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Taxonomic analysis of rohu *Labeo rohita* and mrigal *Cirrhinus cirrhosus* populations in Bangladesh

M. Hasan, M. M. R. Khan and M. A. B. Siddik
Department of Fisheries Biology and Genetics, Bangladesh Agricultural University, Mymensingh-2202

Abstract

A study on the taxonomic analysis of three populations of rohu (*Labeo rohita*) and mrigal (*Cirrhinus cirrhosus*) was conducted sampled from three different sources of Bangladesh viz. Jamuna, Brahmaputra and Jalok hatchery in Mymensingh. The analysis was based on the morphometric and meristic data of the populations collected over a period of three months from March to May 2006. The fifteen morphometric characters of Jamuna population of both rohu and mrigal were higher than those of other two populations. Among nine meristic characters, six (BR, DFR, PvFR, AFR, SALL and SBLL) showed no differences in all the three populations. However, three meristic characters viz. number of pectoral fin rays (PcFR), caudal fin rays (CFR) and scale on lateral line (SLL) were found asymmetric in hatchery population of rohu, whereas number of pectoral fin rays (PcFR) and scale on lateral line (SLL) of hatchery population of mrigal were found different from those of the other two populations. Out of eight different body proportions, seven viz., total length**:**head length (TL**:**HL), standard length**:**head length (SL**:**HL), total length**:**high body depth (TL**:**HBD), standard length**:**high body depth (SL**:**HBD), head length**:**pre-orbital length (HL**:**Pre-OL), head length**:**post-orbital length (HL**:**Pos-OL) and high body depth-low body depth (HBD**:**LBD) showed significant differences at 5% level for all three populations. The study suggested that hatchery population of rohu and mrigal might be deviated from its origin and morphological characters of these species could be used for the determination of purity of the species.

Key words : Rohu, mrigal, morphology, taxonomy

Introduction

Labeo rohita is commonly known as rui, rohit, rohu belongs to family Cyprinidae, Cypriniformes. There are 12 species of *Labeo* and among those, only *Labeo boggut* are not available in Bangladesh (Shaw and Shebbeare ,1937). Mrigal *Cirrhinus cirrhosus* is known as mirka, one of the common members of major carps in Bangladesh found in the rivers, canals and floodplains. The genus is represented by 2 species namely *C. mrigala* and *C. reba Cirrhinus mrigala* (Hamilton) is currently a synonym of *Cirrhinus cirrhosus,* (Bloch). Rohu and mrigal are important major carps in our aquaculture and also a vital source of the protein food supply for the people of Bangladesh (Rahman, 2005). Day by day, its contribution to aquaculture is increasing. In 2004-2005 it gave 22.30% production in our total production (DoF, 2005). Although, they play a vital role to meet the protein requirement in our mushrooming population but some unscrupulous hatchery owners produce hybrid between catla and rohu. Its front part looks like catla but hind side looks like rohu. It is easily identified by the consumers. But very important news is that hybrid (rohu × mrigal) is similar to rohu. This hybrid is not easily revealed by the consumers; since it creates confusion among the minds of the people either it is rohu or mrigal. By getting this opportunity, some hatchery owners produce huge amount of above mentioned hybrid. If this business continues for a longer period of time, the pure species of rohu and mrigal will be threatened. Although, food and feeding habit, growth, morphology and genetic studies were done of these species, but taxonomic information is not available. That is why it is obligatory to find out the species specific differences among the populations of rohu and mrigal in three different sources by using taxonomic characters. Therefore, the study was undertaken to know the taxonomic differences among the Jamuna, Brahmaputra and hatchery populations of the above mentioned.

Materials and Methods

Live fishes of rohu and mrigal were collected from three different stations i. e. the Jamuna, Brahmaputra and hatchery. Details of the sampling localities, number of specimen and date of collection are given in Table 1.

Table 1. Sources, sample size and date of collection of the experimental fish of rohu and mrigal

Sample	Species Name	Source	No. of individual	Date of collection
1	Rohu	Jamuna river	20	March 15, 2006
	Mrigal	Jamuna river	20	March 30, 2006
2	Rohu	Brahmaputra river	20	April 15, 2006
	Mrigal	Brahmaputra river	20	April 30, 2006
3	Rohu	Hatchery*	20	May 15, 2006
	Mrigal	Hatchery*	20	May 30, 2006

* Jalok hatchery in Mymensingh

The fishes were washed with water and preserved in 10% formalin. The jars were labeled containing information such as place and date of collection and name of the specimen. The fifteen morphometric characters were measured following the conventional methods described by Hubbs and Lagler (1958) with the help of a slide calipers. The nine meristic characters were studied by following the methods of Hubs and Lagler (1958) by using a magnifying glass. Non-parametric statistical analyses were used in all the comparisons (Zar, 1996). Differences in morphometric characters and meristic counts of fish were analyzed using the Kruskal-Wallis non-parametric analysis of variance (ANOVA). In instances, where significant differences between groups were detected a non-parametric post hoc test (Zar, 1996) was conducted.

Results and Discussion

Fifteen morphometric characters were recorded from the samples of three river populations of *L. rohita* and *C. cirrhosus* are shown in Table 2. All the morphometric characters of rohu and mrigal of Jamuna population demonstrated higher values than the other two populations (Brahmaputra and hatchery) whereas hatchery population showed the lowest value. Of the 15 studied characters, Brahmaputra population of rohu and mrigal occupied intermediate position among the three populations with some exception of mrigal population since among the examined populations, five characters (TL, DFR, PvFL, AFL and UJL) of Brahmaputra population of mrigal showed the lowest values.

Different proportions of morphometric characteristics (TL:FL, TL:HL, SL:HL, TL:HBD, SL:HBD, HL:Pre-OL, HL:Pos-OL and HBD:LBD of *L. rohita* and *C. cirrhosus* are given in Tables 4 and 5, respectively. The proportions of four morphometric characters (TL:HL, SL:HL, TL:HBD, HL:Pre-OL and HL:Pos-OL) of all river populations of rohu were significantly different ($P<0.05$) from each other. The proportion of total length-high body depth (TL:HBD), standard length-high body depth (SL:HBD) and high body depth-low body depth (HBD:LBD) of hatchery population of rohu were significantly higher ($P<0.05$) than those of other two populations (the Jamuna and Brahmaputra). The proportion of total length-head length (TL:HL), standard length-head length (SL:HL), total length-high body depth (TL:HBD), standard length-high body depth (SL:HBD), head length-post orbital length (HL:Pos-OL) and high body depth-low body depth (HBD:LBD) of hatchery population of mrigal were significantly higher ($p<0.05$) than those of the rest two populations. Total length-head length (TL:HL), standard length-head length (SL:HL), total length-high body depth (TL:HBD) of Jamuna population including standard length-high body depth (SL:HBD), head length-post orbital length (HL:Pos-OL) and high body depth-low body depth (HBD:LBD) of Brahmaputra population of mrigal showed middle position compared to those of others. There was no significant difference among the populations of the proportion of total length:fork length (TL:FL). The proportion of TL:HL of Jamuna population of rohu did not support with the standard value of Rahman (2005), although Brahmaputra and Hatchery population supported with the standard value. In case of TL:HBD and SL:HBD both Brahmaputra and hatchery population of rohu did not agree with the result of Rahman (2005). On the contrary, all proportion i.e. TL:HL, SL:HL, TL:HBD and SL:HBD of hatchery population of mrigal surpassed the standard value of Rahman, 2005 (Table 6).

The nine meristic characters recorded from the three river populations of *L. rohita* and *C. cirrhosus* was shown in Table 3. Of the 9 meristic characters, six (BR, DFR, PvFR, AFR, SALL and SBLL) of rohu in all populations showed no differences from each other whereas the number of pectoral fin rays (PcFR), caudal fin rays (CFR) and scale on lateral line (SLL) of hatchery population of rohu were asymmetric. On the contrary, out of 9 meristic counts, seven (BR, DFR, PvFR, AFR, CFR, SALL and SBLL) of mrigal in all populations showed no difference from each other. In spite of these, some differences were found in the number of pectoral fin rays (PcFR) and scale on lateral line (SLL) of hatchery population of mrigal compared to other populations.
These deviations might be occurred due to environmental, genetic and mismanagement of rohu and mrigal fishes in the hatchery (Mookerjee and Majumder, 1946). According to Rahman (2005), taxonomic formula of Rohu is D. 15-16 (3/12); P_1. 16-17; P_2. 9; A. 7 (2/5) where P_1 and P_2 means pectoral and pelvic fin rays respectively which is supported by our present findings. Similarly, taxonomic formula of mrigal is D. 16 (3/13); P_1. 17 P_2. 9 (1/8); A. 8 (3/5) where P1 and P2 reveals pectoral and pelvics fin rays, respectively (Rahman, 2005) which is also allowed by our present findings**.**

Population of rohu in Bangladesh was morphologically different in some cases (Table 2), such differences being particularly prominent in the Jamuna population. The differences in mode where observed in some morphometric measurements (TL, FL, SL etc) and meristic counts (BR, DFR, PcFR, PvFR etc) were that the characteristics of Jamuna population tend to be more than those of others.

Table 2. Mean values of sixteen morphometric characters of rohu and mrigal from three samples; (n=20 for each group)

Character	Rohu			Mrigal		
	Jamuna (Mean ± SD)	Brahmaputra (Mean ± SD)	Hatchery (Mean ± SD)	Jamuna (Mean ± SD)	Brahmaputra (Mean ± SD)	Hatchery (Mean ± SD)
TL	19.40 ± 0.01	15.91 ± 0.01	13.65 ± 0.01	21.22 ± 0.01	18.12 ± 0.01	18.73 ± 0.01
FL	16.48 ± 0.01	13.74 ± 0.01	11.72 ± 0.01	18.23 ± 0.01	15.88 ± 0.02	15.84 ± 0.01
SL	14.86 ± 0.01	12.36 ± 0.01	10.42 ± 0.01	16.54 ± 0.01	14.48 ± 0.03	14.36 ± 0.02
HL	3.84 ±0.01	3.29 ± 0.01	2.8 ± 0.01	3.66 ± 0.03	3.38 ± 0.02	3.08 ± 0.04
ED	0.96 ± 0.02	0.86 ± 0.01	0.60 ± 0.03	1.00 ± 0.03	0.92 ± 0.01	0.85 ± 0.05
Pre-OL	1.15 ± 0.02	0.95 ± 0.02	0.72 ±0.05	0.93 ± 0.01	0.74 ± 0.03	0.74 ± 0.03
Pos-OL	1.79 ± 0.01	1.82 ± 0.03	1.67 ± 0.02	1.88 ± 0.01	1.78 ± 0.02	1.64 ± 0.04
HBD	4.02 ± 0.01	3.17 ± 0.01	2.67 ± 0.05	3.84 ± 0.05	3.30 ± 0.04	3.22 ± 0.03
LBD	2.02 ± 0.04	1.49 ± 0.01	1.25 ± 0.01	2.06 ± 0.01	1.66 ± 0.03	1.56 ± 0.02
DFR	3.18 ± 0.02	2.38 ± 0.03	2.30 ± 0.02	3.53 ± 0.10	3.00 ± 0.02	3.17 ± 0.12
PcFL	2.80 ± 0.05	2.08 ± 0.06	1.91 ± 0.05	3.00 ± 0.13	2.58 ± 0.21	2.54 ± 0.25
PvFL	2.65 ± 0.02	2.04 ± 0.03	1.85 ± 0.06	2.78 ± 0.04	2.30 ± 0.03	2.40 ± 0.04
AFL	2.78 ± 0.05	2.02 ± 0.01	1.77 ± 0.01	2.87 ± 0.14	2.34 ±0.13	2.56 ± 0.20
SnL	0.83 ± 0.01	0.78 ± 0.01	0.55 ± 0.05	0.69 ±0.01	0.69 ± 0.01	0.56 ± 0.21
UJL	1.66 ± 0.05	1.18 ± 0.05	1.05 ± 0.04	1.94 ± 0.01	1.32 ± 0.22	1.46 ±0.20

TL: Total length, FL: Fork length, SL: Standard length, HL: Head length, ED: Eye diameter, Pre-OL: Pre-orbital length, Pos-OL: Post-orbital length, HBD: High body depth, LBD: Low body depth, DFR: Dorsal fin ray, PcFL: Pectoral fin length, PvFL: Pelvic fin length, AFL: Anal fin length, SnL: Snout length, UJL: Upper jaw length

Table 3. Mean values of nine meristic characters of rohu from three samples; (n=20 for each group)

Character	Rohu			Mrigal		
	Jamuna (Mean ± SD)	Brahmaputra (Mean ± SD)	Hatchery (Mean ± SD)	Jamuna (Mean ± SD)	Brahmaputra (Mean ± SD)	Hatchery (Mean ± SD)
BR	3 ± 0.00	3 ± 0.00	3 ± 0.00	3 ± 0.00	3 ± 0.00	3 ± 0.00
DFR	15 ± 0.01	15 ±0.00	15 ± 0.10	14 ± 0.05	14± 0.43	14 ± 0.27
PcFR (R)	17 ± 0.01	17 ± 0.05	* 16 ± 0.02	16 ± 0.30	16 ± 0.08	* 17 ± 0.49
PcFR (L)	17 ± 0.01	17 ± 0.06	17 ± 0.06	16 ± 0.23	16 ± 0.40	* 17 ± 0.51
PvFR (R)	9 ± 0.00	9 ± 0.00	9 ± 0.00	9 ± 0.00	9 ± 0.00	9 ± 0.00
PvFR (L)	9 ± 0.00	9 ± 0.00	9 ± 0.00	9 ± 0.00	9 ± 0.00	9 ± 0.00
AFR	7 ± 0.00	7 ± 0.00	7 ± 0.00	7 ± 0.07	7 ± 0.10	7 ± 0.05
CFR	22 ± 0.10	22 ± 0.04	* 23 ± 0.02	22 ± 0.04	22 ± 0.51	22 ± 0.26
SLL	42 ± 0.02	42 ± 0.10	* 43 ± 0.11	42 ± 0.20	42 ± 0.33	* 43 ± 0.31
SALL	7 ± 0.00	7 ± 0.00	7 ± 0.00	7 ± 0.00	7± 0.00	7 ± 0.00
SBLL	6 ± 0.00	6 ± 0.00	6 ± 0.00	7 ± 0.00	6 ± 0.00	6 ± 0.00

BR: Branchiostegal ray, DFR: Dorsal fin ray, PcFR (R): Pectoral fin ray (right), PcFR (L): Pectoral fin ray (left), PvFR (R): Pelvic fin ray (right), PvFR (L): Pelvic fin ray (left), AFR: Anal fin ray, CFR: Caudal fin ray, SLL: Scale on lateral line, SALL: Scale above lateral line, SBLL: Scale below lateral line. * indicates assymetric in the meristic counts among the populations

Table 4. Different morphometric proportions of *L. rohita* of three populations

Population	TL:FL	TL : HL	SL: HL	TL: HBD	SL: HBD	HL: Pre-OL	HL: Pos-OL	HBD:LBD
Jamuna	1.17 a	5.05 a	3.87 a	4.82 c	3.69 b	3.33 c	2.14 a	1.99 b
Brahmaputra	1.15 a	4.83 b	3.75 b	5.01 b	3.89 a	3.46 b	1.80 b	2.12 a
Hatchery	1.16 a	4.87 b	3.7 c	5.11 a	3.90 a	3.88 a	1.67 c	2.13 a

Values of the parameters in each column with different letters differ significantly at 0.05 level

Table 5. Different morphometric proportions of *C. cirrhosus* of three populations

Population	TL:FL	TL : HL	SL: HL	TL: HBD	SL: HBD	HL: Pre-OL	HL: Pos-OL	HBD:LBD
Jamuna	1.16 a	5.79 b	4.51 b	5.52 b	4.30 c	3.93 c	1.94 c	1.86 c
Brahmaputra	1.14 a	5.36 c	4.28 c	5.49 c	4.38 b	4.56 a	1.89 ab	1.98 b
Hatchery	1.18 a	6.08 a	4.66 a	5.81 a	4.46 a	4.16 b	1.87 a	2.06 a

Values of the parameters in each column with different letters differ significantly at 0.05 level

Table 6: Comparison of different morphometric proportion of *L. rohita* and *C. cirrhosus* with the standard values of Rahman (2005)

Proportions	Rohu				Mrigal			
	Jamuna	Brahmaputra	Hatchery	Standard *	Jamuna	Brahmaputra	Hatchery	Standard *
TL:HL	5.0	4.83	4.87	4.4 ~ 4.8	5.79	5.36	6.08	5.0 ~ 5.4
SL:HL	3.87	3.75	3.70	3.4 ~ 3.7	4.51	4.28	4.66	4.0 ~ 4.4
TL:HBD	4.82	5.61	5.11	4.5 ~ 4.8	5.52	5.49	5.81	5.0 ~ 5.4
SL:HBD	3.69	3.89	3.90	3.5 ~ 3.7	4.30	4.38	4.46	4.0 ~ 4.3

*(Rahman, 2005)

The meristic counts of rohu can be affected by environmental factors such as tempretaure in freshwater (Schreck and Moyle, 1990 and Kurata, 1975). Pectoral fin rays (PcFR) of rohu and mrigal showed asymmetric in hatchery population. This variation might be due to breeding conditions (Yokogawa and Tajima, 1996). On the contrary, the number of caudal fin rays (CFR) and scale on lateral line (SLL) of rohu and only the deviation of scale on lateral line of mrigal population of hatchery were different from the other populations. The original sources of broods in hatchery may be different and some inbreeding might be occurred here. Similar results were observed by Nishida (1985) and suggested that the ayu (*Plecoglossus sitivelis*) population of Ryukryu Island had higher count in dorsal and anal fin rays whether the geographical variation in each character was the principal pattern but usually it was difficult to consider the environmental factors. The difference might be natural or the genetic imbalance might have influenced the morphological characters (Yokogawa and Tajima, 1996). Some abnormalities observed in Brahmaputra population of rohu and mrigal like pectoral fin disappeared at one side of the body and folding of caudal fin. These may be due to the anthropological and other genetic factors affecting their growth, which got support of the study of Van Der Bank and Ferreira (1987) on *Oreocromis mossambicus.*

The variation of different characters both morphometric and meristic need to be justified for actual taxonomic identity of this species. Research on genetic variability of the rohu and mrigal population of three different sources may be carried out to locate their genetic distance. Different molecular markers like allozyme, microsatellite etc. may provide valuable information on the genetic status of these species.

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