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Variation in morphometric and meristic traits of *Aspidoparia morar* from Brahmaputra and Barak Rivers of Assam, India

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Abstract: The minor carp, *Aspidoparia morar* is a benthopelagic fish belonging to the sub-family Danioninae under the family Cyprinidae. It has emerged as the single most dominant species in the river Brahmaputra in Assam. In the present study, 240 specimens were collected from Guwahati and Tezpur in the Brahmaputra River and Silchar in the Barak River to investigate the morphometric and meristic variation among the populations. For this a total of 20 morphometric traits and 11 meristic traits were studied. The mean lengths for most of the morphometric traits were higher for the Barak River except eye diameter, inter orbital length and anal fin length which were significantly higher on the Brahmaputra River, while the post orbital length and pelvic fin length were found to be almost equal. The regressions of standard length with all the morphometric traits except pelvic fin length, pelvic fin base, pectoral fin length, dorsal fin length, anal fin length, pre orbital length, post orbital length, inter orbital length and eye diameter showed significant variation between the rivers. Two meristic traits viz. branched rays in anal fin and gill rakers on the first gill arch also showed significant variation in the samples of the rivers.

Keywords: *Aspidoparia morar,* Brahmaputra, Barak, Meristic, Morphometric

INTRODUCTION

The analysis of morphometric and meristic characters is one of the most commonly used methods in stock identification. Changes in morphometric characteristics are typically seen to change over a number of generations, slowly and gradually because of selective environmental pressures. Morphometric variability among different geographical populations would be attributed either to distinct genetic structure or to environmental conditions in each area (Kinsey *et al.*, 1994). Morphometric analysis provides information on phenotypic stocks, groups of individuals with similar growth, mortality and reproductive rates (Booke, 1981). Meristic counts may differ as a result of environmental differences during early development (Colman, 1976). Phenotypic variation, such as meristic counts, continues to play an important role in stock identification among groups of fish, despite use of genetic analysis (Swain and Foote, 1999).
Aspidoparia morar (Hamilton, 1822), a small sized minor carp, is one of the most dominant species in Brahmaputra and Barak rivers in Assam, India. The species belongs to the sub-family Danioninae under the family Cyprinidae. CIFRI, Barrackpore has been estimating the fish yield and catch composition in different landing centers of River Brahmaputra in Assam, especially that of Uzanbazar landing centre since 1973. These studies have shown that the miscellaneous finfish species have started dominating the total catch (40-50%) and a minor carp, *A. morar* has emerged as the most dominant fish species at all major landing centers (Vaas *et al.*, 2011). The present study deals with the variation in morphometric and meristic traits of *A. morar* from the two rivers of Assam.

MATERIALS AND METHODS

A total of 240 fish samples were collected from Barak River (Silchar) and from Brahmaputra River (Guwahati and Tezpur) between 15th October 2012 to 16th March 2013. *Aspidoparia morar* was identified as per the description given in Inland Fishes of India and Adjacent Countries (Talwar and Jhingran, 1991). Samples, without any physical damages were collected randomly from the selected fish landing centers. The collected fish specimens were placed in insulated box with ice packs. The cover was sealed with an insulated tape and was transported to the laboratory. Fishes, with normal morphological features were used for the present study. No other organisms were harmed during

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the present study. A total of 20 morphometric traits were measured using digital Vernier caliper. 11 meristic traits were also counted for analysis (Table 1). The data was analysed with the help of SAS software.

RESULTS

The mean lengths for most of the morphometric traits were higher for the Barak River except eye diameter, inter orbital length and anal fin length which were significantly higher on the Brahmaputra River, while the post orbital length and pelvic fin length were found to be almost equal (Table 2). A significant difference was seen between the rivers in all the morphometric traits. With regard to the correlation between various morphometric traits was found to be positive, high and significant. The correlation coefficient of total length with head length, pre dorsal length, dorsal fin length, pre anal length, maximum body depth were obtained as 0.93, 0.97, 0.70, 0.96 and 0.92, respectively. The correlation of maximum body depth with head length and head length with pre dorsal length were estimated as 0.87 and 0.91, respectively. The correlation of dorsal fin length with pre dorsal fin length was 0.67 and dorsal fin length with dorsal fin base length was found to be 0.60. Eye diameter also showed a higher correlation (0.82) with the head length. The correlation of anal fin length (0.24) with pre anal length and the anal fin length (0.31) with the total length was on the lower side. Similarly, inter orbital length and pre orbital length shows a slightly lower correlation of 0.51. The mean sum of squares and model R^2 values from the analysis of variance for morphometric traits are given in table 3. The regressions of all the traits on standard length are significant. The model R^2 values ranged from 5.30 to 58.69 %. The regressions of standard length with all the morphometric traits except pelvic fin length, pelvic fin base, pectoral fin length, dorsal fin length, anal fin length, pre orbital length, post orbital length, inter orbital length and eye diameter showed significant variation between the rivers.

Out of 11 meristic traits studied, 2 were considered for the analysis of variability as others were constant in their value. The overall counts of branched rays in anal fin and gill rakers on the first gill arch (Table 4) ranged from 9-10 and 20-22 respectively. The anal fin unbranched rays counts of the Barak and Brahmaputra River were 9 and 10 respectively while the gill rakers count varied from 20-21 and 20-22 respectively.

DISCUSSION

During the present study it has been observed that the average length of fishes collected from the Barak River was significantly higher than that from the Brahmaputra River. Significant differences were observed in total length, standard length, fork length, pre anal length, pre dorsal length, maximum body depth and caudal peduncle depth. This variation may be the result of high rate of sedimentation and heavy pollution load due to the presence of a number of industries, followed by high turbidity in the Brahmaputra River resulting in low food availability in the form of plankton required for the growth of individuals. Moreover the reduced mean length of the species from the River Brahmaputra can be attributed to the high fishing pressure encountered by the species in the river.

For planktivorous fish, feeding ability was reduced under turbid conditions (Gardner, 1981) while turbidity reduced growth rates in juvenile salmonids (Sigler *et al*., 1984). Turbidity decreases visibility in aquatic systems by decreasing light penetration and also reduces the plankton density of the system. This affects the food availability and feeding rate of the planktivorous fishes leading to low fish productivity. Swain *et al*. (2007) stated that drop in mean length is the consequence of exploitation pressure by size.

Table 1. Morphometric and meristic traits of *A. morar.*

S. N.	Morphometric traits	S. N.	Meristic traits
1	Total length	1	Unbranched fin rays on dorsal fin
2	Standard length		
3	Fork length	2	Branched fin rays on dorsal fin
4	Head length		
5	Pre orbital length	3	Unbranched fin rays on pectoral fin
6	Eye diameter		
7	Post orbital length	4	Branched fin rays on pectoral fin
8	Dorsal fin length		
9	Pectoral fin length	5	Unbranched fin rays on anal fin
10	Pectoral fin base length		
11	Dorsal fin base length	6	Branched fin rays on anal fin
12	Pelvic fin length		
13	Pelvic fin base length	7	Unbranched fin rays on pelvic fin
14	Pre Anal length		
15	Anal fin base length	8	Branched fin rays on pelvic fin
16	Anal fin length		
17	Caudal peduncle depth	9	Gill rakers on left side of the body
18	Maximum body depth		
19	Inter orbital length	10	Unbranched fin rays on caudal fin
20	Pre Dorsal length	11	Branched fin rays on caudal fin

Table 2. Descriptive statistics of morphometric traits.

Traits (mm)	Brahmaputra (N=179)				Barak (N=61)			
	Minimum	**Maximum**	**Mean ± SE**	**Coefficient of variance (%)**	**Minimum**	**Maximum**	**Mean ± SE**	**Coefficient of variance (%)**
Total length	73.96	143.15	94.77 ± 0.79	11.14	58.63	119.27	100.32 ± 1.79	13.93
Standard length	60.44	120.23	78.42 ± 0.67	11.49	50.44	99.76	84.17 ± 1.43	13.31
Fork length	66.79	128.76	85.22 ± 0.73	11.49	55.29	107.12	91.13 ± 1.56	13.35
Head length	11.89	23.06	15.88 ± 0.14	11.79	9.43	18.80	16.06 ± 0.28	13.48
Maximum body depth	13.29	29.46	18.47 ± 0.19	13.72	11.86	24.48	19.79 ± 0.36	14.15
Pre dorsal length	33.01	65.01	42.84 ± 0.35	10.92	29.55	54.47	45.50 ± 0.74	12.62
Post orbital length	6.20	13.23	8.65 ± 0.09	13.28	4.43	10.51	8.65 ± 0.18	16.53
Pre orbital length	1.84	4.72	2.96 ± 0.03	15.34	1.94	3.66	2.98 ± 0.05	12.10
Eye diameter	3.76	6.88	4.89 ± 0.04	12.10	2.81	5.79	4.80 ± 0.08	13.69
Depth of caudal peduncle	5.10	12.44	8.08 ± 0.09	15.23	4.88	10.84	8.84 ± 0.18	16.15
Dorsal fin length	6.25	18.90	11.01 ± 0.16	19.46	5.26	15.90	11.49 ± 0.32	21.83
Dorsal fin base length	5.62	14.08	8.62 ± 0.09	14.40	3.65	11.75	9.42 ± 0.21	17.10
Pectoral fin length	9.95	25.82	15.15 ± 0.16	14.28	5.93	21.46	15.53 ± 0.46	22.97
Pectoral fin base length	1.20	3.40	2.31 ± 0.03	19.19	2.20	4.80	3.07 ± 0.06	14.18
Pelvic fin length	5.93	14.23	9.34 ± 0.12	17.67	3.49	14.10	9.36 ± 0.31	25.46
Pelvic fin base length	2.12	7.14	4.08 ± 0.07	21.88	1.77	6.14	4.26 ± 0.13	23.22
Anal fin length	4.18	10.99	6.89 ± 0.10	18.91	3.20	10.04	6.96 ± 0.23	25.79
Anal fin base length	6.38	15.23	9.33 ± 0.09	13.42	3.73	13.24	10.08 ± 0.23	17.79
Pre anal length	43.07	83.77	56.69 ± 0.50	11.86	36.47	74.20	61.69 ± 1.08	13.73
Inter orbital length	4.32	8.37	5.68 ± 0.05	11.76	3.25	6.62	5.50 ± 0.10	13.76

Table 3. Analysis of variance for different morphometric traits from the two rivers.

Morphometric traits (mm)	Degrees of freedom	Mean sum of squares	Model R^2 Value
Total length	1	1405.39**	24.09
Standard length	1	1508.46**	26.65
Fork length	1	1592.83**	28.67
Head length	1	254.51**	20.22
Pre orbital length	1	0.87NS	8.29
Eye diameter	1	0.11NS	30.32
Post orbital length	1	0.15NS	22.82
Dorsal fin length	1	2.65NS	21.43
Pectoral fin length	1	2.79NS	17.42
Pectoral fin base length	1	26.85**	58.69
Dorsal fin base length	1	29.45**	20.62
Pelvic fin length	1	1.75NS	5.42
Pelvic fin base length	1	0.09NS	7.17
Pre Anal length	1	1139.05**	31.06
Anal fin base length	1	25.76**	12.86
Anal fin length	1	0.74NS	5.30
Caudal peduncle depth	1	26.64**	27.26
Maximum body depth	1	78.93**	31.06
Inter orbital length	1	0.31NS	27.13
Pre Dorsal Length	1	322.18**	25.07

(**$P \leq 0.01$); NS= Non Significant

Table 4. River wise frequency distribution of meristic characters of *Aspidoparia morar*.

River		Anal fin branched		Gill raker			Total
		9	10	20	21	22	
Brahmaputra	Frequency	0	179	10	151	18	179
	Percent	0.00	74.58	4.16	62.92	7.50	74.58
Barak	Frequency	61	0	54	7	0	61
	Percent	25.42	0.00	22.50	2.92	0.00	25.42
Total	Frequency	61	179	64	158	18	240
	Percent	25.42	74.58	26.67	65.83	7.50	100.00

It has been observed that the maximum caudal peduncle depth of fishes from Barak River is significantly higher than the Brahmaputra. Relationship between deeper caudal peduncle depth and turbulent water has been reported by Imre *et al.* (2002). He demonstrated the morphological variation in caudal region of brook charr (*Salvelinus fontinalis*) from microhabitats differing in water velocity and has observed deeper caudal peduncle in fishes from turbulent waters. The Barak River is narrow and steep, as compared to the Brahmaputra, which is very wide. The Barak valley is a part of the Meghalaya plateau and is characterized by hilly terrain, while the Brahmaputra valley is completely a plain area. Therefore the water velocity in the Barak is higher compared to the mighty Brahmaputra. Thus it appears that the relatively greater depth of caudal peduncle of *A. morar* from the Barak River, may be due to the turbulent water in which it inhabits.

Among all vertebrates fishes exhibit greater variance in morphological traits and are more susceptible to environmentally induced morphological variation (Dunham *et al.,* 1979). Thus environmental variations in the form of temperature, food availability, water current, water quality and other features may determine the phenotypic variation in *A. morar*. Phenotypic variation also indicates that majority of the fishes spend their entire lives in geographically isolated regions. Meristics characters are generally set early in ontogeny and remain stable throughout life, thus reflecting environmental effects over a relatively brief time of larval development. As a result, significant statistical differences may occur within a stock among year classes or geographic subgroups subjected to varying environmental conditions. However consistent environmental influences can probably provide discrimination in stocks provided there is genetic divergence between the actual stocks (Hubbs and Laglar, 1958; Begg and Waldman, 1999). Values attained for meristic features are usually the results of interactions between genetics and environment (Marr, 1957; Swain and Foote, 1999).

Variation in the gill raker counts has been noticed in the samples from the two rivers. Moodie (2004) reported that variation in gill raker numbers within species significantly vary in tropical species. Amundsen *et al.* (2004) reported that variation in gill rakers is related to the difference in inter-raker spacing. Variation in inter-raker spacing in fishes is related to the prey size (Matsumoto and Kohda, 2001).

Lindsey (1981) reported that physiological parameters as water temperature also affects gill raker morphology, which seems related to the present study.

Conclusion

Fish stocks identification is very much essential for effective fisheries management. Stock identification also forms the basis for fish Stock assessment. Traditional tools such as morphometric and meristic characters are of significant importance in identifying fish stocks. Studies at molecular level can be made in the future to validate the present findings.

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