

Study of the Morphometry and Meristic Analyses of Three *Mystus* species from the Chandubi Beel, Kamrup District, Assam

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ABSTRACT- The morphometric and meristic analyses of three species of freshwater catfish, *Mystus cavasius*, *Mystus vittatus* and *Mystus bleekeri* of Chandubi beel, Assam were investigated. The morphometric characters vary effectively among the three different species making its application taxonomically significant. In terms of their total length, *M. bleekeri* is found to be the longest with 97.48 mm and *M. vittatus* is found to be the shortest with 83.9 mm. Moreover, *M. vittatus* has also shown an extension of their barbel length upto 74.6% of the total length. Such morphometric variations and advancements indicate the adaptive capability of the *Mystus spp.* over the varied geographical, climatic and nutritive factors in their habitat.

Key-words- Morphometry, *Mystus vittatus*, *Mystus bleekeri*, *Mystus cavasius*, Barbels, Dorsal spine

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INTRODUCTION

Siluriformes is a diverse group of fish ranking second or third among the orders of vertebrate series. Although very little is known about the origin of the Siluriformes, the fossil records in Seymour island suggest their inhabitation during Eocene age in the inland and coastal water of all the continents [1]. The earliest known fossil Siluriformes were in freshwater and marine deposits of late Cretaceous age. Due to their worldwide distribution, at present, the catfishes became a subject of great interest to ecologists and evolutionary biologists and are important in the study of biogeography.

Among more than 30 recognized families of Siluriformes, the South American Pimelodidae and the African-Asian Bagridae are the two largest families yet known. Bagridae is a family of catfish that includes about 250 species.

Most of the bagrid fishes are used as food and individuals of 6-9 cm are of high ornamental value [2].

Fishes of Bagridae family can be easily identified by their 4 pairs of well developed barbels covered by a layer of taste bud enriched epithelium [3].

Mystus spp. is one of the most easily available Bagrids in Assam. These small to medium sized catfishes are distributed throughout India, Pakistan, Bangladesh, Afghanistan and Nepal [4,5]. In course of time extensive studies on *Mystus spp.* contributed significantly to the identification of new species such as *Mystus dibrugarensis* [2] in upper brahmaputra basin. Many workers described different fish species with the help of morphometric measurements. For example the identification of *Mystus cavasius* [6] in Myanmar. *Mystus ngasep* was identified in Manipur [7].

Morphometry is an essential tool to provide a concept of size and shape of the specimens making their identification taxonomically significant. According to Sajina *et al* [8], "A morphometric Trait proves to be the most frequently employed and cost effective method." Species, Populations and Races were separated in the past by morphometric analyses and even it is used for identifying different stocks of fish [9]. In fact, animals with the same morphometric characteristics are believed to belong to the same species [10]. The interactive effect of environment, selection and

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heredity on body shape and size of a species can study by morphometry [11].

However, extensive studies on Bagridae revealed dramatic changes in the taxonomic characters of the family in course of time. According to Nelson [12], the family is very different from that recognized in previous study. Therefore, in order to re-examine such changes morphometric analyses of the bagrids are still in progress. The present work is focused on comparing 11 fish specimens, collected from the Chandubi Beel, Assam, India based on their morphometric characters. The specimens are *Mystus cavasius* (3 specimens), *Mystus vittatus* (3 specimens), and *Mystus bleekeri* (5 specimens).

MATERIALS AND METHODS

Collection of Specimens

Specimens of *Mystus vittatus*, *Mystus bleekeri* and *Mystus cavasius* were collected from Chandubi wetland, Kamrup district, Assam, India with the help of local fishermen using different types of nets.

Collected fishes were brought to the laboratory and preserved in 10% formalin solution in containers.

Experimental Work

The meristic and morphometric characters were measured using Vernier caliper (Least count = 0.01 mm), magnifying glasses, needles and identified up to species level with the help of standard key and books (Day, 1878; Jayaram, 1999; Talwar and Jhingram, 1991).

The morphometric parameters measured from each species are as follows:

Total length

Straight measurement from the tip of the snout to the posterior end of the last vertebrae.

Standard length

Straight measurement from the tip of the snout to the posterior end of the last vertebrae.

Body depth at anus

The vertical distance from the dorsal margin of the body to the ventral margin of the body measured near the base of the pectoral fin near the anus.

Pre dorsal length

Straight-line measurement taken from the front of the snout to the insertion of the first ray of the dorsal fin.

Pre anal length

Straight-line measurement taken from the tip of the snout to the point of insertion of the anal fin.

Pre pelvic length

Straight-line measurement taken from the front of the snout to the insertion of the pelvic fin.

Pre pectoral length

Straight-line measurement taken from the front of the snout to the origin of the pectoral fin.

Length of dorsal fin base

Length of the insertion of the first fin to the insertion of the last of the dorsal fin.

Dorsal spine length

The entire length of the dorsal spine present near the dorsal fin.

Anal fin length

Length of the insertion of the first fin to the tip of the largest fin.

Pelvic fin length

Length of the point of insertion of the fin to the tip of the longest fin.

Pectoral fin length

Straight-line measurement from the point of insertion of the fin to the end of the pectoral fin.

Caudal fin length

Straight-line measurement from the point of insertion of the fins to the end of the caudal fin.

Adipose fin base length

Length of the base of the adipose fin from its anterior to its posterior insertion.

Dorsal to adipose length

Straight-line measurement from the point of insertion of the last ray of the dorsal fin to the anterior insertion of the adipose fin.

Post adipose length

Straight-line measurement from the point of the posterior insertion of the adipose fin to the base of the caudal fin flexure.

Caudal peduncle length

Straight-line measurement taken from the insertion of the anal fin to the caudal flexure.

Caudal peduncle depth

Vertical length taken from the dorsal margin to the ventral margin near the caudal flexure.

Head length

Straight-line measurement taken from the front of the snout to the origin of operculum.

Head width

The distance between the two widest points of the head.

Snout length

The distance between the upper jaw and the anterior margin of the orbit.

Eye diameter

Diameter of eye.

Interorbital distance

The space between the eyes; bones on the roof of the skull between the eyes.

Barbel length

The length of the barbells present in the fish:

- i) Maxillary barbel length
- ii) Nasal barbel length
- iii) Inner Mandibular barbel length
- iv) Outer Mandibular barbel length

The meristic counts used for the fishes are discussed as follows:

Ray counts

Fins are the distinct structures attached to the body of a fish and are composed of mobile filaments. Conventional abbreviations for the various fins in the reporting of numbers of fin rays are as follows;

- i) D – dorsal
- ii) A – anal
- iii) C – caudal
- iv) P – pectoral
- v) P2 – pelvic

There are two basic types of fin rays, true spines and soft rays.

True spines

These single, median structures are unbranched and lack joints. They usually occur in the anterior part of a single fin or in the anterior of two separate fins. All true spines are designated by upper roman numerals (I, II, III etc) whether they are stiff or flexible.

Soft rays

These articulated structures are composed of numerous movable joints. The unbranched soft rays are designated by lower case roman numerals (i, ii, iii etc). The branched soft rays are designated by Arabic numerals (1, 2, 3 etc).

Direction of counts

Dorsal fin rays

These are counted back to front, i.e, the posterior most ray is counted as first ray and count is done towards anterior.

Anal fin rays

These are counted front to back, i.e, the anterior most ray is counted as first ray and count is done towards posterior.

Caudal fin rays

These are counted from the outermost ray to the inner most ray.

RESULTS

The mean morphometric measures of *M. vittatus*, *M. bleekeri* and *M. cavasius* are presented in Table 1, Table 2 and Table 3 and their mean total lengths are 83.9 mm, 97.48 mm and 85.63 mm respectively. They have an adipose fin whose base length varies from 16.53 mm in *M. vittatus* to 23.63 mm in *M. cavasius*. The mean head lengths of *M. vittatus*, *M. bleekeri* and *M. cavasius* are found to be 15.53 mm, 17.5 mm and 13.93 mm whereas their mean head widths are 9.9 mm, 11.16 mm and 7.86mm respectively.

The meristic counts depict the number of dorsal fin rays to be indifferent (7). However, the anal fin rays ranges from eight to nine in number.

Table 1: Morphometry of *Mystus vittatus* (mm) with average & SD

Parameters	Specimen 1	Specimen 2	Specimen 3	Average	Standard deviation
Total length	86.2	83.2	82.3	83.9	2.042057786
Standard length	66.7	65	66.5	66.06667	0.929157324
Body depth at anus	14.1	14	12.4	13.5	0.953939201
Pre dorsal length	23	24.2	26.9	24.7	1.997498436
Pre anal length	47.1	48	46.7	47.26667	0.665832812
Pre pelvic length	34.4	34	34.6	34.33333	0.305505046
Pre pectoral length	14.1	14.4	15.3	14.6	0.6244998
Length of dorsal fin base	11	8.7	9.4	9.7	1.178982612
Dorsal spine length	11	17	9.4	12.46667	4.00666112
Anal fin length	12.5	12.2	12.1	12.26667	0.2081666
Pelvic fin length	11	12	11	11.33333	0.577350269
Pectoral fin length	13.6	12.4	13.4	13.13333	0.642910051
Caudal fin length	17.4	14.2	15.4	15.66667	1.616580754
Adipose fin base length	16.1	16.2	17.3	16.53333	0.665832812
Dorsal to adipose length	5.1	4.2	3.7	4.333333	0.709459888
Post adipose length	9.6	9.6	10.3	9.833333	0.404145188
Caudal peduncle length	11.2	10.6	12.6	11.46667	1.026320288
Caudal peduncle depth	7.1	7.1	7.4	7.2	0.173205081
Head length	15.7	15.4	15.5	15.53333	0.152752523
Head width	10.2	10	9.5	9.9	0.360555128
Snout length	6.1	5.2	5.9	5.733333	0.472581563
Eye diameter	3.5	4	3.6	3.7	0.264575131
Interorbital distance	9.3	9.5	9.3	9.366667	0.115470054
Maxillary barbel length	65	61	62	62.66667	2.081665999
Nasal barbel length	12	13	12	12.33333	0.577350269
Inner mandibular barbel length	14	15	14	14.33333	0.577350269
Outer mandibular barbel length	28	26	21	25	3.605551275

Table 2: Morphometry of *Mystus bleekeri* (mm) with average & SD

Parameters	Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5	Average	Standard deviation
Total length	99	110.7	96.5	87.7	93.5	97.48	8.507761163
Standard length	76.5	88.2	77.3	69.5	73.5	77	6.969218034
Body depth at anus	16.6	17.5	14.6	15.6	13.6	15.58	1.549838701
Pre dorsal length	31.2	35.3	27.3	27.6	26.4	29.56	3.693643188
Pre anal length	52.1	62.6	54.4	49.6	54	54.54	4.889580759
Pre pelvic length	39.5	44.1	36.7	36.5	35	38.36	3.596943147
Pre pectoral length	17.7	20.2	15.4	15.5	18	17.36	1.993238571
Length of dorsal fin base	11.5	12.2	10	9.2	10	10.58	1.229634092
Dorsal spine length	10.6	15	10	9.6	9.4	10.92	2.326370564
Anal fin length	15.5	12	13.2	13.6	12.1	13.28	1.420211252
Pelvic fin length	14.2	14.4	11.6	11	12.4	12.72	1.527088734
Pectoral fin length	17.3	17.1	14.2	13	13.4	15	2.055480479
Caudal fin length	22.5	20.3	17.7	18	19.8	19.66	1.94242117
Adipose fin base length	20.5	17.2	30.2	16	32.3	23.24	7.532131173
Dorsal to adipose length	5.1	9.4	0.01	6.1	1.5	4.422	3.743650625
Post adipose length	12.3	12.6	9	9	7.4	10.06	2.279912279
Caudal peduncle length	14.1	15	18	10	15.6	14.54	2.92027396
Caudal peduncle depth	9.4	9.7	8	8.2	6.8	8.42	1.167047557
Head length	18.6	20.2	16.1	16.6	16	17.5	1.838477631
Head width	11.5	14	10	10.8	9.5	11.16	1.761533423

Snout length	6	5.6	6.2	5.5	7	6.06	0.598331012
Eye diameter	3.6	4.1	4.2	4.4	4.2	4.1	0.3
Interorbital distance	11.6	13.2	9.7	10.3	8.7	10.7	1.747855829
Maxillary barbel length	67	80	56	57	59	63.8	10.03493896
Nasal barbel length	13	15	6	13	9	11.2	3.633180425
Inner mandibular barbel length	13	23	11	15	12	14.8	4.816637832
Outer mandibular barbel length	31	35	24	24	22	27.2	5.540758071

Table 3: Morphometry of *Mystus cavasius* (mm) with average & SD

Parameters	Specimen 1	Specimen 2	Specimen 3	Average	Standard deviation
Total length	86.3	87.8	82.8	85.63333	2.56580072
Standard length	59.4	67.2	62	62.86667	3.971565602
Body depth at anus	9.2	12.7	12	11.3	1.852025918
Pre dorsal length	18.2	23.7	23.2	21.7	3.041381265
Pre anal length	40.4	46.8	49	45.4	4.467661581
Pre pelvic length	25.3	32.5	30.2	29.33333	3.677408508
Pre pectoral length	11.8	16.5	15	14.43333	2.400694344
Length of dorsal fin base	6.5	8.8	8.6	7.966667	1.27410099
Dorsal spine length	6	9	8.2	7.733333	1.553490693
Anal fin length	9	11.4	11.6	10.66667	1.446835628
Pelvic fin length	8.7	10.8	10.7	10.06667	1.18462371
Pectoral fin length	8.8	12	11.3	10.7	1.682260384
Caudal fin length	16.2	21	20	19.06667	2.532455988
Adipose fin base length	20.1	25.3	25.5	23.63333	3.061590001
Dorsal to adipose length	0.02	0.09	0.07	0.06	0.036055513
Post adipose length	5.3	7.3	6.4	6.333333	1.00166528
Caudal peduncle length	10.3	14.5	13.1	12.63333	2.138535324
Caudal peduncle depth	4.3	6.1	5.6	5.333333	0.929157324
Head length	11.9	15.2	14.7	13.93333	1.77857621
Head width	6.7	8.8	8.1	7.866667	1.069267662
Snout length	3.7	5.8	5	4.833333	1.059874206
Eye diameter	3.9	4.4	4.3	4.2	0.264575131
Interorbital distance	5.7	7.3	7.3	6.766667	0.923760431
Maxillary barbel length	67	70	69	68.66667	1.527525232
Nasal barbel length	6	10	10.1	8.7	2.338803113
Inner mandibular barbel length	9	15	14	12.66667	3.214550254
Outer mandibular barbel length	23	27	24	24.66667	2.081665999

Table 4: Morphometry of *Mystus vittatus* (%) with average

Parameters	Specimen 1	Specimen 2	Specimen 3	Average
Total length	100%	100%	100%	1
Standard length	77.30%	78.10%	80.80%	0.787333
Body depth at anus	16.30%	16.80%	15%	0.160333
Pre dorsal length	26.70%	28%	32.70%	0.291333
Pre anal length	54.60%	55.70%	56.70%	0.556667
Pre pelvic length	39.90%	40.80%	42%	0.409
Pre pectoral length	16.30%	17.30%	18.60%	0.174
Length of dorsal fin base	12.70%	10.40%	11.40%	0.115

Dorsal spine length	12.70%	19.70%	11.40%	0.146
Anal fin length	14.50%	14.60%	14.70%	0.146
Pelvic fin length	12.70%	14.40%	13.40%	0.135
Pectoral fin length	15.70%	14.90%	16.30%	0.156333
Caudal fin length	20.20%	17%	18.70%	0.186333
Adipose fin base length	18.70%	19.50%	21%	0.197333
Dorsal to adipose length	5.90%	5%	4.50%	0.051333
Post adipose length	11.10%	11.50%	12.50%	0.117
Caudal peduncle length	12.90%	12.74%	15.30%	0.136467
Caudal peduncle depth	8.20%	8.50%	8.90%	0.085333
Head length	18.20%	18.50%	18.80%	0.185
Head width	11.80%	12%	11.50%	0.117667
Snout length	7%	6.20%	7.10%	0.067667
Eye diameter	4%	4.80%	4.30%	0.043667
Interorbital distance	10.70%	11.40%	11.30%	0.111333
Maxillary barbel length	75.40%	73.30%	75.30%	0.746667
Nasal barbel length	13.90%	15.60%	14.60%	0.147
Inner mandibular barbel length	16.20%	18%	17%	0.170667
Outer mandibular barbel length	32.50%	31.20%	25.50%	0.297333

Table 5: Morphometry of *Mystus bleekeri* (%) with average

Parameters	Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5	Mean
Total length	100%	100%	100%	100%	100%	1
Standard length	77.20%	79.60%	80.10%	79.20%	78.60%	0.7894
Body depth at anus	16.70%	15.80%	15.10%	17.80%	14.50%	0.1598
Pre dorsal length	31.50%	31.80%	28.30%	31.50%	28.20%	0.3026
Pre anal length	52.60%	56.50%	56.40%	56.50%	57.70%	0.5594
Pre pelvic length	39.90%	39.80%	38%	41.60%	37.40%	0.3934
Pre pectoral length	17.90%	18.20%	16%	17.70%	19.20%	0.178
Length of dorsal fin base	11.60%	11.02%	10.40%	10.50%	10.70%	0.10844
Dorsal spine length	10.70%	13.50%	10.40%	10.90%	10%	0.111
Anal fin length	15.60%	10.80%	13.60%	15.50%	12.90%	0.1368
Pelvic fin length	14.30%	13%	12%	12.50%	13.20%	0.13
Pectoral fin length	17.40%	15.40%	14.70%	14.80%	14.30%	0.1532
Caudal fin length	22.70%	18.30%	18.30%	20.50%	21.20%	0.202
Adipose fin base length	20.70%	15.50%	31.20%	18.80%	34.50%	0.2414
Dorsal to adipose length	5.15%	8.50%	0%	6.90%	1.60%	0.0443
Post adipose length	12.40%	11.40%	9.30%	10.20%	7.90%	0.1024
Caudal peduncle length	14.20%	13.50%	18.60%	11.40%	16.70%	0.1488
Caudal peduncle depth	9.50%	8.70%	8.30%	9.30%	7.30%	0.0862
Head length	18.80%	18.20%	16.70%	18.90%	17.10%	0.1794
Head width	11.60%	12.60%	10.40%	12.30%	10.20%	0.1142
Snout length	6.06%	5.06%	6.42%	6.30%	7.50%	0.06268
Eye diameter	3.60%	3.70%	4.30%	5.01%	4.50%	0.04222
Interorbital distance	11.70%	11.90%	10%	11.70%	9.30%	0.1092
Maxillary barbel length	67.70%	72.20%	58%	64.90%	63.10%	0.6518

Nasal barbel length	13.10%	13.50%	6.20%	14.80%	9.60%	0.1144
Inner mandibular barbel length	13.10%	20.70%	11.40%	17.10%	12.80%	0.1502
Outer mandibular barbel length	31.30%	31.60%	24.90%	27.40%	23.50%	0.2774

Table 6: Morphometry of *Mystus cavasius* (%) with average

Parameters	Specimen 1	Specimen 2	Specimen 3	Mean
Total length	100%	100%	100%	1
Standard length	79%	76.50%	74.90%	0.768
Body depth at anus	13.90%	14.40%	14.50%	0.142667
Pre dorsal length	27.40%	26.90%	28.02%	0.2744
Pre anal length	53.50%	53.30%	59.20%	0.553333
Pre pelvic length	38.10%	37%	36.50%	0.372
Pre pectoral length	17.80%	18.80%	18.10%	0.182333
Length of dorsal fin base	9.80%	10%	10.40%	0.100667
Dorsal spine length	9.04%	10.20%	9.90%	0.097133
Anal fin length	13.60%	12.90%	14%	0.135
Pelvic fin length	13.10%	12.30%	12.90%	0.127667
Pectoral fin length	13.30%	13.70%	13.60%	0.135333
Caudal fin length	24.40%	23.90%	24.10%	0.241333
Adipose fin base length	30.30%	28.80%	30.80%	0.299667
Dorsal to adipose length	0.00%	0.00%	0.00%	0.000007
Post adipose length	7.90%	8.30%	7.70%	0.079667
Caudal peduncle length	15.50%	16.50%	15.80%	0.159333
Caudal peduncle depth	6.50%	6.90%	6.80%	0.067333
Head length	17.90%	17.30%	17.70%	0.176333
Head width	10.10%	10%	9.80%	0.099667
Snout length	5.60%	6.60%	6.03%	0.060767
Eye diameter	5.90%	5.01%	5.20%	0.0537
Interorbital distance	8.60%	8.30%	8.80%	0.085667
Maxillary barbel length	85.90%	85.40%	83.30%	0.848667
Nasal barbel length	9.05%	11.40%	12.20%	0.108833
Inner mandibular barbel length	10.50%	17.08%	16.90%	0.148267
Outer mandibular barbel length	24.10%	30.70%	26.60%	0.271333

Table 7: Meristic counts of *Mystus vittatus*

Parameters	Specimen 1	Specimen 2	Specimen 3
Dorsal fin (soft rays)	7	7	7
Pectoral fin (soft rays)	7	8	8
Pelvic fin (soft rays)	6	6	6
Anal fin (soft rays)	8	9	9
Caudal fin (soft rays)	18	18	18

Table 8: Meristic counts of *Mystus bleekeri*

Parameters	Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5
Dorsal fin (soft rays)	7	7	7	7	7
Pectoral fin (soft rays)	7	8	8	7	8
Pelvic fin (soft rays)	6	6	6	6	6
Anal fin (soft rays)	9	9	9	9	9
Caudal fin (soft rays)	18	18	18	19	20

Table 9: Meristic counts of *Mystus cavasius*

Parameters	Specimen 1	Specimen 2	Specimen 3
Dorsal fin (soft rays)	7	7	7
Pectoral fin (soft rays)	7	7	8
Pelvic fin (soft rays)	6	6	6
Anal fin (soft rays)	9	9	10
Caudal fin (soft rays)	20	21	19

Photographs of the Specimens



Plate 1: *Mystus bleekeri*



Plate 2 – *Mystus cavasius*



Plate 3: *Mystus vittatus*

DISCUSSION

The head lengths of *Mystus spp.* with respect to their total length is found to be nearly 18% whereas the head width is about 10% to that of their total length. Therefore, the Head width of dorsoventrally flattened head of the *Mystus spp.* is nearly half of their head length. The mouth bears four pairs of unequal barbels, among which the maxillary barbels are significantly longer in *M. cavasius*. Chattopadhyay *et al* (2014) have reported that the maxillary barbels have extended up to 60% of the total length in *M. vittatus*

CONCLUSIONS

The Northeastern India is well known for its immense biodiversity yet fewer studies have been made so far on the aquatic living entities found here. Although the present study is confirmed to only three species of *Mystus spp.*, still a convincing mass of information has been obtained. It was found that the *Mystus spp.* has evolved varied morphological characteristics depending upon their external environment. The *Mystus spp.* was found to have four pairs of barbells extending beyond their standard

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collected from Bolpur, West Bengal. However, the present study has shown their extension up to 74.6% of the total length. The increase in the relative length could be an outcome of the gustatory arrangement in the body due to varied geographical, climatic and nutritive factors. Moreover, the *Mystus spp.* has shown eloquent interspecific variation. The mean Interorbital distance is significantly smaller in *M. cavasius*. In like manner, *M. vittatus* have shown a significantly shorter adipose fin base length.

length, in some. Such gustatory outgrowths must ease their labour to trace their food in the water bodies. Moreover, the eloquent interspecific variations shown by the *Mystus spp.* could be a consequence of their adaptability to varied geographical and climatic environment and a strong reason for their abundance in the sub-continent. From this study, it is understood that Morphometry is not only a strong tool for the taxonomic identification of the organisms but also an essential tool to determine the variations among them.

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