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MORPHOMETRIC AND MERISTIC STUDY OF *GUDUSIA CHAPRA* (HAM. 1822) AND *GONIALOSA MANMINA* (HAM. 1822) (CLUPEIDAE) FROM THE KAPTAI LAKE, BANGLADESH

MOHAMMAD ALI AZADI * AND A.S.M.SHARIFUR RAHMAN
Department of Zoology, Chittagong University, Chittagong-4331, Bangladesh

ABSTRACT

Twenty-two morphometric and nine meristic characters of 280 *Gudusia chapra* (Total length 30-210mm) and 264 *Gonialosa manmina* (Total length 40-150 mm), the two important clupeids from the Kaptai lake, were studied during 1996-1997 to detect the plastic and non-plastic characters. Wide and medium range characters are plastic characters and hence are controlled by the environment while the narrow range characters are genetically controlled and non-plastic and hence can be used for differentiation of stock or sub-species. Three different categories of morphometric characters of the two species were recognised, viz., wide range, medium range and narrow range. Wide range morphometric characters varied within the range of 21.47% to 140.62% in the case of *G. chapra* and 24.04% to 87.19% in the case of *G. manmina* while the medium range characters varied within the range of 11.76% to 13.75% in the case of *G. chapra* and 11.55% to 18.92% in the case of *G. manmina* and less than 10% range characters were designated as narrow range. The relationships between the different morphometric characters (both dependent and independent variables) were found to be linear and in all the cases the relationships were found to be highly significant ($P< 0.001$).

Key words: Morphometirc and meristic study, *Gudusia chapra, Gonialosa manmina,* Clupeids, Kaptai lake, Bangladesh

INTRODUCTION

Morphometric characters are used frequently in the identification of species of fish (Day 1878, 1889, Chondar 1974, 1976, Jayaram 1981, Shafi and Quddus 1982, Bhuiyan and Biswas 1984, Rahman 1989, Talwar and Jhingran 1991 and Tandon *et al.* 1993). McConnel (1978) stated that the information on morphometric measurements of the fishes and the study of statistical relationships could play an important role in the taxonomic studies of fishes. On the other hand,

* Corresponding author : maazadi@yahoo.com

the morphometric characters of wide and medium range contribute in the indication of population of a species inhabiting the different water bodies or in different geographical regions. It is well known that ecological conditions of a water body have great impact on morphometric characters. Although some works on morphometric study of other fishes have been done in Bangladesh and India (Ghosh *et al.* 1968, Islam *et al.* 1984, Chatterjii 1985, Hoque and Islam 1990) but no works on morphometry of *G. chapra* and *G. manmina* were found except a short mormhometric study (with 10 characters) on *G. chapra* by Haque and Rahman (1985) in Bangladesh and Chondar (1974) and Tandon *et al.* (1993) on the morphometric and meristic study of *G. chapra* in India; but no studies on *G. manmina* were found.

In the present investigation morphometric and meristics characters for each of the two important clupeids, *G. chapra* and *G. manmina,* were studied. The equations relating to the various morphometric characters of the fishes derived here can fruitfully be utilized in the conversion of one measurement into the other and also to detect the origin of stock by comparing the result.

MATERIALS AND METHODS

Two hundred eighty specimens of *G. chapra* (Total length 30-210 mm) and 264 specimens of *G. manmina* (Total length 40-150mm) irrespective of sex, were used to study the meristic and morphometric characters. A monthly average of 24 specimens of *G. chapra* and 22 specimens of *G. manmina* utilized for the study were collected from the fishermen catch by gill nets from the Rangamati area of the Kaptai lake during the period from September 1996 to August 1997. After collection the fishes were frozen in a freeze, and during the study period the fishes were thawed for taking all sorts of measurements. All the measurements were taken by a millimeter scale except the eye diameter and inter-orbital space which were taken by a Vernier Caliper with the accuracy of ±0.01 mm. For calculating the relationships among the different types of variables the fishes were divided into 18 length groups at an interval of 10 mm. The morphometric characters which were taken into consideration were total length (TL) and head length (HL) as independent variables. Other than these all were dependent variables i.e. standard length (SL), fork length (FL), dorsal fin length (DFL), pectoral fin length (PecFL), pelvic fin length (PelFL), anal fin length (AFL), caudal fin length (CFL), predorsal distance (PreDD), post dorsal distance (PostDD), preanal distance (PreAD), depth of dorsal fin (DDF), depth of anal fin (DAF), maximum body depth (MaxBD), minimum body depth (MinBD), distance between pectoral and pelvic fins (Dpec-pel), distance between pelvic and anal fins (Dpel-anal), length of caudal peduncle

(LCP), length of caudal fin (LCF), head depth (HD), eye diameter (ED) and inter orbital distance (IOD).

The morphopetric measurements and meristic counts were considered following Jayaram (1981) and Tandon *et al*. (1993). To explain the relationship between the measurements, the regression equation ($Y = a + bx$) was followed; where 'x' stands for independent variables and 'Y' for the dependent variables.

RESULTS AND DISCUSSION

The regression equation, mean, range, t-test, standard deviation and correlation co-efficients of 22 various morphological characters of *G. chapra* and *G.manmina* are given in Tables 1 and 2. The variations of the measurements of different morphological characters were divided into three categories, viz., wide range, medium range and narrow range (Johal *et al.* 1989).

Wide range (21.47% - 140.62% for G. chapra; 24.04% - 87.19% for G. manmina)

It includes the body proportions like total length with fork length, standard length, predorsal distance, post dorsal distance, preanal distance and maximum body depth in both *G. chapra* and *G. manmina*; and total length with pectoral fin length, dorsal fin length, depth of anal fin, pectoral and pelvic fin distance, pelvic and anal fin distance, minimum body depth and in proportions of head length with head depth in *G. chapra*.

Medium range (11.76% - 13.75%) for G. chapra

It includes the body proportions like total length with pelvic fin length, depth of dorsal fin, length of caudal peduncle and in proportion of head length with-orbital distance in *G. chapra*.

Medium range (11.55% - 18.92%) for G. manmina

Body proportions like the percentage of total length with head length, dorsal fin length pectoral fin length, depth of anal fin, pectoral and pelvic fin distance, pelvic and anal fin distance, length of caudal fin, minimum body depth and the percentage of head length with head depth are included in this category.

TABLE 1. REGRESSION EQUATION (Y=a + b log X), MEAN (RANGE), CORRELATION COEFFICIENT (r), AND STANDARD DEVIATION (SD) BETWEEN DIFFERENT MORPHOLOGICAL CHARACTERS OF *GUDUSIA CHAPRA* (HAM.).

Parameters Total length vs	*Regression equation* $Y = a + bx$	Mean (range) mm	'r'	'SD'	't'	Significant
Standard length	Y= -0.11998 + 1.0076x	94.763(29.04 – 163.23)	0.99868	43.642	77.77	P<0.001
Fork length	Y= -0.05239 + .99157x	102.286(32.26–172.88)	0.99880	46.204	81.57	P<0.001
Head length	Y= -0.38460 + .89040x	28.971(10.14 – 43.31)	0.99480	11.309	39.07	P<0.001
Dorsal fin length	Y= -0.91526 + 1.01852x	15.945(4.68 – 26.15)	0.99815	7.054	65.66	P<0.001
Pectoral fin length	Y= -0.76970 + .96256x	16.981(5.55 – 27.2)	0.99732	7.173	54.52	P<0.001
Pelvic fin length	Y= -1.00267 + .95513x	9.608(3.25 – 17)	0.99589	4.208	43.98	P<0.001
Anal fin length	Y= -1.01636 + .88254x	6.546(2.44 – 11.23)	0.99462	2.767	38.40	P<0.001
Predorsal distance	Y= -0.35161 + .96734x	45.563(14.96 – 74.36)	0.99789	19.709	61.47	P<0.001
Post dorsal distance	Y= -0.53828 + 1.01377x	37.196(10.95 – 62.38)	0.99836	16.855	69.75	P<0.001
Pre anul distance	Y= -0.18177 + .95649x	63.777(20.15– 100.13)	0.99701	26.669	51.52	P<0.001
Distance between pectoral and pelvic fin	Y= -0.75337 + .96204x	17.575(5.61 – 28.2)	0.99768	7.427	57.63	P<0.001
Distance between pelvic and anal fin	Y= -0.74788 + .96742x	18.256(5.9 – 29.5)	0.99776	7.854	58.87	P<0.001
Depth of dorsal fin	Y= -0.88188 + .92365x	10.849(3.95 – 17.25)	0.99374	4.464	25.10	P<0.001
Depth of anal fin	Y= -0.92682 + 1.03310x	16.750(5.31 – 27.13)	0.99487	7.679	39.07	P<0.001
Maximum body depth	Y= -0.60449 + 1.00543x	30.583(9.05 – 48.65)	0.99716	13.236	54.40	P<0.001
Minimum body depth	Y= -0.82183 + 1.02980x	20.894(6.03 – 33.75)	0.99714	9.262	52.40	P<0.001
Length of caudal peduncle	Y= -1.24849 + 1.06958x	9.560(2.92 – 16.44)	0.99494	4.634	39.45	P<0.001
Length of caudal fin	Y= -0.53933 + .94921x	27.078(9.31 – 43.25)	0.99718	11.580	52.40	P<0.001
Head length vs						
Head depth	Y= -0.10016 + 1.02745x	25.7(8.1 – 41.29)	0.99890	10.640	85.20	P<0.001
Eye diameter	Y= -0.41865 + .88113x	7.332(2.94 – 10.45)	0.99723	2.576	53.33	P<0.001
Preorbital distance	Y= -0.40432 + .82254x	6.323(2.7 – 9.3)	0.99646	2.156	47.01	P<0.001
Interobital distance	Y= -0.55769 + 1.05817x	9.981(3.34 – 15.3)	0.99751	4.121	56.46	P<0.001

TABLE 2. REGRESSION EQUATION (Y=a + b log X), MEAN (RANGE), CORRELATION COEFFICIENT (r), AND STANDARD DEVIATION (SD) BETWEEN DIFFERENT MORPHOLOGICAL CHARACTERS OF *GONIALOSA MANMINA* (HAM.).

Parameters Total length vs	Regression equation Y = A + BX	Mean (range) mm	'r'	'SD'	't'	Significant
Standard length	Y= -0.390528 + 1.14006x	73.73(30.14-116.5)	0.9984	28.370	52.969	P<0.001
Fork length	Y= -0.15114 + 1.04173x	81.29(36.91-124.1)	0.9994	29.207	86.563	P<0.001
Head length	Y= -0.06374 + .70401x	21.06(13-29.4)	0.9974	5.458	41.521	P<0.001
Dorsal fin length	Y= -0.48056 + .80643x	12.92(7.55-29.4)	0.9905	3.909	21.608	P<0.001
Pectoral fin length	Y= -0.33485 + .75078x	13.00(8.45-20.31)	0.9931	3.938	25.405	P<0.001
Pelvic fin length	Y= -0.82236 + .84816x	7.11(4-10.21)	0.9966	2.180	36.287	P<0.001
Anal fin length	Y= -0.86885 + .81006x	5.37(3.2-7.91)	0.9882	1.634	19.355	P<0.001
Predorsal distance	Y= -0.06613 + .83145x	37.58(20.89-54.68)	0.9984	11.309	52.969	P<0.001
Post dorsal distance	Y= -0.07205 + .7992x	32.01(18.75-47.25)	0.9918	9.594	23.281	P<0.001
Pre anul distance	Y= -0.01638 + .86554x	53.25(3013-79.65)	0.9902	17.211	21.270	P<0.001
Distance between pectoral and pelvic fin	Y= -0.44951 + .81935x	14.71(8.15-22)	0.9966	4.407	36.287	P<0.001
Distance between pelvic and anal fin	Y= -0.50254 + .87135x	16.56(9.23-25-1)	0.9880	5.327	19.190	P<0.001
Depth of dorsal fin	Y= -0.81132 + .89775x	9.17(5-14)	0.9931	3.047	25.405	P<0.001
Depth of anal fin	Y= -0.44928 + .82905x	15.39(8.81-23)	0.9956	4.696	31.874	P<0.001
Maximum body depth	Y= -0.16569 + .81212x	27.46(16.96-41)	0.9702	8.769	12.012	P<0.001
Minimum body depth	Y= -0.36442 + .82478x	18.35(10.54-28.08)	0.9940	5.626	27.262	P<0.001
Length of caudal peduncle	Y= -0.80745 + .84031x	7.10(3.95-10.08)	0.9965	2.152	35.762	P<0.001
Length of caudal fin	Y= -0.13224 + .73998x	21.30(13.69-32.61)	0.9710	6.275	12.184	P<0.001
Head length vs						
Head depth	Y= -0.17869 + 1.08680x	18.248(10.89-26.15)	0.9979	5.188	46.281	P<0.001
Eye diameter	Y= -0.67555 + .1.0955x	5.974(3.61-9.0)	0.9961	1.750	33.868	P<0.001
Preorbital distance	Y= -0.82745 + 1.16419 x	5.21227(3.14-8.0)	0.9898	1.661	20.843	P<0.001
Interobital distance	Y= -0.57268 + 1.12631x	8.320(4.86-12.38)	0.9990	2.548	67.031	P<0.001

Narrow range (less than 10%) for G. chapra

It includes the body proportions like total length with anal fin length and proportions of head length with eye diameter and pre-orbital distance.

Narrow range (less than 10%) for G. manmina

It includes the body proportions like total length with pelvic fin length, anal fin length, depth of dorsal fin, length of caudal peduncle and the percentage of head length with eye diameter, post orbital distance and inter-orbital distance.

Meristic characters

The comparative meristic counts of *G. chapra* and *G. manmina* are shown in Tables 3 and 4.

TABLE 3. COMPARATIVE MERISTIC COUNTS OF *G. CHAPRA* (HAM.)

Reference	Fin rays					Scales in lateral line	Scutes		
	Dorsal(D)	Pectoral(P)	Pelvic(V)	Anal(A)	Caudal(C)		Pre-pelvic	Post-pelvic	Abdominal
Day 1880	14-16	13	8	21-24	17	80-110	18-19	9-10	
Chondar Keethan Lake 1976	15			22-23		82-107	17-20	8-11	
Ganga river	16			23-24		81-108	17-19	8-10	
Jayaram, 1981	16			21-24		80-120	18-19	8-10	
Shafi & Quddus 1982	14-15	13	8	21-25	19	80-120			
Rahman, 1989	14-15 (3/11-12)	13(1/2)	7	23-25 (2/11-23)		85-105	17-19	9-10	26-29
Talwar & Jhingran 1991	iv11-13	12-13	7	(ii)iii19-22		77-91			26-29
Tandon *et al.* 1993	14-15	11-13	8	22-24	17-19	80-97			
Present observations	14-15	13-14	7-8	23-25	18-19	82-118	18-19	9-10	27-28

TABLE 4. COMPARATIVE MERISTIC COUNTS OF *G. MANMINA* (HAM.)

References	Fin rays					Scales in lateral line	Scutes		
	Dorsal(D)	Pectoral(P)	Pelvic(V)	Anal(A)	Caudal(C)		Prepelvic	Post-pelvic	Abdominal
Jayaram1981	14-16			22-28		55-65	17-18	11-13	
Shafi & Quddus 1982	14-15	25	8	21-24	19	58-63	16-19	10-13	
Rahman 1989	(3/12-13)	14-15	8	24-25		55-60	17	13-14	30-31
Talwar & Jhingran 1991	iii-iv11-13	i 14	i 8	ii-iii 20-24		51-71	16-20	11-14	27-33
Present observations	14—15	14-16	8	22-25	17-19	53-67	16-18	12-14	29-31

Dorsal fin rays (D)

The dorsal fin starts with longer rays and the rays gradually grow shorter to its end. The dorsal fin rays count 14 – 15 in total number in *G. chapra* and similar number of fin rays were also found in *G. manmina.*

Pectoral fin rays (P)

It originates just from below the operculum and the number of pectoral fin rays were 13 – 14 in *G. chapra* and 14 – 16 in *G. manmina*.

Pelvic fin rays (Pv)

A single short pelvic fin is situated just opposite to the dorsal fin having 7 –8 rays in *G. chapra* and 8 rays in *G. manmina*.

Anal fin rays (A)

Numbers of anal fin rays were 23 – 25 in *G. chapra* and similar numbers of rays were also observed in *G. manmina*.

Caudal fin rays (C)

In *G. chapra* and *G. manmina* the caudal fin rays were 18 – 19 and 17 –19 respectively.

Scutes

In *G. chapra* the belly is convex and serrated with 18 – 19 prepelvic scutes, 9 – 10 post pelvic scutes and 27-28 abdominal scutes. In *G. manmina* the prepelvic scutes were 16-17, postpelvic scutes were 12-14 and abdominal scutes were 29-31.

Lateral line scales

The minimum and maximum number of scales on the lateral line series of *G. chapra* and *G. manmina* were recored as 82-118 and 53-67, respectively.

The following meristic counts of these fishes from Kaptai lake have been recorded.

G. chapra : Br. vi; D. 14-15; P. 13-14; V. 7-8; A. 23-25; C. 18-19; L.l. 82-118.
G. manmina : Br. vi; D. 14-15; P. 14-16; V. 8; A. 22-25; C. 17-19; L.l. 53-67.

Morphometric and meristic characters of fishes are divided into three categories, (Vladykov, 1934). (i) Characters which do not appear to be modified by the environment such as number of fin rays of caudal and ventral fins. These characters are genetically controlled, (ii) Characters which appear to be slightly modified by environment such as pectoral fin rays and gill rakers on the first branchial arch, (iii) Characters which appear to be strongly modified by the environment. It includes morphological characters, rays in dorsal and anal fins, and size of the fish, etc.

In general, characters belonging to the first category show minimum range of variation, while the second category shows moderate and the third category maximum range of variation. On the basis of present investigation more characters could be included in each of Vladykov's (1934) category.

The regression equations and coefficient of correlations between different body characters of *G. chapra* and *G. manmina* did not show significant difference between the observed and calculated values indicating the practical applicability of these equations (Tables 1, 2). The values of 'r' were highly positive and it is clear that most of the characters included in the present studies increased in direct proportion to each other. The comparative account presented here on morphometric relationships of *G. chapra* and *G. manmina* from Kaptai reservoir gives a picture of little variations with the results obtained by earlier workers in other water bodies. The variations found in the percentage values of the various body measurements did not differ markedly with the findings made by Whitehead (1965) and Chondar (1974, 1976). The slight variation in the morphometric characters of the fish and their relationships observed by different authors may be due to the variations in the size range as well as in the number of specimens recorded by them from different water bodies located in the different geographical range which might have different ecological conditions which exerted an influence on the proportionate growth of the various mormhometric body parts.

The comparative meristic counts *of G. chapra* and *G. manmina* showed some variations with the results obtained by earlier workers (Day 1889; Chondar

1976; Shafi and Quddus 1982; Jayaram 1981; Rahman 1989; Talwar and Jhingran 1991). In both the species number of dorsal fin rays (14-15) were same, but contained distinctly variable number of scutes and scales on the lateral line, while only little variations have been observed in the remaining meristic characters. Among the clupeids the meristic characters were utilized in the racial studies by Chondar (1976). Schanackenbeck (1936) showed that meristic counts had little use, specially when involved technical difficulties and were found to be unreliable. The fin-rays, scales and scutes counts are not satisfactory characters as these have not led to any definite conclusions (Whitehead 1965; Schanachenbeek 1936). However, Lindsey (1961) stated that counting of meristic series is a convenient technique in looking for evidence of population segregation. The present authors also share the view of Lindsey (1961). The variations in the values of different meristic counts (Tables 3 and 4) and morphological characters with those of earlier published data may be due to the different geographical location of the studied areas and ecological conditions of the water body. So, it is clear from the present study that the identification manuals for the fishes should be restricted to smaller geographical regions rather than the larger geographical range though most of the existing manuals or hand books cover the vast areas that may fail to provide correct information. Similar opinion is also given by Johal *et al.* (1989).

REFERENCES

BHUIYAN, A.S. AND BISWAS, B. 1984. Studies on the morphometry of *Puntius chola* (Hamilton-Buchanan) (Cyprinidae:Cypriniformes). *Univ. J. Zool. Rajshahi Univ*. **1**:29-34.

CHATTERJII, A. 1985. A study on the morphometric characters of *Labeo gonius* (Ham.) from two different freshwater environments. *Bangladesh J. Zool.* **13** (2):73-76.

CHONDAR, S. L. 1974. Morphometric characters and their relationship in *Gudusia chapra* (Hain.), *Proc. Ind Acad Sci. B.* **80** (3):51-67.

CHONDAR, S. L. 1976. Meristic and non-meristic characters in analysis of races of *Gudusia chapra* (Ham.), *Agri. Univ. Jour. Res. Sci.* **25**(l):103-124.

DAY, F. 1878. *The Fishes of India.* (photo-litho offset, 1958) William Dawson and Sons Ltd., London, 635 pp.

DAY, F. 1889. *The Fauna of British India including Ceylon and Burma,* Fishes, Vol. 1 & 2, Taylor and Francis, London, 579 pp.

GHOSH, A.N., BHATTACHARYA, R.K. AND. RAO, K.V. 1968. On the identification of the sub-population of *Hilsha ilisha* (Ham.) in the Gangetic system with a note on their distribution. *Proc. Nat. Acad. Sci. India. Sec. B.* **34**(1):44-57.

HOQUE, B. AND RAHMAN, K. M.1985. Morphometric characters and their relationship in *Gudusia chapra* (Ham.), *Chittagong Univ. Stud, Part II* : *Sci.* **9**(2):85-88.

HOQUE, B. AND ISLAM, M. A.1990. Statistical relationships between body measurements of the climbing perch, *Anabas testudineus* (Bloch). *J. Asiat. Soc. Bangladesh, Sci.* **16**(2):113-117.

ISLAM, M.A., CHOWDHURY, M.H. AND RAHMAN, M.M. 1984. Some morphological characteristics of maturing and non-maturing *Labeo rohita* of a lentic and lotic environment. *Bangladesh J. Fish*. **6**(1-2):69-78.

JAYARAM, K. C. 1981. *The Freshwater Fishes of India, Pakistan, Bangladesh, Burma and Srilanka - A Handbook*, Zoological survey of India, Calcutta, India, XXII + 475.

JOHAL, M. S., CHAHAL, R.K., KINGRA, J. S. AND JOIR, R. S. 1989. On the morphometry of *Colisa fasciata* from Punjab, India. *Vest ex spolec. Zool.* **53**: 188-194.

LINDSEY, C. C. 1961. The bearings of experimental meristic studies on racial analysis of fish populations, *Proc. Ninth Pacific Science Congress,* Bangkok, 54-58.

McCONNEL, R. H. L. 1978. Identification of freshwater fishes. In: *Methods for Assessment of Fish Production in Freshwater* (ed. T. Begenal), Blackwell Scientific Publications, London. 48-83 pp.

RAHMAN, A. K. 1989. *Freshwater Fishes of Bangladesh.* The Zool. Soc. Bangladesh, C/O., Dept. Zool., Univ. Dhaka. 369 pp.

SCHANACKENBEEK, W. 1936. The present state of knowledge concerning the origin and distribution of herring populations in Western European Waters. *Rap. Proc. Verbl.* **100**: 28-31.

SHAFI, M. AND QUDDUS, M. M. A. 1982. *Bangladesher Matsya Sampad* (Fisheries resources of Bangladesh), (in Bengali). Bangla Academy, Dhaka. 444 pp.

TALWAR, P. K. AND JHINGRAN, A. G. 1991. *Inland Fishes of India and Adjacent countries,* Oxford and IBH Publishing Co. Pvt. Ltd. New Dellhi, India. Vol. **1**, 541 PP.

TANDON, K.K., JOHAL, M.S. AND MAHAJAN, M. 1993. Morphometry, length-weight relationship, age and growth of *Gudusia chapra* (Hamilton, 1822) from two different localities of Rajastan State, India, *Res. Bull. Panjab Univ*. **43**(I-IV): 87-104.

VLADYKOV, V. 1934. Environmental and taxonomic characters of fishes. *Tran Roy. Canadian Inst.* **20**(1): 99-140.

WHITEHEAD, P. J. P. 1965. A preliminary revision of the Indo-Pacific Alosinae (Pisces: Clupeidae). *Bull. Brit Mus. Nat Hist,* **12**(4):15-56.

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