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Morphometric and Meristic Analysis of Rasbora in East Java Province

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Abstract

Rasbora (*Rasbora* sp.) is one of the native freshwater fish species in East Java, which is currently being threatened due to environmental degradation, human activities and pollution. In East Java, it is known that there are several species of Rasbora. This study aims to determine the diversity of *Rasbora* sp. in East Java. Samples were taken at five different locations, specifically: Nganjuk (Brantas Watersheds), Ngawi (Bengawan Solo Watersheds), Silowo Springs Tuban, Umbulan Springs Pasuruan and the Setail river (Sampean Watersheds Banyuwangi). The main parameters observed were morphology including morphometric and meristic. The morphological analysis used identification guidelines, while morphometric data were obtained through 15 parameters measurement and then analyzed using a one-way Anova test on SPSS 25 software. Based on the morphometric and meristic analysis, it is known that the species of Rasbora in Nganjuk and Ngawi regencies are *Rasbora argyrotaenia* and the species of Rasbora in Tuban, Pasuruan and Banyuwangi regencies are *Rasbora lateristriata*. One-way Anova test showed Rasbora from the five locations were significantly different based on the $p<0.05$.

INTRODUCTION

Rasbora is included in the genus *Rasbora* (Actinopterygii: Cyprinidae). There are 70 valid species of Rasbora that are naturally distributed in Indonesia (Lumbantobing, 2014; Hasan *et al.*, 2021). Rasbora has a slender and flat body shape and varied colors. Several types of Rasbora fish can be grouped as ornamental fish (Mills, 2000). The distribution of Rasbora in Indonesia covers Sumatra, Kalimantan, and Java. Currently, several species of Rasbora have been detected on Java Island, including *R. argyrotaenia*, *R. aurotaenia*, *R. lateristriata*, (Budiharjo, 2002) and *R. baliensis* (Hubert *et al.*, 2019). The habitat

of Rasbora in East Java is in rivers and springs, which also affect the phenotype of Rasbora.

In general, morphometrics can be defined as a technique for describing body shape and is a method that is widely used in ichthyological or taxonomic systematic studies through measurable components (measuring the length or distance between physical features or landmarks) of fish anatomies, such as the size of body parts and fins, and body length ratio. Over the last 50 years, morphometric methods have successfully discriminated against many fish stocks worldwide (Stiasny *et al*., 1996, Dwivedi and Dubey, 2013). This technique is very useful for testing and graphically displays the differences in shape when combined with multivariate statistical procedures (Baur and Leuenberger, 2011). Morphometric and meristic analysis are the main approach to species characterisation, becoming more challenging when dealing with closely related species. These challenges include identifying juvenile species whose phenotype greatly influences morphology (Aminan *et al*., 2020). The quantitative morphology of fish can be studied through morphometric and meristic techniques. These two techniques are the main numerical techniques used in the process of scientific description of fish (Barriga-Sosa *et al*., 2004; Pinheiro *et al*., 2005).

METHODOLOGY

Place and Time

Samples were taken in five districts in East Java Province randomly based on the presence of Rasbora in February 2021 (Figure 1). Morphometric and meristic measurements were carried out in March 2021 at Toxoplasma Laboratory of the Institute of Tropical Diseases (ITD) Universitas Airlangga Surabaya.

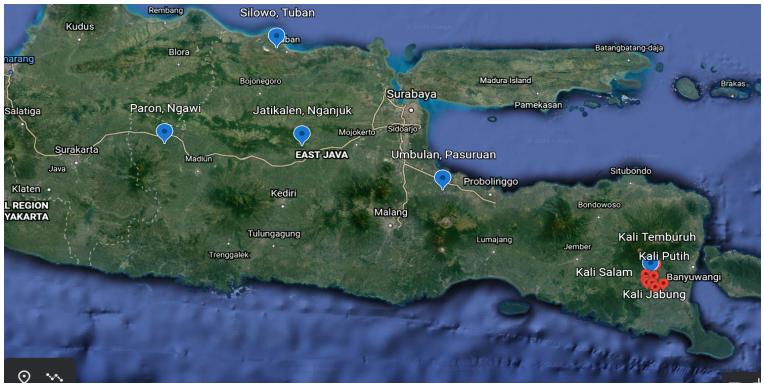

Figure 1. Map of sampling locations for Rasbora (https://earth.google.com/web).

Research Materials

The materials used in this research are Rasbora from five locations. The five samples came from the Umbulan Pasuruan spring, the Silowo Tuban spring, the Brantas watershed in Nganjuk Regency, the Bengawan Solo watershed in Ngawi Regency, the Setail river in Banyuwangi Regency (Sampean watershed) (Table 1). The number of samples obtained ranged from 7-17 Rasbora. And the equipment used in this study included sample bottles, digital scales, digital calipers and rulers.

Table 1. Coordinates and number of samples at each location.

Location Coordinates	Location	Sample Total
N 7,4894° E 112,1688°	Jatikalen, Nganjuk, Jawa Timur	12
N 7,3946° E 111,3868°	Paron, Ngawi, Jawa Timur	7
N 6,8815° E 111,9850°	Silowo Tuban, Jawa Timur	17
N 7,7589° E 112,4346°	Umbulan, Pasuruan, Jawa Timur	12
N 8,3465° E 114,1333°	Setail, Banyuwangi, Jawa Timur	13

Research Design

This research is an exploratory research with direct sampling and then carried out a morphological and meristic approach as well as analysis related to the diversity of wader pari at several sampling locations. The research design used in this study is a cross sectional study, the measurement of sample variables at the same time within a specified period.

Work Procedure

Morphometric Measurement

The number of morphometric parameters calculated is 15 parameters (Lumbantobing, 2014; Aminan *et al*., 2020). Morphological parameters are measured in Figure 2.

Meristic Calculation

The stiff fingers are represented by Roman numerals, even though the fingers are very short. For measurements of soft fins are described using ordinary numbers. *R. lateristriata* has two spines on the back; 7 soft dorsal spines, three anal spines, five soft anal fins, 12 scales between the nape and back, seven rows of scales between the lateral lines above the middle of the caudal peduncle. *R argyrotaenia* has the characteristics of 2 dorsal spines; Soft dorsal spines are 7, anal spines are 3, Soft anal fin is 5, has 12-13 scales between the nape and back. The lateral line ultimately reaches the tail nine rows of scales between the lateral lines above the middle of the caudal peduncle (Kottelat, 2013).

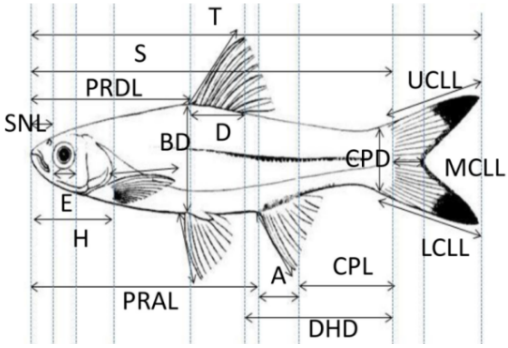

Figure 2. Morphometric measurements of Rasbora specimens (Lumbantobing, 2014).

Coloration in Fresh Specimen

Specific character based on body color, body shape, lateral line, and eye shape refers to www.fishbase.se to determine the species of Rasbora.

Data Analysis

The morphometric analysis was carried out using PCA (Principal Component of Analysis) using PAST 4.07b software. Meristic analysis was carried out by counting the number of fins in fish which were divided into two types, namely rigid fins and soft fins.

RESULTS AND DISCUSSION

Morphometric Analysis

Morphometric analysis was performed using one-way Anova test and PAST 4.07b software by calculating the F value in each of the tested morphometric parameters. The number of morphometric parameters calculated is 15 parameters. Several characteristics were able to distinguish Rasbora species ($p<0.05$) significantly.

The color matrix of the two species is depicted in Figure 4. The colour pattern shows the diversity of the morphometric parameters of *R. argyroatenia* (a) with *R. lateristriata* (b), the lowest diversity is shown in the SnL parameter (snout length), while the lowest diversity is shown in the PrAL parameter (pre-anal length). Intraspecies relationships can also be identified from morphometric data in several districts, namely *R. argyrotaenia* (Nganjuk Regency and Kediri Regency) and *R. lateristriata* (Tuban, Pasuruan, and

Banyuwangi Regency) using neighbor-joining Clustering on PAST 4.07b software in Figure 5.

Table 2. Morphometric measurement of *R. lateristriata*.

Morphometric Parameters	*R. lateristriata* Tuban	*R. lateristriata* Pasuruan	*R. lateristriata* Banyuwangi
SnL (snouth length)	2,79±0,39	2,86±0,50	3,53±0,47
ED (Eye Diameter)	4,11±0,48	4,60±0,51	4,47±0,50
HL (Head Length)	12,56±1,13	14,24±2,16	12,03±2,08
PrDL (Pre-back length)	26,01±2,54	31,41±4,43	28,87±4,31
SL (Standard Length)	49,19±4,80	62,08±8,82	55,00±8,38
BD (Body Length)	11,49±1,06	13,64±1,87	12,49±2,46
(PrAL (Pre-Anal Length)	34,46±2,93	42,59±6,56	38,97±5,75
TL (Total Length)	61,00±5,98	77,76±11,08	68,77±10,33
DD (Dorsal Depth)	5,42±0,89	6,69±1,15	5,55±0,92
CPD (Caudal Peduncel Depth)	6,24±0,52	7,89±1,22	7,14±1,26
CPL (Caudal Peduncle length)	10,63±1,60	13,93±1,99	12,31±2,34
DHD (Dorsohypural distance)	17,27±3,21	24,21±3,33	20,14±3,32
LcLL (Lower Caudal Lobe length)	10,83±2,19	14,34±2,00	11,93±2,15
McLL (Median Caudal Lobe Length)	5,31±0,79	7,84±1,54	6,76±1,26
(UCLL) Upper Caudal Lobe length	10,39±1,08	14,76±2,01	12,30±2,12

Table 3. Morphometric measurement of *R. argyrotaenia.*

Morphometric parameters	*R. argyrotaenia* Ngawi	*R. argyrotaenia* Nganjuk
SnL (snouth length)	2,79±0,35	2,29±0,21
ED (Eye Diameter)	3,74±0,34	3,41±0,42
HL (Head Length)	11,26±1,59	9,81±1,24
PrDL (Pre-back length)	23,79±3,12	20,56±2,43
SL (Standard Length)	43,78±5,51	38,78±4,77
BD (Body Length)	10,28±1,14	8,20±1,51
(PrAL (Pre-Anal Length)	31,07±4,20	26,25±3,77
TL (Total Length)	55,48±7,08	49,34±6,06
DD (Dorsal Depth)	4,23±0,54	3,98±0,61
CPD (Caudal Peduncel Depth)	5,26±0,90	4,53±0,68
CPL (Caudal Peduncle length)	9,60±01,42	7,28±0,83
DHD (Dorsohypural distance)	15,35±2,20	13,48±1,76
LcLL (Lower Caudal Lobe length)	11,05±1,60	10,27±1,51
McLL (Median Caudal Lobe Length)	5,25±1,06	5,03±0,59
(UCLL) Upper Caudal Lobe length	10,96±1,40	10,17±1,09

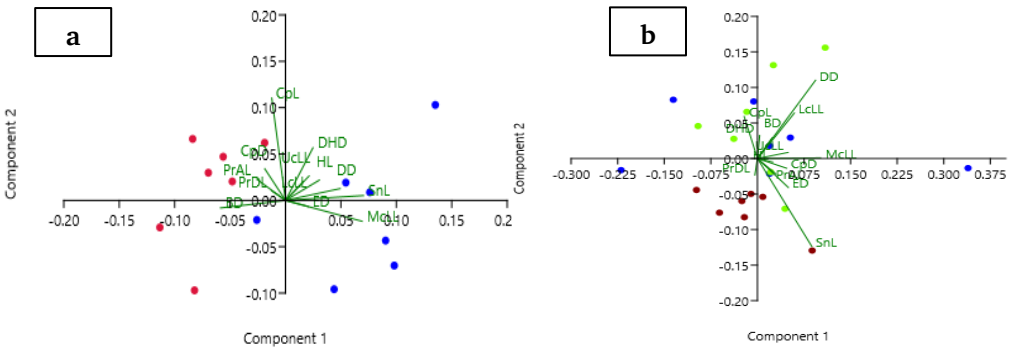

Figure 3. Intraspecies morphometric diversity pattern, (a) *R. argyrotaenia* and (b) *R. lateristriata* using PAST 4.07b software.

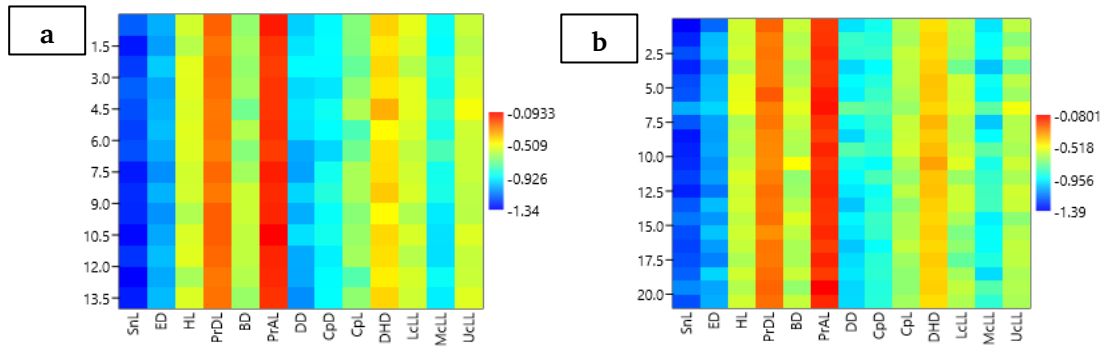

Figure 4. Intraspecies morphometric matrix, (a) *R. argyrotaenia* and (b) *R. lateristriata*.

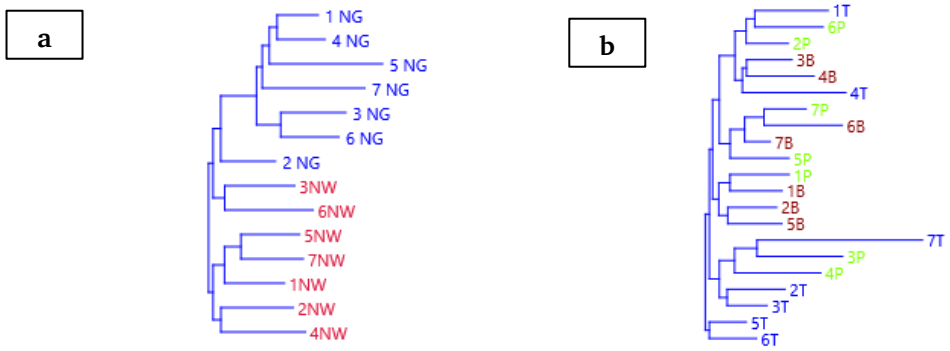

Figure 5. Neighbour-Joining algorithm of intraspecies morphometry, (a) *R. argyrotaenia* and (b) *R. lateristriata*.

The morphometric closeness of kinship is shown through the neighbor-joining Cluster in Figure 5 for the two species Rasbora identified. In the species *R. argyroatenia* (a), it appears that the groups from Nganjuk Regency and Ngawi Regency are separated and gathered together in the same clade, which means that the population is the original population of the two regencies. In the neighbor-joining *R. lateristriata* diagram (b), several clades appear consisting of several types of fish from different districts. This could be because *R. lateristriata* in Tuban, Pasuruan and Banyuwangi is an introduced species originating from the exact location.

Meristic Analysis

Table 4. Meristic analysis of *R. lateristriata*.

Type	Meristic Character	*R. lateristriata* (this study)			Reference (Kottelat, 2013)
		Tuban	Pasuruan	Banyuwangi	
Number of Scales	Dorsal	12	12	12	12
	Linea Lateralis	7	7	7	7
Number of Dorsal Fin Rays		II.7	II.7	II.7	II.7
Number of Anal Fin Rays		III.5	III.5	III.5	III.5

Table 5. Meristic analysis of *R. argyrotaenia*.

Type	Meristic Character	*R. argyrotaenia* (this study)		Reference (Kottelat, 2013)
		Ngawi	*Nganjuk*	
Number of Scales	Dorsal	12-13	12-13	12-13
	Linea Lateralis	9	9	9
Number of Dorsal Fin Rays		II.7	II.7	II.7
Number of Anal Fin Rays		III.5	III.5	III.5

Meristic parameter measurement results indicate that the species obtained from Nganjuk Regency and Ngawi Regency is *R. argyrotaenia* and samples from the other three districts are *R. lateristriata*, according to the identification of the two species at https://www.fishbase.se. Based on the five samples obtained, the results of colouration identification showed that there were two types of *Rasbora* sp, namely *R. argyrotaenia* (Nganjuk Regency and Ngawi Regency) (Figure 6) and *R. lateristriata* (Tuban Regency, Pasuruan Regency and Banyuwangi Regency (Figure 7). *R. argyrotaenia* has the characteristics of a silver body with a slightly shiny yellow color. There is a black line on the side of the body starting from the operculum to the base of the tail, round eyes, all fins silver white and a fork-shaped tail (Figure 6).

The colouration identification of samples from Tuban, Pasuruan and Banyuwangi districts showed that Rasbora in three locations was *R. lateristriata* (Figure 7). Visible characteristics include an elongated flat shape with golden yellow color, a bulging back with a slightly lighter yellow color, a shiny body, an elongated flat body shape on a slimmer abdomen, an upturned mouth with small slits, round eyes, black lines on the sides. Slightly dark in color, yellowtail with slightly blackish edges.

Coloration in Fresh Specimen

The results of colouration observations at the five sample locations had morphological characteristics such as Rasbora. The characteristics of Rasbora are the long and flat body shape on the abdomen, and the back is bulging, the back is shiny black, half of the body is lighter and shiny silver, and the side has a thick black line. *R. lateristriata* back color is dark brown, whitish to yellowish on the sides and underside, and the scales on the edges have small dark spots; silvery black-spotted operculum (Figure 7). Complete lateral line, reaching the tail, whereas for *R. argyrotaenia* yellowish brown with silver luster, dorsal darker, scales bordered by brown lines or dots (https://www.fishbase.se/) (Figure 6).

Figure 6. Morphology of *R. argyrotaenia* from Nganjuk and Ngawi.

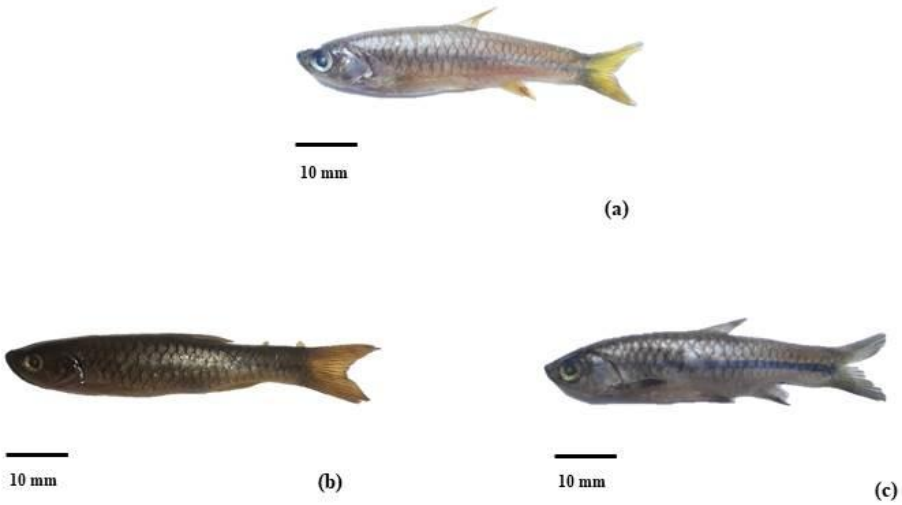

Figure 7. Morphology of *R. lateristriata* from Tuban, Pasuruan and Banyuwangi.

Morphological diversity can be influenced by several factors such as different environmental conditions, topography and habitats (Solomon *et al*., 2015) which distinguishes between the five samples. The sampling location in each district comes from different habitats. Samples from Nganjuk Regency, Ngawi Regency and Banyuwangi Regency were taken in the Brantas River, Bengawan Solo River, and the Setail River. In contrast, samples from Tuban Regency and Pasuruan Regency were taken from springs, namely Umbulan Springs and Silowo Springs.

CONCLUSION

The morphometric diversity of the stingray wader in the five districts in East Java was distinguished into *R. argyrotaenia* and *R. lateristriata* species. *R argyrotaenia* in Nganjuk and Ngawi Regencies morphologically have different characteristics and particular kinship means that the population of *R. argyrotaenia* is a native species that exist in both districts, the type of *R. lateristriata* identified from Tuban Regency, Pasuruan Regency, Banyuwangi Regency has characteristics that are almost the same as close kinship. The close relationship between several samples indicated that *R. lateristriata* was an introduced species.

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