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# Morphometric, meristic and landmark-based analysis of a rare croaking gourami, *Trichopsis vittata*

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**Abstract.** The truss network systems was constructed with the help of landmark points along with the morphometric and meristic characteristics to evaluate the population status of rare croaking gourami, *Trichopsis vittata*. A total of 25 fish specimens were collected from three selected locations of the Meghna river of Bangladesh during March, 2014. All the data of the studied characteristics were obtained using the digital photograph of the samples which were analyzed through Klonk image measurement software. Nine morphometric and six meristic characters were analyzed along with thirty truss network measurements. Non parametric Kruskal-Wallis test was applied for comparing meristic counts and no significant differences were observed among the groups. Univariate statistics (ANOVA) showed no significant difference among three groups. For both morphometric and landmark measurements the first discriminant function (DF) accounted for 72.1% and 78.2% and the second DF accounted for 27.9% and 21.8%, respectively of the among group variability. With morphometric measurements 87.5% of group 1, 66.7% of group 2 and 75% of group 3 samples were correctly classified. As the truss network system revealed, all the samples were clearly separated from each other in the discriminant space.

**Keywords:** Morphometrics, Meristics, Croaking gourami, *Trichopsis vittata*

## Introduction

The croaking gourami, *Trichopsis vittata*, is a small freshwater fish of the Perch group. They are native to still waters in Southeast Asia and are distributed worldwide (Robins *et al*. 1991). Croaking gouramis are mostly insectivorous, feeding on insects and insect larvae. They are capable of producing a "croaking" noise using their pectoral fins (Ladich *et al*. 1992). This species is usually not fished commercially but regularly seen in the aquarium fish trade (Rainboth 1996). They can reach an average size of about 3.8 cm (Hugg 1996), though some individuals can grow as large as 7 cm (Baird *et al*. 1999). Coloration is highly variable, ranging from pale brown and green to dark purple with black or red spots on the fins. Two to four brown or black stripes or rows of spots are present on their sides (Rainboth 1996). Morphometric and meristic characters of fish are the measurable or countable characters common in all fishes. The truss network systems constructed with the help of landmark points are powerful tools for stock identification. Information on the biology and population structure of *T. vittata* is a prerequisite for developing its management and conservation strategies and may be applicable for studying short-term and environmentally induced variations. The overall objective of the study is to assess the morphological features of *T. vittata*. The specific objectives are - to study the morphometric and meristic characters of *T. vittata* among

three different groups and to assess and describe the shape variation of *T. vittata* using truss network.

## Materials and Methods

The fish samples were collected from three different locations of the Meghna River in Chandpur Sadar Upazila, Bangladesh (Table I). Collected samples were placed individually into plastic bags and kept in ice box until transportation to the laboratory under the Department of Fisheries Biology and Genetics, Bangladesh Agricultural University, Mymensingh, Bangladesh**.**

**Table I. Sampling locations and dates in the Meghna river**

| Sample (Sources) | Locations | Groups | No. of fish | Date of collection |
|---|---|---|---|---|
| The Meghna River | Tarpurchandi | Group 1 | 8 | 27 March,2014 |
| | Bishnupur | Group 2 | 9 | 27 March,2014 |
| | Kalyanpur | Group 3 | 8 | 28 March,2014 |

### *Measurement of morphometric and meristic characters*

A total of nine morphometric characters of the sampled fishes were measured. Traditional measurements and the truss network system were used to describe the shape of fish body. Traditional data, such as total length (TL), total weight (TW), standard length (SL), head length (HL), maximum body depth (MBD), eye diameter (ED), pre orbital length (PrOL), post orbital length (POL), caudal peduncle length (CPL) and pre dorsal length (PrDL) were recorded ( Fig. 1). Six meristic characters were examined using the number of pectoral fin rays (PcFR), dorsal fin rays (DFR), pelvic fin rays (PvFR), caudal fin rays (CFR), anal fin rays (AFR) and transverse lateral line scales (TLS) under a binocular stereomicroscope.

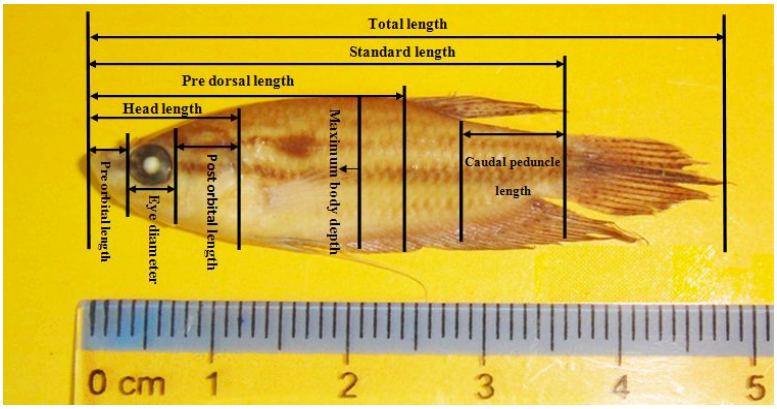


**Fig. 1.** Morphometric measurements of *T. vittata.*

### *Measurement of landmark distances of the species*

For measurement of Landmark distances of the species the truss network system described for fish body morphometric (Hossain *et al*. 2010) was used to construct a network on fish body. The points are selected as such the truss networks represent the best possible structure of the studied fish. Twelve landmarks determining thirty distances were produced and measured (Fig. 2). The twelve landmark point's outlines were digitized using an image analysis system consisting of a high resolution camera and the images were analyzed by Klonk professional image measurement software version 3.2.1.2.

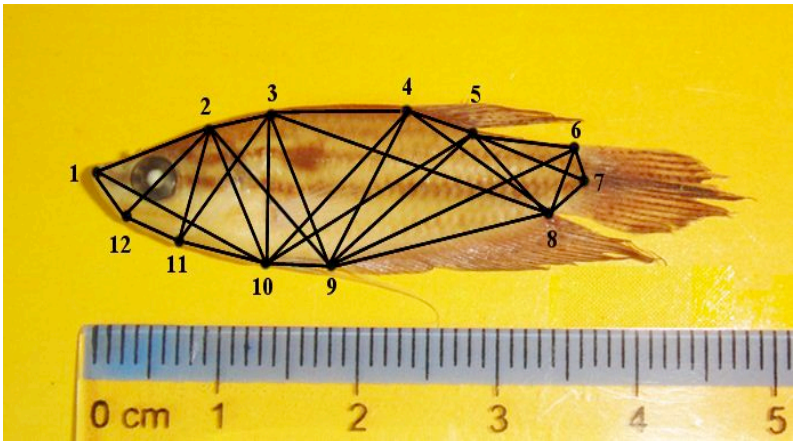


**Fig. 2.** Locations of 12 landmark points used for Truss network analysis for *T. vittata*.

### *Statistical analysis*

A multivariate discriminant analysis was used for morphometric data to identify the combination of variables that best separate *T. vittata* species. Prior to the analysis, size effects from the data set were eliminated. An allometric formula given by Elliott *et al*. (1995) with slight modification was used to remove the size effect from the data set.

$$M_{adj} = M\,(L_s / L_o)^{b}$$

Where M: Original measurement, $M_{adj}$: Size adjusted measurement, $L_o$: Total length of fish, and $L_s$: Overall mean of total length for all fish from all samples.

Parameter b was estimated for each character from the observed data as the slope of the regression of log M on log $L_o$. Univariate analysis of variance (ANOVA) was carried out to test the significance of morphological differences. Comparison of meristic characters was done using nonparametric Kruskal-Wallis test. All statistical analyses were done using SPSS v 16.0.

## Results

Although this species is available in Bangladesh but taxonomists could not identify the fish in Bangladesh in the past (IUCN-Bangladesh 2015).

### *Meristic counts*

Meristic counts of all specimens ranged, 7-10 ($m_e$= 8) for dorsal fin rays, 14-17 ($m_e$= 15) for caudal fin rays, 31-37 ($m_e$= 34) for anal fin rays, 8-11 ($m_e$= 9) for pectoral fin rays, 5-8 ($m_e$= 5) for pelvic fin rays and 10-13 ($m_e$= 11) for transverse lateral line scales. The mean number of dorsal fin rays, anal fin rays, pectoral fin rays, pelvic fin rays caudal fin rays and transverse lateral line scales were same among the groups and showed no significant different ($p > 0.05$) (Table II).

**Table II. Meristic characters of *T. vittata***

| Meristic characters | Populations | | |
|---|---|---|---|
| | Tarpurchandi | Bishnopur | Kalyanpur |
| Dorsal fin rays | 8(7-10) | 8(7-10) | 8(7-10) |
| Anal fin rays | 34(31-37) | 34(31-37) | 34(31-37) |
| Pectoral fin rays | 9(8-11) | 9(8-11) | 9(8-11) |
| Pelvic fin rays | 5(5-8) | 5(5-8) | 5(5-8) |
| Caudal fin rays | 15(14-17) | 15(14-17) | 15(14-17) |
| Transverse lateral line scales | 11(10-13) | 11(10-13) | 11(10-13) |

### *Morphometric and landmark distance*

Efficiency of the allometric formula in removing size effects from the data was justified by using correlation between total length and the adjusted character. Total lengths were excluded first and not transformed because using this parameter as the standard all other parameters were standardized. None of eight morphometric measurements showed significant correlation with total length. Univariate statistics showed no significant difference among three groups (Table III). In truss network measurements, none of the transformed measurements showed significant correlation with total length. Therefore, all the values were used for further calculation. Univariate statistics revealed 30 measurements showing no significant difference among the groups (Table IV). For both morphometric and landmark measurements the first DF accounted for 72.1% and 78.2% and the second DF accounted for 27.9% and 21.8%, respectively of among-group variability, explaining 100% of total among-groups variability. All the samples were not clearly separated from the discriminant space (Fig. 3) with virtually overlapping in varying degrees. This suggests that there is intermingling among groups and the populations are not separated. In case of morphometric measurements three groups are much more similar. With morphometric measurements 87.5% of group 1, 66.7% of group 2, 75% of group 3 samples were correctly classified. With truss network system all the samples were more clearly separated from each other in the discriminant space (Fig. 4). With truss network system of three all groups, 100% samples were correctly classified. Pooled within-groups correlations between discriminant variables and DFs revealed that among eight morphometric measurements– post orbital length (POL), eye diameter (ED), pre dorsal length (PDL), maximum body depth (MBD) dominantly contributed to first DF and the rest four-caudal peduncle length(CPL), standard length (SL), head length (HL), and pre orbital length (PrOL) contributed to the second DF.

**Table III. Morphometric characters analysis of *T. vittata***

| Character | Wilks' Lambda | F | Significance |
|---|---|---|---|
| Standard length (SL) | 0.845 | 2.021 | 0.156 |
| Head length (HL) | 0.995 | 0.059 | 0.943 |
| Eye diameter (ED) | 0.872 | 1.610 | 0.222 |
| Caudal peduncle Llngth(CPL) | 0.827 | 2.302 | 0.123 |
| Pre dorsal length (PrDL) | 0.923 | 0.924 | 0.412 |
| Pre orbital length (PrOL) | 0.998 | 0.021 | 0.979 |
| Post orbital length (POL) | 0.861 | 1.778 | 0.192 |
| Maximum body Depth (MBD) | 0.953 | 0.541 | 0.590 |

**Table IV. Landmark distance analysis of *T. vittata***

| Character | Wilks' Lambda | F | Significance |
|---|---|---|---|
| Distance from 1 to 2 | 0.871 | 0.891 | 0.436 |
| Distance from 2 to 3 | 0.834 | 1.191 | 0.337 |
| Distance from 3 to 4 | 0.963 | 0.231 | 0.797 |
| Distance from 4 to 5 | 0.950 | 0.318 | 0.733 |
| Distance from 5 to 6 | 0.876 | 0.848 | 0.452 |
| Distance from 6 to 7 | 0.911 | 0.590 | 0.570 |
| Distance from 7 to 8 | 0.886 | 0.775 | 0.842 |
| Distance from 8 to 9 | 0.976 | 0.145 | 0.866 |
| Distance from 9 to 10 | 0.904 | 0.634 | 0.547 |
| Distance from 10 to 11 | 0.692 | 2.668 | 0.110 |
| Distance from 11 to 12 | 0.879 | 0.826 | 0.461 |
| Distance from 12 to 1 | 0.723 | 2.302 | 0.143 |
| Distance from 1 to 10 | 0.962 | 0.238 | 0.792 |
| Distance from 2 to 12 | 0.830 | 1.232 | 0.326 |
| Distance from 2 to 11 | 0.911 | 0.583 | 0.573 |
| Distance from 2 to 10 | 0.996 | 0.026 | 0.974 |
| Distance from 2 to 9 | 0.936 | 0.408 | 0.674 |
| Distance from 3 to 11 | 0.869 | 0.906 | 0.430 |
| Distance from 3 to 10 | 0.955 | 0.282 | 0.759 |
| Distance from 3 to 9 | 0.881 | 0.809 | 0.468 |
| Distance from 3 to 8 | 0.935 | 0.415 | 0.669 |
| Distance from 4 to 10 | 0.940 | 0.381 | 0.691 |
| Distance from 4 to 9 | 0.983 | 0.102 | 0.904 |
| Distance from 4 to 8 | 0.933 | 0.434 | 0.658 |
| Distance from 5 to 10 | 0.895 | 0.705 | 0.514 |
| Distance from 5 to 9 | 0.979 | 0.131 | 0.879 |
| Distance from 5 to 8 | 0.911 | 0.589 | 0.570 |
| Distance from 5 to 7 | 0.877 | 0.840 | 0.456 |
| Distance from 6 to 9 | 0.852 | 1.045 | 0.382 |
| Distance from 6 to 8 | 0.627 | 3.576 | 0.061 |

In case of truss measurements, 15 among 30 measurements – 6 to 8, 5 to 8, 5 to 7, 3 to 8, 3 to 9, 4to 10, 4 to 8, 6 to 9, 4 to 9, 5 to 6, 11 to 12, 6 to 7, 2 to10, 3 to 10, 3 to 4 dominantly contributed to first DF and the rest fifteen contributed to the second DF.

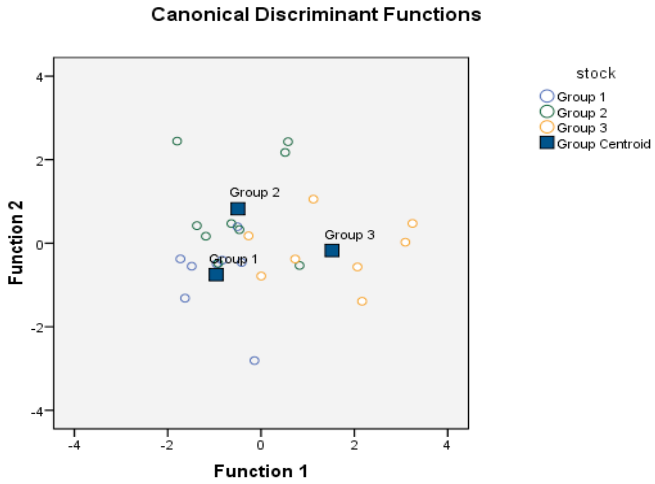


**Fig. 3.** Sample centroids of discriminant function scores based on morphometric measurements.

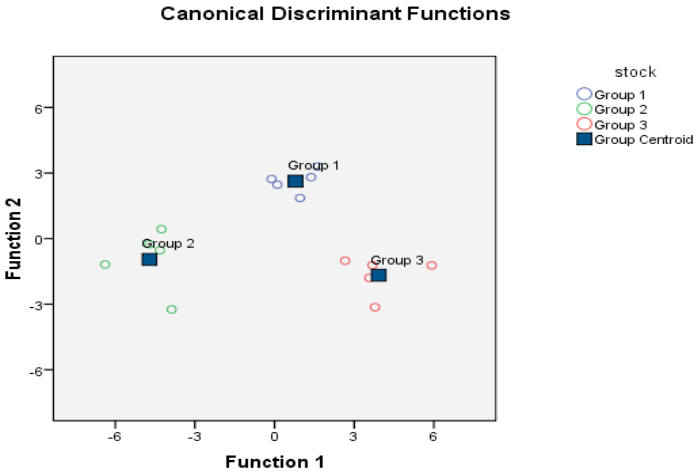


**Fig. 4.** Sample centroids of discriminant function scores based on truss measurement.

## Discussion

### *Meristic characters*

Meristic characters are the numbers of discrete, serially repeated, countable structures like fin rays. In the present study, dorsal fin rays ranged from 7-10, caudal fin rays ranged from 14-17, anal fin rays ranged from 31-37, pectoral fin rays ranged from 8-11, pelvic fin rays ranged from 5-8, and scales for transverse lateral line ranged from

10-13. The result is similar to that reported for *T. vittata* by Utayopas (2001) from Thailand. The mean number of dorsal fin rays, anal fin rays, pectoral fin rays, pelvic fin rays, caudal fin rays and transverse lateral line scales were the same among the populations and showed no significant difference ($p > 0.05$). Reed *et al*. (1967) and Hold *et al*. (1972) found that fin rays of same species did not differ much. The fairly constant value of fin rays among populations showed similarity with the finding of Cakmak *et al*. (2010).

***Morphometric characters***

Eight morphometric characters showed no significant difference among the three populations of gourami (*T. vittata*). From canonical discriminant function analysis based on morphometric measurements three groups showed a varying degree of overlapping. The result is similar to that reported for *T. vittata by* Utayopas (2001). Narejo *et al*. (2000) found no significant morphological difference between the sexes of *Gudusia chapra* of Keenjhar Lake in Pakistan.

***Landmark analyses***

In case of landmark points none of the 30 measurements were significantly different among samples. From canonical discriminant function based on land mark points showed three groups are clearly separated from each other. Hossain *et al*. (2010) observed significant differences ($p < 0.05$) in four of 22 truss network measurements in endangered Indian major carp, kalibaus (*Labeo calbasu)*, from stocks of two isolated rivers, the Jamuna and the Halda, and a hatchery in Bangladesh. Mollah *et al*. (2012) showed significant differences in the body shape among three stocks of tank goby, *Glossogobius giuris* and Rahman *et al*. (2014) revealed segregation among three different stocks of shing, *Heteropneustes fossilis*.

## Conclusions

It should be emphasized that application of genetic techniques would be very beneficial to confirm the detected phenotypic differentiation. The result of this study may be used as baseline information about *T. vittata* for further studies involving large number of samples and extended habitats of the fish might pave the way for conservation of the available stocks through proper management and save this rare species form being extinct.

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