Y=0.571+0.480X
11.	Length of pectoral fin	1.77	0.17	1.5-2	0.5	0.802	Y=0.128+0.406X
12.	Length of ventral fin	1.58	0.17	1.3-1.9	0.6	0.695	Y=0.110+0.404X
13.	Minimum body depth	1.03	0.10	0.8-1.2	0.4	0.777	Y=0.071+0.263X
14.	Maximum body depth	2.04	0.23	1.6-2.5	0.9	0.783	Y=0.175+0.180X
15.	Distance between pectoral and ventral fin	2.86	0.35	2.5-3.4	0.9	0.865	Y=0.291-0.233X
16.	Distance between pelvic and anal fin	2.34	0.24	2-2.9	0.9	0.466	Y=0.077+1.517X
17.	Length of caudal fin	2.35	0.36	1.6-3	1.4	0.625	Y=0.215+0.063X
18.	Length of caudal peduncle	1.16	0.18	0.9-1.5	0.6	0.526	Y=0.057+0.546X
In the percentage of head length							
19.	Eye diameter	0.48	0.06	0.4-0.6	0.2	0.481	Y=0.176+0.146X
20.	Interorbital distance	0.94	0.09	0.8-1.1	0.3	0.476	Y=0.164+0.629X
21.	Preorbital distance	0.82	0.11	0.7-0.9	0.2	0.783	Y=0.524-0.166X
22.	Postorbital distance	0.73	0.08	0.6-0.9	0.3	0.715	Y=0.372+0.021X
23.	Length of rostral barbells	0.22	0.06	0.1-0.3	0.2	0.216	Y=-0.054+0.223X
24.	Length of Maxillary barbells	0.12	0.04	0.1-0.2	0.1	0.202	Y=0.200+0.780X
25.	Head depth	1.16	0.06	1.1-1.3	0.2	0.485	Y=0.200+0.780X

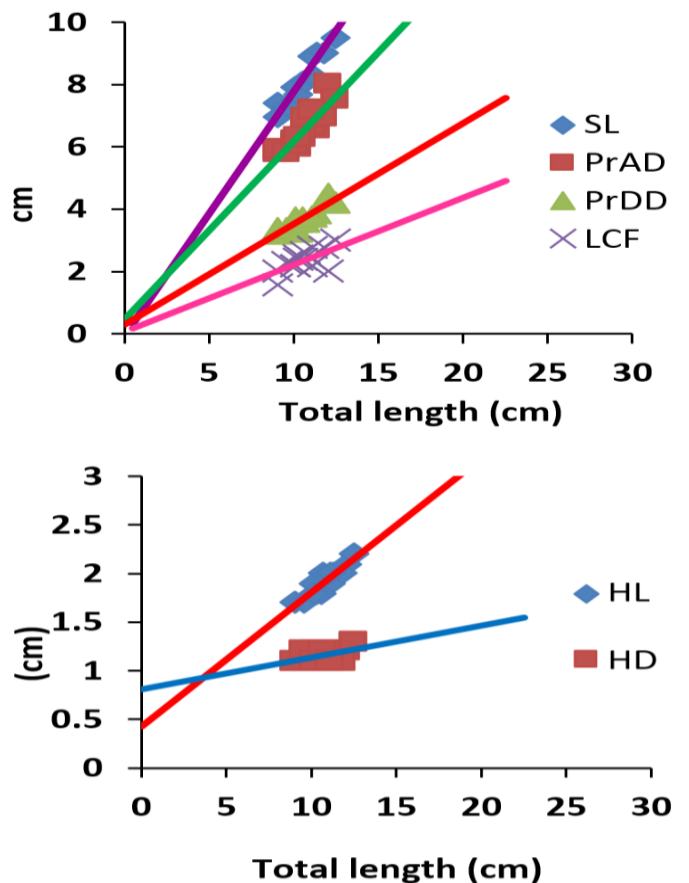**Table 2:** Meristic characters of *Crossocheilus latius latius* (Hamilton-Buchanan).

Meristic characters	Range
Dorsal fin ray	8-9(1-2/7-8)
Pectoral fin ray	13-14(1-4/8-12)
Ventral fin ray	8(1-2/6-7)
Anal fin ray	5-6(1-2/3-5)
Caudal fin ray	19-22
Lateral line scales	38-40
Lateral line transverse scales	5-6/4-5

in formula = D. 8-9(1-2/7-8), P. 13-14(1-4/8-12), V. 8(1-2/6-7), A. 5-6(1-2/3-5), C. 19-22, Ll. 38-40, L.tr. 5-6/4-5.

to each other and characters like head depth, postdorsal distance, length of dorsal fin, depth of dorsal fin, depth of anal fin, length of pectoral fin, length of ventral fin, minimum body depth, maximum body depth, distance between pectoral and ventral fin, length of caudal fin and length of caudal peduncle in the percentage of total fish length show moderate correlation coefficient. The characters like length of anal fin and distance between pelvic and anal fin in percentage of total length show least correlation coefficient (Table.1). Linear relationships have been observed between all the independent and dependent characters (Fig.3). Seven morphometeric characters in the percentage of head length have been undertaken for correlation coefficient. It has been observed that pre-orbital distance and post orbital distance shows moderate correlation coefficient and length of rostral barbels, length of maxillary barbels, head depth, interorbital distance and eye diameter shows least correlation coefficient (Table.1). The linear relationship has been observed between these parameters (Fig.4).

The following meristic counts of this fish from Ranjit Sagar Wetland have been recorded:-
Fin formula = D. 8-9(1-2/7-8), P. 13-14(1-4/8-12), V. 8(1-2/6-7), A. 5-6(1-2/3-5), C. 19-22, Ll. 38-40, L.tr. 5-6/4-5.
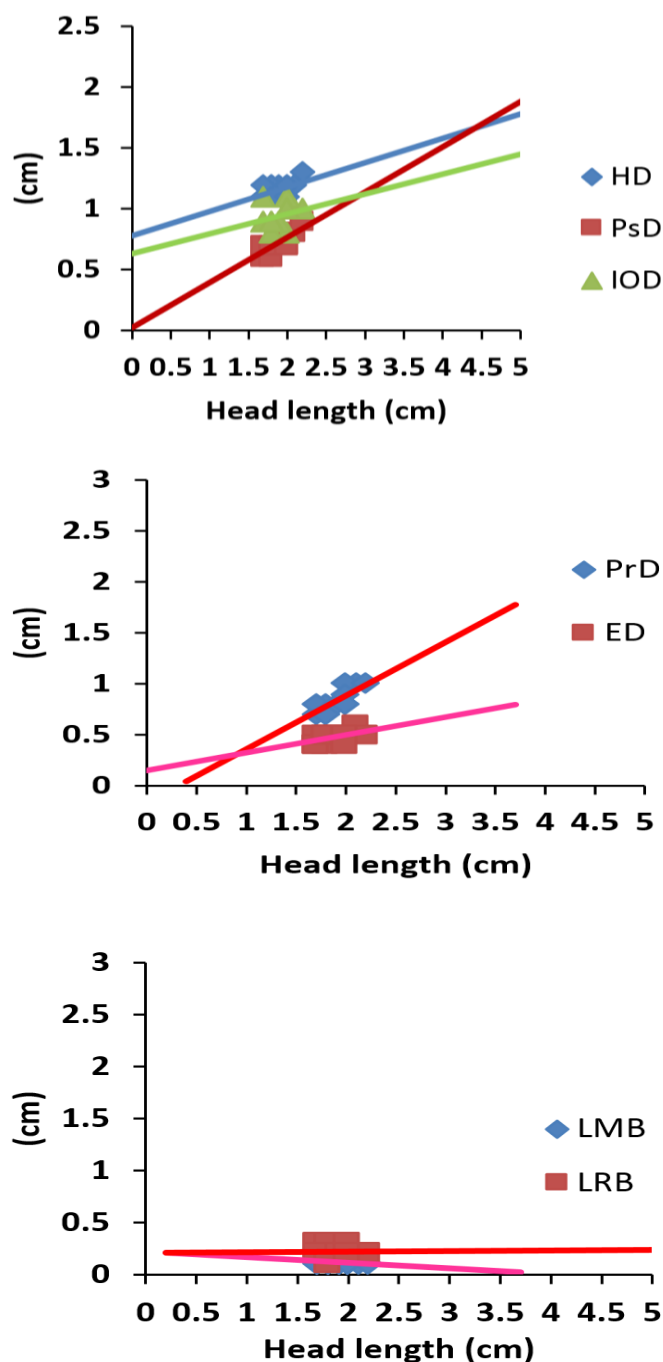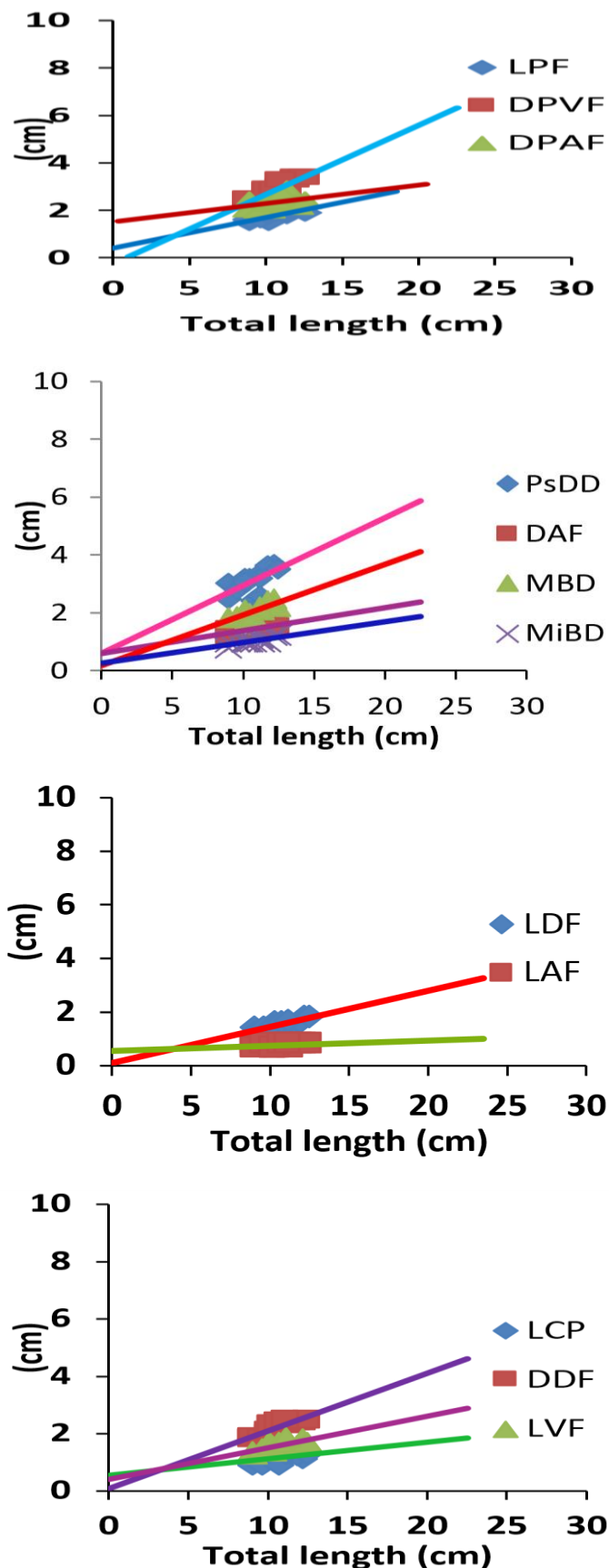
Fig 3: Relationship of Total Fish Length (TL) with Standard Length (SL), Pre-Anal Distance (PrAD), Pre-Dorsal Distance (PrDD), Length of Caudal Fin (LCF), Head length (HL), Head depth (HD), Length of pectoral fin (LPF), Distance between pectoral and ventral fin (DPVF), Distance between pectoral and anal fin (DPAF), Maximum body depth (MBD), Minimum body depth (MiBD), Post dorsal distance (PsDD), Depth of anal fin (DAF),Length of dorsal fin (LDF), Length of anal fin (LAF), Length of caudal fin (LCF), Depth of dorsal fin (DDF), Length of ventral fin (LVF).

Fig 4: Relationship of Head Length (HL) with Head depth (HD), Postorbital distance (PsD), Interorbital distance (IOD), Preorbital distance (PrD), Eye diameter (ED), Length of Rostral barbel (LRB) and Length of Maxillary barbell (LMB).

Fishes are very sensitive to environmental changes and quickly adapt themselves by changing necessary morphometrics. It is well-known factor that morphological characters can show high plasticity in response to differences in environmental conditions, such as food abundance and temperature (Allendorf and Phelps, 1988 [18]; Swain *et al.,* 1991[19] and Wimberger, 1992) [9]. During the present investigations, it has been observed that thirteen characters were genetically controlled, four characters were intermediate and one character was observed to be environmentally controlled character in percentage of total length. In percentage of head length all the characters were observed to be genetically controlled.

The phenotypic plasticity of fish is very high. They adapt quickly by modifying their physiology and behavior to environmental changes. These modifications ultimately change

their morphology. In general fish demonstrate greater variances in morphological traits both within and between populations than any other vertebrates and are more susceptible to environmentally induced morphological variations (Stearns, 1983 [20], Allendorf *et al.,* 1987 [8] and Wimberger, 1992) [9]. 13 characters in relation to total length to be genetically controlled in *Gudusia chapra* from Gobind Sagar population (Tondon *et al.,* 1993) [21]. 13 characters in relation to tatal length to be genetically controlled in *Tor putitora* from Gobind Sagar reservoir in Himachal Pradesh and also reported 12 out of 22 morphometric characters were genetically controlled and 5 were environmentally controlled characters in *Tor putitora* from Pongdam reservoir in Himachal Pradesh (Johal *et al.,* 1994) [14]. 12 characters in relation to total length which have considered as genetically controlled characters, two are intermediate and only one character has been found to be environmentally controlled in *Tor putitura* from foothill section of Ganga and in relation to head length three characters have been found to be intermediate and two are environmentally controlled characters (Bhatt *et al.,* 1998) [22]. 18 characters, 11 characters were found to be genetically controlled, 5 characters were intermediate and 2 characters were environmentally controlled in *Tor putitora* from Pong reservoir in Himachal Pradesh (Johal *et al.,* 2003) [23]. During the present investigation, thirteen characters were genetically controlled, four characters were intermediate and one character is environmentally controlled. It gives clear indication that area in around Ranjit Sagar Wetland is still undisturbed from environmental point of view.

Further, the correlation coefficient has been found to be very high in relation to total length. The characters like standard length, predorsal distance, preanal distance and head length in relation to total fish length shows high value of correlation coefficient. Dube and Dubey (1986-87) [24] reported 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 in a population of *Tor tor* from Narmada River. Nautiyal *et al.* (1998) [25] showed postdorsal distance as the most significantly correlated variable where as Johal *et al.* (1994) [14] found standard length as most correlated body part in *Tor putitora* from Gobindsagar. Bhatt *et al.* (1998) [22] observed the eye diameter as a least correlated variable and the results are comparable with the present studies. Johal *et al.* (2003) [23] showed that almost all the characters show high degree of correlation coefficient.

Variations in meristic characters were reported in many fishes such as *Nematalosa nasus* (AlHassan, 1987) [26], *Pseudobagrus ichikawai* (Watanable, 1998) [27] and *Pterophyllum scalare* (Bibi *et al.,* 2008) [28]. During present studies, it has also observed that the meristic counts are dependent of body size and there is change in meristic counts with increase in body length. Jayaram (2010) [29] reported *Crossocheilus latius latius* (Hamilton-Buchanan) from Gangetic watershed of the Himalaya and other parts of the India as well as World. He described number of lateral line scales 37-39 from those areas. During the present studies this fish is reported from the Ranjit Sagar Wetland situated on the Ravi River which is a part of Indus river system and described 38-40 lateral line scales which is different from earlier studies. The difference in lateral line count indicates that different locations and environment have considerable impact on meristisc characters.

4. Conclusions

The morphometric measurements and meristic counts confirmed that the test organism *Crossocheilus latius latius* (Hamilton-Buchanan) has very little impact of environment because this area is still undisturbed from environmental degradation point of view. Eighteen characters have been studied in percentage of total fish length from which thirteen characters were genetically controlled, four characters were intermediate and one character was environmentally controlled. In percentage of head length all characters were to be genetically controlled. The meristric characters were counted and have definite number. Specific ranges of various were found in almost all the fishes. But, sometimes environment can play an important role to change meristic characters. Positive correlation has been observed between total length and external body parts. Linear relationships have been observed between all the independent and dependent characters. Further it can be said that this fish is a typical hill stream fish and thrives well even in fast flowing waters. The modification like adhesive disc is helpful to attach with big boulders to withstand high current of water. The rampant removal of boulders from stream as well as river beds should be stopped if this fish is to be conserved, otherwise it will slip into threatened category of fishes.

5. Acknowledgements

6. References

1. Molur S, Walker S, CAMP. (Conservation Assessment Management Plan) workshop. Zoo outreach organization, CBSG, India, 1998.
2. Singh L. *Crossocheilus latius.* In: IUCN 2013. IUCN Red List of Threatened species. Version 2013, 2, 2010, www.iucnredlist.org.
3. Nayman. Growth and Ecology of Fish Population. J Anim Ecol 1965; 20:201-219.
4. Ihssen PE, Booke HE, Casselman JM, McGlade JM, Payne MR, Utter FM. Stock identification: Materials and smethods. Can J Fish Aquat Sci 1981; 38:1838-1855.
5. Hubbs CL. Geographic variation of Notemigonus crysoleucas on American minnows. Trans Illinois St Acad Sci 1921; 1018:147-151.
6. Vladykov VD. Environmental and taxonomic characters of fishes. Trans Res Can Inst 1934; 20:99-144.
7. McHugh JI. Geographical variation in pacific herring. Copeia 1954; 2:139-151.
8. Allendorf FW, Ryman N, Utter F. Genetics and fishery management: past, present and future in population genetics and fisheries management. Seattle, WA & London: University of Washington press, 1987, 1-20.
9. Wimberger PH. Plasticity of fish body shape the effects of diet, development, family and age in two species of *Geophagus* (Pisces, Cichlidae). Biol J Limnol Soc 1992; 45:197-218.
10. King M. *Fisheries biology assessment and management.* (2nd Ed.), Blackwell Scientific publications, Oxford, 2007, 1-381.
11. Hossain MAR, Nahiduzzaman M, Saha D, Khanam MUH, Alam MS. Landmark-Based morphometric and meristic variations of the endangered carp, Kalibaus *Labeo calbasu*, from stocks of two isolated Rivers, the

Jamuna and Halda and a Hatchery. Zool Stud 2010; 49(4):556-563.

12. Narejo NT. Morphometric characters and their relationship in *Gudusia chapra* (Hamilton) from Keenjhar lake (Distt: Thatta), Sindh. Pak. J. Zool 2010; 42(1):101-104.

13. Tandon KK, Johal MS, Bala S. Morphometry of *Cirrhinus reba* (Hamilton) from Kanjli Wetland, Punjab, India. Res Bull Panjab Univ 1992; 43:73-79.

14. Johal MS, Tandon KK, Sandhu GS. Mahseer in Lacustrine Waters, Gobindsagar Reservoir. Morphometry of *Tor putitora*. In P. Nautiyal (Eds.), Mahseer the Game Fish., Jagdamba, Prakashan Publisher, Srinagar, Garhwal 1994, 67-85.

15. Holden MJ, Raitt DFS. Manual of fishery science. Part 2. Methods resource investigation and their application. FAO Fish Tech Pap (115), Rev 1974; 1:214.

16. Jayaram KC. The freshwater fishes of India, Pakistan, Bangladesh, Burma, Sri Lanka: a handbook. (Calcutta): Zoological Survey of India 1981, 475.

17. Snedecor GW, Cochran WG. Statistical methods. Sixth edition. The Iowa State University, Press, Ames, USA, 1967.

18. Allendorf FW, Phelps SR. Loss of genetic variation in hatchery stock of cutthroat trout. Trans. Am Fish Soc 1988; 109:537-543.

19. Swain DP, Ridell BE, Murray CB. Morphological differences between hatchery and wild populations of coho salmon (*Oncorhynchus kisutch*): environmental versus genetic origin. Can J Fish Aquat Sci 1991; 48:1783-1791.

20. Stearns SC. A natural experiment in life-history evolution: field data on the introduction of mosquito fish (*Gambusia affinis*) to Hawaii. Evolution 1983; 37:601-617.

21. Tandon KK, Johal MS, Bala S. Morphometry of *Cirrhinus reba* (Ham.) from Kanjli wetland, Punjab India. Res Bull Panjab Univ 1993; 43:76-79.

22. Bhatt JP, Nautiyal P, Singh HR. Racial structure of Himalayan mahseer, *Tor putitora* (Ham.) in the river Ganga between Rishikesh and Hardwar. Indian J Anim Sci 1998; 68:587-590.

23. Johal MS, Negi RK, Negi T. Age and growth of golden mahseer Tor putitora from Pong reservoir, Himachal Pradesh, India. Him. J Env Zool 2003; 17(1):17-29.

24. Dube K, Dubey GP. Biometric studies of Indian mahseer *Tor tor* (Ham.) from Narmada River. Matsya 1986-87, 12-13, 126-132.

25. Nautiyal P, Bhatt JP, Rawat VS, Kishor B, Nautiyal R, Singh HR. Himalayan Mahseer: magnitude of commercial fishery in Garhwal hills. Muzaffarnagar: NATCON Publication 1998; 5:107-114.

26. AlHassan LAJ. Variations in meristic characters of *Nematalosa nasus* from Iraqi and Kuwaiti waters. Jap. J Ichthyol 1987; 33(4):422.

27. Watanabe K. Meristic variation in the endangered bagrid catfish, Pseudobagrus ichikawai. Ichthyol Res 1998; 45(1):99-104.

28. Bibi Koshy E, Oyyan Selvaraj Sekaran M. Variation in meristic characters of four strains of Malaysian freshwater angelfish *Pterophyllum scalare* (L.). Malaysian J Sci 2008; 27(1):69-73.

29. Jayaram KC. The freshwater fishes of the Indian Region (2nd Ed.), Narendra Publishing House, Delhi, 2010, 167-169.