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Morphometeric characters of *Cyprinus carpio* collected from Dal Lake, Kashmir, India

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Abstract
Morphometeric characters of 75 samples of *Cyprinus carpio* collected from three basins of Dal Lake, namely Hazratbal basin, Nigeen basin and Gagribal basin were studied. Eighteen characters have been studied in percentage of total fish length and five in percentage of head length. The morphometric characters were classified into genetically (Narrow range), intermediate (Moderate range) and environmentally (Vast range) controlled characters. Characters belonging to the genetically controlled shows minimum range of variation, characters belonging to intermediate shows moderate range of variation and the characters belonging to environmentally controlled shows maximum range of variation. Statistical analysis was done between different morphometric characters of the fish.

Keywords: *Cyprinus carpio*, Dal lake, morphometric, Kashmir.

Introduction
The Common carp, *Cyprinus carpio* (L., 1758) is a freshwater cyprinid fish that is widely farmed fish distributed in the world. It occurs in shallow ponds, lakes rich in vegetation and slow moving rivers. It burrows in mud in the dry season or winter and tolerates cold, organic pollutants and low oxygen concentration in water (Weber *et al*, 2010) [26]. Since it is a fast growing and hardy fish that can withstand adverse environmental conditions, it has been successfully introduced into fresh waters throughout the world (Seegers *et al*. 2003; Golemi *et al*, 2013) [20, 7]. It is an important food fish in the world that is available round the year. This is also a popular culture fish due to its omnivorous habit, fast growth rate and easy breeding in confined water (Ram *et.al* 2015) [17]. As a result, this exotic fish has now become common in natural and manmade water bodies and makes substantial proportion of the commercially important fish species.

Common carp was first introduced to India from Ceylon in 1939 and later again from Bangkok in 1957. In Kashmir Common carp was introduced in 1959 to augment the fish yield (Sehgal, 1989) [19]. *Cyprinus carpio* is cultured and easily available in Dal lake, Kashmir and from the view of local consumption, this fish is rather economically important one. It has been categorized as eurythermal i.e. it can withstand wide range of temperature fluctuation, so it is well suited for culture in the climatic conditions of Kashmir Valley. The length weight relationship gives an idea about the mathematical relationship between length and weight. It assists in understanding the general wellbeing of fish, gonadal development, setting up yield equations, growth patterns and comparing population in the time and space. So, morphometric measurement of fishes and the study of statistical relationship among them are essential for taxonomic study of a species. Length weight relationships are needed to estimate weight from length because direct weight measurements can be time consuming in the field (Koutrkis and Tsiklirs, 2003, Sinoveic *et al*, 2004) [12, 21].

The relative condition factor is an important quantitative parameter of well being of the fish in question and by extension its health status (Blackwell *et al*, 2000) [5]. It determines present and future population success by its influence on growth, reproduction and survival. It also reflects fluctuations by interaction of feeding components, parasitic infection and physiological factors. Condition factor is estimated by comparing individual fish weight of a given length to a standard weight. It is assumed that heavier fish reflect a healthier physiological state (Ricker, 1975) [18]. It is also used to detect seasonal variations in the condition of fish which may vary with food abundance and average reproductive stage of the stock (King, 1995) [11]. It is an important concept in fisheries management and can be used to assess the health and potential

of any fishery to support the fishing pressure. This simple approach and interpretation can therefore aid in development of intervention measures which can easily be implemented by fishery managers especially with respect to maintaining a healthy fish population through controlling of the fishing effort. In the present study every possible aspect of size frequency distribution, length-length relationship, length–length relationship, length weight relationship, condition factor of *Cyprinus carpio* has been analyzed critically. The morphometric characters were classified into genetically (Narrow range), intermediate (Moderate range) and environmentally (Vast range) controlled characters.

Materials and Methods

A total of 75 specimens of *Cyprinus carpio* were collected from three basins of Dal Lake, namely Hazratbal, Nigeen and Gagribal basin situated between 34° 5′ - 34° 6′ N latitude and 74° 8′ – 74° 12′E with an altitude of 1584 ASL. All the specimens were preserved in 10% formalin at their respective sampling spot. The total length of the fish was measured to its nearest 0.01 mm. and total body weight was measured to its nearest 0.01g. (Bagenal, 1978) [2]. The morphometric measurements were recorded with the help of a measuring scale following the method given in Holden and Raitt, 1974. The statistical calculations such as regression equation and correlation coefficient have also been calculated following (Snedecor and Cochran, 1967) [22].

Results

After proper identification of the fishes, different morphometric characters which are expressed in the percentage of total fish length and in the percentage of head length have been taken for statistical analysis like mean, standard deviation, range, range difference, correlation coefficient and regression equation (Table 1)

In Percentage of Total Fish Length

Eighteen characters have been studied in percentage of fish length from which four characters were genetically controlled, twelve characters were intermediate and two characters were environmentally controlled. Out of eighteen characters, nine characters show high values of correlation coefficient indicating that these characters are directly proportional to each other and seven characters show moderate correlation coefficient.

In Percentage of Head Length

Five morphometric characters have been under taken for correlation coefficient it has been observed that one characters show least correlation coefficient and four characters moderate correlation coefficient. The characters like eye diameter, interorbital distance, preorbital distance and postorbital distance have been genetically controlled while as head depth and has been found to be intermediate.

Table 1: Showing Mean, S.D., Range, range difference, Correlation coefficient (r) and regression equation (Y= a+ bX) between different morphometric characters of *Cyprinus carpio.*

S.No.	In % age of total fish length	Mean	S.D.	Range	Range difference	Correlation coefficient	Regression equation
1	Standard length	10.2	1.65	7.0-11.0	4.0	0.981	Y=0.712-0.042X
2	Head length	2.9	0.35	1.8-3.5	1.7	0.842	Y=0.362-0.421X
3	Head depth	1.5	0.41	1.3-2.6	1.3	0.812	Y=0.171-0.417X
4	Pre dorsal distance	4.6	0.51	2.8-4.4	1.6	0.912	Y=0.432+0.541X
5	Post dorsal distance	2.6	0.51	2.2-4.0	1.8	0.632	Y=0.174+0.712X
6	Length of dorsal fin	1.7	0.32	1.0-3.0	2.0	0.922	Y=0.162+0.037X
7	Depth of dorsal fin	2.3	0.37	1.9-3.6	1.7	0.912	Y=0.412+0.030X
8	Length of pectoral fin	2.1	0.24	0.9-3.0	2.1	0.924	Y=0.178+0.482X
9	Length of ventral fin	2.3	0.25	1.8-2.8	1.0	0.937	Y=0.179+0.047X
10	Length of anal fin	0.7	0.15	0.6-1.2	0.6	0.823	Y=0.712+0.042X
11	Depth of anal fin	2.0	0.47	1.1-2.5	1.4	0.927	Y=0.175-0.104X
12	Pre anal distance	6.8	1.01	6.8-10.0	3.2	0.966	Y=0.571+0.242X
13	Minimum body depth	1.4	0.26	1.7-2.6	0.9	0.554	Y=0.09+0.402X
14	Maximum body depth	2.6	0.32	1.5-2.0	0.5	0.834	Y=0.892-0.324X
15	Distance between pectoral and ventral fin	2.8	0.45	2.0-3.8	1.8	0.841	Y=0.324+0.081X
16	Distance between pelvic and anal fin	2.4	0.46	1.7-3.0	1.3	0.827	Y=0.322-0.091X
17	Length of caudal fin	2.6	0.42	1.9-3.2	1.3	0.935	Y=0.472-0.037X
18	Length of caudal peduncle	1.1	0.41	0.8-1.7	0.9	0.857	Y=0.126-0.179X
	In %age of head length						
19	Eye diameter	0.3	0.04	0.4-0.6	0.2	0.126	Y=0.008+0.724X
20	Inter orbital distance	1.0	0.07	0.7-1.3	0.6	0.835	Y=0.238 +0.451X
21	Pre orbital distance	1.2	0.41	0.7-1.0	0.3	0.854	Y=0.064+0.672X
22	Post orbital distance	0.6	0.27	0.7-1.4	0.7	0.628	Y=0.045+0.367X
23	Head depth	1.5	0.41	1.3-2.6	1.3	0.822	Y=0.671+0.170X

Discussion

On the basis of range differences the morphometric characters are classified into genetically (narrow range), intermediate (moderate range) and environmentally controlled characters (vast range) (Johal *et al*., 1994) [10]. Characters belonging to the genetically controlled show minimum range of variation, characters belonging to intermediate show moderate range and the characters belonging to environmentally controlled shows maximum range of variation.

During the present investigation, 4 characters were genetically controlled, 12 characters were intermediate and 2 characters were environmentally controlled in percentage of total length and in percentage of head length only one character was intermediate and four characters were genetically controlled. Bhat *et al* (2016) [3] reported 3 characters were genetically controlled, 13 characters were intermediate and two

characters were environmentally controlled in *Cyprinus* sp collected from River Jhelum, Kashmir. Brraich and Akther (2015) [6] reported that in *Crossocheilus latius latius* thirteen characters were genetically controlled, four characters were intermediate and one character was environmentally controlled while in percentage of head length all characters were to be genetically controlled. Tandon *et al* (1993 a,b) [23, 24] studied *Cirrihinus reba* and *G. chapra* and reported that 14 out of 19 and 13 out of 18 morphometeric characters respectively exhibited wide range differences and hence environmentally controlled while in *Tor putitora* 9 were environmentally controlled. In contrary to that Bhatt *et al* (1998) [4] reported that 12 out of 20 characters were genetically controlled while 3 were environmentally controlled in the population of *Tor putitora* inhabiting the foot hills of Ganga. 13 characters in relation to total 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) [10]. In the *Barilius bendelisis* and *Barilius vagra*, the majority of their morphometric characters showed narrow range and were genetically controlled (Negi and Nautiyal, 2002) [15]. In *Tor putitora* 11 characters were genetically controlled, 5 characters were intermediate and 2 characters were environmentally controlled. In *Barilius bendelisis* all the characters show linear relationship and 13 characters were genetically controlled, 4 characters were of intermediate and 2 characters were environmentally controlled from hill streams of Himachal Pradesh (Johal and Kaur, 2005) [9]. In *Gudusia chapra* and *Gonialosa manmina* linear relationship have been observed between both dependent and independent characters (Azadi and Rahman, 2008) [1]. In *Schizothorax richardsonii* 19 characters were genetically controlled, 1 character was intermediate and 1 character was environmentally controlled (Negi and Negi, 2010) [16].

Further, the characters like standard length, predorsal distance, length of dorsal fin, pectoral fin, ventral fin and caudal fin, depth of dorsal fin, anal fin, preanal distance in relation to total fish length shows high value of correlation coefficient while minimum body depth showed the least. In relation to percentage of head length, eye diameter was observed to be least correlated variable. Bhat *et al* (2016) [3] reported that in *Cyprinus* sp out of eighteen characters in relation to total fish length ten characters show high values of correlation coefficient and eight characters show moderate correlation coefficient while in percentage of head length three characters showed least correlation coefficient and four showed moderate correlation. Nautiyal *et al*. (1998) [14] showed post dorsal distance as the most significantly correlated variable whereas Johal *et al.* (1994) [10] found standard length as most correlated body part in *Tor putitora* from Gobindsagar. Bhatt *et al*. (1998) [4] observed the eye diameter as a least correlated variable and the results are comparable with the present studies.

Conclusion

Eighteen characters have been studied in percentage of total fish length from which four characters were genetically controlled, twelve characters were intermediate and two characters were environmentally controlled. Surprisingly, the intermediate characters are observed highest in this fish which indicates that these characters are not very much stable in nature from this place. So there is a great chance for these characters to be controlled environmentally if proper conservation strategies have not been planned for this fish. Out of eighteen characters, nine characters show high values of correlation coefficient indicating that these characters are directly proportional to each other and seven characters show moderate correlation coefficient. In percentage of head length four were genetically controlled and one was intermediate. Out of which one character shows least correlation coefficient and four showed moderate correlation. This study will enlighten biologists about the status and growth condition of this fish in natural waters and will be useful for the fishery biologists and conservation agencies, for successful development, management, production and ultimate conservation. Finally it is recommended that it may be necessary to conduct the same experiment for a long period covering all season and various parts of the lake in comparison with the performance of other competing species of the lake.

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