Morphometric analysis of three species gourami group (Osphronemidae) from Aceh waters, Indonesia

A W Perdana1*, A S Batubara1, F M Nur2, A Syahril1 and Z A Muchlisin1

1Department of Aquaculture, Faculty of Marine and Fisheries, Universitas Syiah Kuala, Banda Aceh 23111, Indonesia.
2Graduate Program of Doctor Mathematic and Applied Sciences, Graduate Studies, Universitas Syiah Kuala, Indonesia.
*Corresponding author: adliwaliul@unsyiah.ac.id

Abstract. The objective of the present study was to analyze the morphometric character of the three species within Gourami group, namely Trichopsis vittata, Trichopodus pectoralis and Trichopodus trichopterus. The T. vittata samples were collected from Aceh Tamiang District, the T. pectoralis were collected from Aceh Besar District, and the T. trichopterus were collected from Aceh Jaya District, Indonesia. A total 150 individual of fish samples (50 individual of every species) were measured for traditional morphometric characters. The results of univariate (ANOVA) analysis showed that all morphometric characters measured in three fish species were significantly different (P <0.05). Multivariate (Discriminant function analysis, DFA) analysis showed that T. pectoralis and T. trichopterus have more similar morphological characteristics, whereas T. vittata was discriminated distinctly. These results confirm that the level of relationship between T. trichopterus and T. pectoralis is closer than T. vittata.

1. Introduction
Aceh Province has a high potential for fisheries diversity. It is supported by several studies have been observed in this area, such as the diversity of fish species in Aceh Province [1], inventory of fish species in the south west region of Aceh [2-4], fish species in Lake Laut Tawar, Aceh Tengah District [5], fish species in Aceh Besar District [6,7]. In addition, more than 155 fish species have been identified in Aceh province [8], of which three species are gourami group, namely Trichopsis vittata, Trichopodus pectoralis and Trichopodus trichopterus (Figure 1). T. pectoralis and T. trichopterus are widely distributed in Aceh Province covering the western, eastern and northern regions of Aceh [1], while T. vittata is distributed only in the eastern region of Aceh (personal observation).

Previous reports revealed that T. pectoralis and T. trichopterus have the potential to be cultivated as consumption and ornamental fish [9,10], while T. vittata has the potential to be ornamental fish [11]. They have the advantage of being able to live in low oxygen waters because they have additional respiratory organs (labyrinth) [12], so they are easily cultivated at high density without aerator device.

Several studies have been conducted on T. pectoralis such as cultivation biotechnology [10,13,14] and genetics [15-17]. Furthermore, research has been conducted on T. trichopterus such as air-breathing organs [18, 19], reproduction [20] and growth [21-23]. In addition,
research has been conducted on *T. trichopterus* such as ontogeny development [24], distribution [25-27] and genetics [28]. However, research on the morphological comparisons of the three species has never been reported, it is important for the management of fishery resources in the future.

![Figure 1. Gourami group species, (a) *Trichopsis vittata*, (b) *Trichopodus pectoralis* and (c) *Trichopodus trichopterus*](image)

2. **Material and Methods**

2.1 **Time and site**
The *T. vittata* samples were collected from Aceh Tamiang District (4°16'46.0"N, 98°03'56.6"E), the *T. pectoralis* were collected from Aceh Besar District (5°34'05.9"N, 95°23'13.1"E), and the *T. trichopterus* were collected from Aceh Jaya District, Indonesia. Surveys and data collection were conducted in August 2019.

2.2 **Sampling procedure**
Fish sample collection was conducted using casting nets (mesh size of ½ inch). The sampling sites were carried out in swamps and rice fields. A total 50 fish samples were collected per species.

The samples of fish caught were measured for length (total length (TL) and standard length (SL)) using a digital caliper (Mitutoyo, CD-6CS. Error = 0.01 mm), and weight using digital scales (Toledo, AB-204. Error = 0.01 g). Measurement of morphometric characters was carried out at the Ichthyology Laboratory, Faculty of Marine and Fisheries, Universitas Syiah Kuala after the samples were preserved using 10% formalin solution.

2.3 **Morphometric measurements**
Traditional morphometric measurements refer to Batubarra et al. [29]. The measurement method is as follows:
Figure 2. Landmark traditional morphometric [29]

Table 1. The description of traditional morphometric characters measured in the study [29]

| No. | Characters | Code | Descriptions |
|-----|------------|------|--------------|
| 1.  | TL         | Total length | The distance from the left foremost tip of the snout to the posterior edge of the forked portion of the caudal fin |
| 2.  | SL         | Standard length | The distance from the left foremost tip of snout to the end of caudal peduncle |
| 3.  | HL         | Head length | The distance from the tip of the snout to the posterior edge of the operculum. |
| 4.  | SNL        | Snout length | The distance from tip of the snout in the middle of the upper lip to the anterior rim of the orbital. |
| 5.  | DFD        | Dorsal fin depth | The length of the longest simple dorsal ray. |
| 6.  | DFBL       | Dorsal fin base length | The base length between the first and the last ray of the dorsal fin. |
| 7.  | ED         | Eye diameter | The distance between the anterior and posterior edge of the eyeball. |
| 8.  | CPD        | Caudal peduncle depth | The Depth at the narrowest part of the peduncle. |
| 9.  | BD         | Body depth | The distance between the origin of the dorsal fin and pelvic fin. |
| 10. | PFL        | Pectoral fin length | The distance from the origin of the pectoral fin to the tip of the longest pectoral fin ray |
| 11. | VFL        | Pelvic fin length | The distance from the origin of the pelvic fin to the tip of the longest pelvic fin ray |

The data of morphometric measurements are transformed through Microsoft Excel with the formula referring to Schindler and Schmidt [30] as follows:

\[ M_{\text{trans}} = \frac{M \times 100}{TL} \]

Where: \( M_{\text{trans}} \) = data transformation, \( M \) = measurement data, \( TL \) = total length.
2.4 Data analysis
The transformed data was entered in the software SPSS version 22.0 and then univariate (ANOVA) and multivariate (discriminant function analysis, DFA) tests were carried out. The results of the analysis are described quantitatively.

3. Results and Discussions
The results of ANOVA analysis showed morphometric characters measured in three fish species were significantly different (P < 0.05) (Table 2). The morphometric characters between *T. trichopterus* and *T. pectoralis* were more similar than that of *T. vittata*. There are five morphometric characters were not significantly different (P > 0.05) between *T. trichopterus* and *T. pectoralis*, including SL, HL, VFL, DFBL and CPD. However, the morphometric characters between *T. vittata* and *T. pectoralis* were all significantly different (P < 0.05), whereas between *T. vittata* and *T. trichopterus* only ED characters were not significantly different (P > 0.05). This indicates that the same genus has adjacent morphometric characters.

Table 2. The mean transformed values of traditional morphometric characters according to three species of gourami group. The values in the same row followed by different superscripts are significantly different (P<0.05).

| No. | Characters (code) | Presumed Taxa | Presumed Taxa | Presumed Taxa |
|-----|------------------|---------------|---------------|---------------|
|     |                  | *T. vittata* (n= 50) | *T. trichopterus* (n=50) | *T. pectoralis* (n=50) |
| 1.  | Standard length (SL) | 72.47±0.33 a | 74.78±0.33 b | 75.73±0.41 b |
| 2.  | Snout length (SnL)  | 7.07±0.11 c | 5.13±0.15 a | 5.62±0.09 b  |
| 3.  | Eye diameter (ED)   | 7.30±0.09 b | 7.14±0.08 b | 6.42±0.06 a  |
| 4.  | Head length (HL)    | 25.35±0.27 b | 24.12±0.26 a | 24.57±0.23 a |
| 5.  | Pectoral fin length (PFL) | 14.07±0.25 a | 21.36±0.51 b | 23.33±0.22 c |
| 6.  | Ventral fin length (VFL) | 32.07±0.64 a | 53.41±0.43 b | 54.72±0.46 b |
| 7.  | Body depth (BD)     | 20.99±0.17 a | 30.72±0.29 c | 24.77±0.43 b |
| 8.  | Dorsal fin depth (DFD) | 24.45±0.59 a | 27.11±0.26 b | 29.22±0.47 c |
| 9.  | Dorsal finbase length (DFBL) | 10.03±0.19 a | 17.98±0.30 b | 19.18±0.30 b |
| 10. | Caudal Peduncle depth (CPD) | 10.88±0.10 a | 12.17±0.17 b | 11.78±0.39 b |

The results of the discriminant function analysis (DFA) produce two functions, where function one has an eigenvalues value of 13,279 with % variance value of 84.9%, while function 2 has an eigenvalues value of 2,361 with % variance value of 15.1%. The morphometric characters were contributed in the function one reach 6 characters, including VFL, PFL, SnL, CPD, HL and SL, while function two reaches four characters, including BD, ED, DFD and DFBL. The scatter plot succeeded to cluster of three fish species into three groups, where *T. trichopterus* and *T. pectoralis* were grouped at a closer distance than *T. vittata*. The results confirm that the level of relationship between *T. trichopterus* and *T. pectoralis* is closer than that of *T. vittata*.

According to Turan [31] multivariate morphometric functions to investigate inter and intra-relationship fish species. Inter-species have key characters that serve as differentiators between fish species. In this study, the morphometric characters of VFL, PFL, SnL, CPD, HL and SL are
the key characters to distinguish fish species. Therefore, this key character may be used as a species differentiator in the osphronemidae family.

According Batubara et al. [29], morphometric analysis effectively identified cryptic fish species. Morphometric analysis is very helpful in the identification process. In addition, this method has also succeeded in classifying fish species based on different populations, example morphometric characters of three populations *T. pectoralis* from Kalimantan [32], morphometric characters between five strains of *Oshpronemus gouramy* [33], morphometric variation among populations of *Atherinops affinis* [34], morphometric variation among *Sardina pilchardus* populations [35] and morphometric comparisons among *Clarias gariepinus* populations [36].

Table 3. Eigenvales, % variance and matrix structure of traditional morphometric characters.  
The star indicates higher loading.

| Function                  | 1          | 2          |
|---------------------------|------------|------------|
| Eigenvales                | 13.279     | 2.361      |
| % Variance                | 84.9       | 15.1       |
| Canonical Correlation     | 0.964      | 0.838      |
| Ventral fin length (VFL)  | 0.774*     | -0.249     |
| Pectoral fin length (PFL) | 0.427*     | -0.299     |
| Snout length (SnL)        | -0.267*    | -0.101     |
| Caudal peduncle depth (CPD)| 0.225*    | 0.131      |
| Head length (HL)          | -0.214*    | 0.036      |
| Standard length (SL)      | 0.138*     | -0.127     |
| Body depth (BD)           | 0.419      | 0.633*     |
| Eye diameter (ED)         | -0.110     | 0.366*     |
| Dorsal fin depth (DFD)    | 0.142      | -0.201*    |
| Dorsal finebase length (DFBL)| 0.019   | -0.084*    |

Figure 3. Scatter plot traditional morphometric characters of three presumed taxa of Gourami group
4. Conclusion
Univariate and multivariate analyzes succeeded in grouping the fish into 3 valid species. Based on discriminant function analysis revealed the key characters for the identification of the three species were VFL, PFL, SnL, CPD, HL and SL. These results confirm that the level of relationship base on morphological character between *T. trichopterus* and *T. pectoralis* is closer than *T. vittata*.

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