Morphometric Variations of Rasbora Lateristriata Bleeker Population in Different Habitat: Based on Truss Character Analysis

Sang Ayu Made Putri Suryani[a], **I Gede Putu Wirawan[b]**, **Rindang Dwiyani[c]**, **Made Sritamin[d]**

Corresponding Author [a]

Abstract

Rasbora lateristriata is an alternative source of protein for the people around the river and fish consumption in Indonesia. *Rasbora lateristriata* also an economically fish in the streams so that people make it a prime target of the catch. *Rasbora lateristriata*, Bleeker called yellow Rasbora is a genus of freshwater fish from the family of Cyprinidae and is often found living in groups based on small rivers with a temperature range between 22-24 ° C, pH 6.0 -6.5. The purpose of this study was to determine the method Truss morphometric variation in the upstream, branch, middle and downstream and analyze the effects of water quality to morphometric character of *Rasbora lateristriata* population as scientific information in the conservation of fish. Morphometric variation of *R. lateristriata* based on Truss morphometric characters found their closeness between the four populations character of *R lateristriata* with the degree of similarity that upstream populations with 100% similarity, branch with 60% similarity, middle and downstream with 75%. Morphometric similarity value of *R. lateristriata* in the Sungi river area of 77.5%. Morphometric value in all habitats close to 80%, which means *R, lateristriata* have the same shape on the branch, middle, and downstream, while the upstream population does not have a body shape similarities with the other groups to make a subpopulation.

[a] Program Study Doctoral (S3) of Agricultural Sciences, Agriculture Faculty, Udayana University, Denpasar, Indonesia

[b] Udayana University, Denpasar, Indonesia

[c] Udayana University, Denpasar, Indonesia

[d] Udayana University, Denpasar, Indonesia

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1   Introduction

Rasbora found in the upstream and midstream areas but is extremely rare in the downstream areas and estuaries. These fish usually live at depths of less than 1 meter (Ahmad & Novrizal, 2011). Rasbora fish is a fish that lives clustered or schooling fish (Dina *et al.,* 2011). The upstream of the area enter the ingredients of organic and inorganic derived from land and surrounding vegetation. The middle of the river is a transport zone which distributes organic material on to downstream water bodies. While the downstream is central to deposit organic and inorganic materials that are stored in the bottom waters and places composed (Vannote *et al.,* 1980). The structure of *Rasbora lateristriata* fish populations in the Sungi river varies from upstream to downstream. At the upstream, Sungi river has a population structure of *Rasbora lateristriata* is low compared to the middle and downstream. This was due to the upstream availability of feed for *Rasbora lateristriata* very low compared to the middle and downstream where the abundance of plankton, namely 51 366 ind / l (Upstream), 264 168 ind / l (Middle), 139 422 ind / l (Branch), and 403 490 ind / l (Downstream), (Suryani *et al.,* 2019). One species have a longitudinal distribution of the river is a reflection of the adaptation of species to changes in environmental factors (Townsend, 1980). Environmental factors affecting the distribution of fish longitudinal is physical and chemical factors. Water quality of rivers in Indonesia are mostly in contaminated conditions, especially after passing through residential areas, industrial and agricultural (Simon & Hidayat, 2008). Domestic activities, agriculture, and industry will influence and impact the water quality conditions of the river mainly domestic activities that provide the greatest BOD concentration. A river can decrease the quality of water if the water cannot be used water quality status. Water quality status is the water quality level conditions showed blackened condition or good conditions at a water source in a given time by comparing with water quality standards. Determination of the status of water quality can use Pollution Index Method. Pollution Index (Air Pollution Index) used to determine the contamination level relative to water quality parameters (KLH Tabanan, 2010).

Sungi river is one of the ten rivers that deteriorated due to contamination by sewage (BLH Bali, 2009). Pollutant parameters that have exceeded the quality standard that is BOD, COD, Total Phosphate, Total coliform and faecal coliform where conditions are important to note because Sungi River is a drawing point for drinking water at Tabanan Regency (BLH Bali, 2009). Activities at Sungi River are dominated by agricultural activities, settlements, farms in household, and industrial-scale contained in the downstream areas. Waste from these activities led to the deterioration of water quality can be shown as an increase in the content of BOD, COD, total coliform, and faecal coliform (Peralta *et al.,* 2005; Garat *et al.,* 2018; Ayala *et al.,* 2011). Increased content of this occurs in the middle of the river and decreases in the downstream areas. The quality status of Sungi River on the upstream still water quality grade 1, while the middle and lower reaches relatively lightly polluted. Water quality parameters exceed water quality grade 1 in the Sungi River are Total Phosphate 0,55mg/l to the middle, 0.61 mg/l downstream, and faecal coliform with an average value of 280/100 ml at the middle and 200/100 ml at the downstream (Setiari *et al.,* 2012).

2 Materials and Methods

Location sampling

Sungi river basin is divided into four, namely upstream, branch, middle, and downstream. At the upstream at point 8 ° 21'4 "S 115 ° 10'49" E, on the branch 8 ° 22'25 "S 115 ° 11'5" E), the middle at the point 8 ° 33'695 "S-115 ° 09'538 "E and downstream at the point 8 ° 3'053" S-115 ° 06'068 "E.

Water and fish sampling

The sample bottle is used to take water samples to be analyzed in the analytical laboratory at Udayana University as TDS, TSS, BOD, COD, CO2, Phosphate, Amonium, Nitrate, Nitrite and phytoplankton. Some parameters such as temperature, DO and pH in the direct analysis of research sites are on the upstream side, branches, midstream, and downstream. Water sampling using the combined sample (composite sample) to obtain samples as homogeneous as possible so that samples can represent the true environmental quality, and stored at 20°C before analyzed in the laboratory. Fish samples were collected on the upstream, branch, middle and downstream of the Sungi River using nets stocking 3 pieces mesh with each 1.25 x 1.25 cm; 1 x 1 cm; and 0.5 x 0.5 cm. as many as 15 tails for each location that is used for observation of color, the distribution of pigmentation, so that a total of 80 morphometric characters tail (Kusuma *et al.,* 2016). Morphometric characters *Rasbora lateristriata* fish population in the river Sungi with Truss morphometric method with measurement points are observed as shown in Table 1.

Table 1
Description of truss morphometric characters used

No.	Code	Landmark	Description
1.	A1	1-2	Front nose tip to the base of the dorsal fin
2	B1	2-3	Dorsal fin base to the tip of the dorsal fin/rear
3	C1	3-4	The tip of the dorsal fin to the beginning of the tail fin
4	D1	4-5	Top to the bottom tail fin
5	E1	5-6	Bottom of the dorsal fin to the tip of the anal fin
6	F1	6-7	Anal fin until the beginning of pelvic fin
7	G1	7-8	Pelvic fins pectoral fin to the starting point
8	H1	8-1	Pectoral fin until the end of the muzzle nose
9	I2	2-7	Dorsal fin to the starting point pelvic fin
10	J2	2-6	Dorsal fin to the starting point of the anal fin
11	K2	3-7	Dorsal fin to the starting point pelvic fin
12	L2	3-6	Dorsal fin to the starting point of the anal fin
13	M2	3-5	Dorsal fin to the caudal fin starting point
14	N2	4-6	On the initial point through the end of the caudal fin anal
15	O2	5-7	Tail fin to the tip of the anal fin

Data analysis

Analysis of the morphometric characters performed by one-way ANOVA to test differences among species for each character and then followed by multivariate data analysis. Discriminant Function Analysis (DFA) using SPSS version 20 and presented in canonical discriminant diagrams and dendrogram (Patil & Mody, 2005; Roser & Korsch, 1988; Mundry & Sommer, 2007).

3 Results and Discussions

3.1 Results

In this study using measurements with Truss morphometric methods (Table 1). The result's morphometric character can be used as an identifying characteristic fish taxonomy. Each species has different absolute sizes are influenced by age, gender, and the environment. The results of the comparison measurement of morphometric characters in Table 2. In the table, it can be seen that the average results morphometric measurements highest in the branch on the whole character group that is A1, B1.C1, D1, E1, F1, G1, H1, I2, J2, K2, L2, M2, N2, and O2. The one way ANOVA test showed that all truss character was significantly different at 95% of confident level the four groups except E1 is non significantly (Table. 3).

Table 2
The mean character value of a truss network character

Characters	Average	Upstream	Middlestream	Branch	Downstream
A1	2.95 ± 0:45	2.87 ± 0:56	2.60 ± 0:39	3:38 ± 0:44	2.94 ± 0:40
B1	0.64 ± 0:11	0.60 ± 0:13	0:52 ± 0:08	0.74 ± 0:11	0.68 ± 0:10
C1	2:02 ± 0:35	1.94 ± 0:45	1.89 ± 0:32	2:26 ± 0:26	2:03 ± 0:34
D1	0.78 ± 0:17	0.73 ± 0:17	0.69 ± 0:09	0.88 ± 0:11	0.82 ± 0:27
E1	1:21 ± 0:17	1:11 ± 0:29	1:18 ± 0:21	1:29 ± 0:18	1:25 ± 0:25
F1	1:50 ± 0:26	1:47 ± 0:31	1:28 ± 0:23	1.70 ± 0:27	1:54 ± 0:21
G1	1:44 ± 0:31	0:18 ± 0:42	1:20 ± 0:18	1.62 ± 0:26	1:51 ± 0:33
H1	1.72 ± 0:29	1.65 ± 0:32	1:51 ± 0:22	1.96 ± 0:21	1.76 ± 0:36
I2	1.99 ± 0:34	1.92 ± 0:42	1.74 ± 0:26	2:30 ± 0:29	2:02 ± 0:35
J2	1:48 ± 0:23	1:45 ± 0:30	1:30 ± 0:18	1.70 ± 0:21	1:49 ± 0:18
K2	1.81 ± 0:27	1.75 ± 0:37	1:58 ± 0:20	2:06 ± 0:23	1.85 ± 0:25
L2	1:50 ± 0:24	1:49 ± 0:30	1:35 ± 0:19	1.69 ± 0:26	1:46 ± 0:19
M2	1:33 ± 0:20	1:34 ± 0:28	1:17 ± 0:15	1:50 ± 0:17	1:30 ± 0:17
N2	2:20 ± 0:37	2:09 ± 0:47	2:07 ± 0:32	2:44 ± 0:28	2:20 ± 0:38
O2	1.61 ± 0:25	1:38 ± 0:28	2:08 ± 0:32	1:58 ± 0:19	1:42 ± 0:20

Table 3
The similarity of the test group mean on location

Character	Wilks' Lambda	F	DF1	DF2	Sig.
A1	.712	10 258	3	76	.000
B1	.627	15,062	3	76	.000
C1	.841	4806	3	76	.004
D1	.847	4,582	3	76	.005
E1	.920	2,197	3	76	**.095**
F1	.737	9,025	3	76	.000
G1	.793	6602	3	76	.001
H1	.743	8775	3	76	.000
I2	.721	9782	3	76	.000
J2	.697	10 988	3	76	.000
K2	.697	10 992	3	76	.000
L2	.789	6,767	3	76	.000
M2	.732	9267	3	76	.000
N2	.855	4,313	3	76	.007
O2	.439	32 343	3	76	.000

The results of the analysis Discriminant Function Analysis (DFA) generated three functions. Function 1 scored eigenvalues mostly of the functions 2 and 3. So the function of 1 to 3 has a significant role in the discrimination of four group locations. Function 1 with 9.405 eigenvalues explained 88.4% of the total variance, function 2 with 0.841 eigenvalues explain 7.9% of the total variance, and function 3 with 0.390 eigenvalues explain 3.7% of the total variance. No character contributes to function 1. Characters are a contribution to the second function is O2, B1, A2, A1, I2, K2, H1, N2, C1, D1, F1, E1, and G1. Characters that contribute to function 3 is M2 and L2 (Table 4).

Table 4
Eigenvalue, the total variance, and canonical correlation Truss morphometric characters

Function	1	2	3
Eigenvalue	9.405	0.841	0.39
% Of Variance	88.4	7.9	3.7
Canonical Correlation	0.951	0.676	.530
O2	-.343	**.450 ***	-.084
B1	.216	**.428 ***	.082
J2	.172	**.398 ***	-.241
A1	.163	**.398 ***	-.243
I2	.162	**.393 ***	-.163
K2	.179	**.389 ***	-.121
H1	.152	**.386 ***	-.082
N2	.083	**.349 ***	-.094
C1	.101	**.325 ***	-.116
D1	.106	**.295 ***	.060
F1	.172	**.295 ***	-.098
E1	.030	**.282 ***	.169
G1	.159	**.164 ***	-.031
M2	.160	.288	**-.380 ***
L2_	.127	.300	**-.324 ***

A Scatter plot of the first three canonical discriminant functions accounted for 88.4% of the total variation and managed to describe the specimen distribution among the population although distribution is formed showing the separation of the population that is not perfect because there is cone specimen overlap between populations (Figure 1).
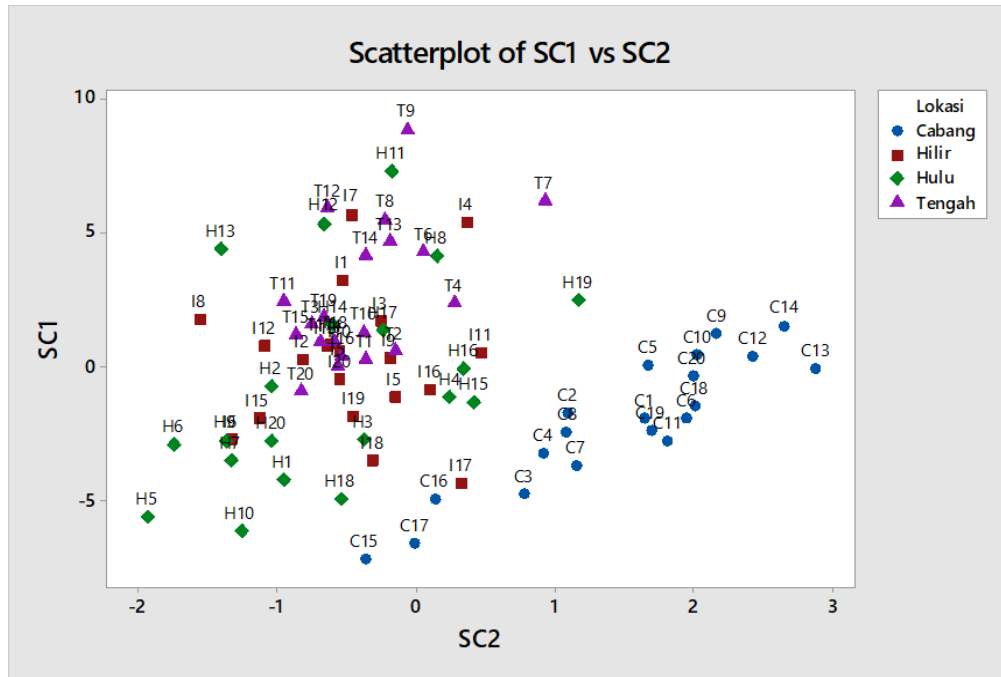
Figure 1. The main components scatter diagram 1 and 2 at the location group *Rasbora lateristriata* population uses 15 characters truss morphometric

Distribution of morphometric characters *Rasbora lateristriata* in upstream, branch, midstream and downstream has a character adjacent to each other to have a very close genetic relationship and still be in the population (Figure 1). Scatter plot function 1 vs function 2 shows 4th location group successfully into 2 groups of fish apart (Figure 1) where the function 1 has discriminant/group the first group to the right (positive correlation) that the group branch here explained that the group branches have similarities the other group because they show a separation of the population is not perfect. After all, it still looks overlap specimens among populations. On the negative correlation (left) there are three groups, namely the upstream, midstream, and downstream. Because of the character of the upstream, midstream, and downstream, which is close to it can be concluded that the three groups of these fishes almost have the same morphometric characters.

Table 5
Values phenotype similarities within and between groups based on morphometric characters

Group_			Predicted Group Membership				Total
			1	2	3	4	
Original	Count	1 (Upstream)	20	0	0	0	20
		2 (Middle)	0	15	3	2	20
		3 (Branch)	0	6	12	2	20
		4 (Downst)	0	4	1	15	20
	%	1 (Upstream)	100.0	.0	.0	.0	100.0
		2 (Middle)	.0	75.0	15.0	10.0	100.0
		3 (Branch)	.0	30.0	60.0	10.0	100.0
		4 (Downst)	.0	20.0	5.0	75.0	100.0

a. 77.5% of original grouped cases classified Correctly

Viewing picture distribution area code morphometric *Rasbora lateristriata* upstream, branch, midstream and downstream (Table 5) obtained value of the same character in a group with other groups as follows: Group 1 (upstream) the value of the same character morphometric by 100%, Group 2 (Middle) morphometric characters similarity value is 75%, 15% have the same character with group 3 (Branch) and 10% have the same character

with group 4 (Downstream). Group 3 (Branch) has the same character 60% while 30% have the same character with group 2 (middle) and 10% similarity morphometric characters with Group 4 (downstream). Group 4 (downstream) has the same character 75% while 20% have the same character with group 2 (middle) and 5% had a degree of similarity with group 3 (branch).

Cluster analysis is used to clarify population groupings resulting from the discriminant analysis. The results of cluster analysis using Euclidean distance showed that *Rasbora lateeristriata* from four populations namely upstream, branch, middle, and downstream cluster into 3 main clusters. Cluster one grouping between upstream and downstream, the second cluster is a branch group and the third cluster is the middle group (Figure 2).
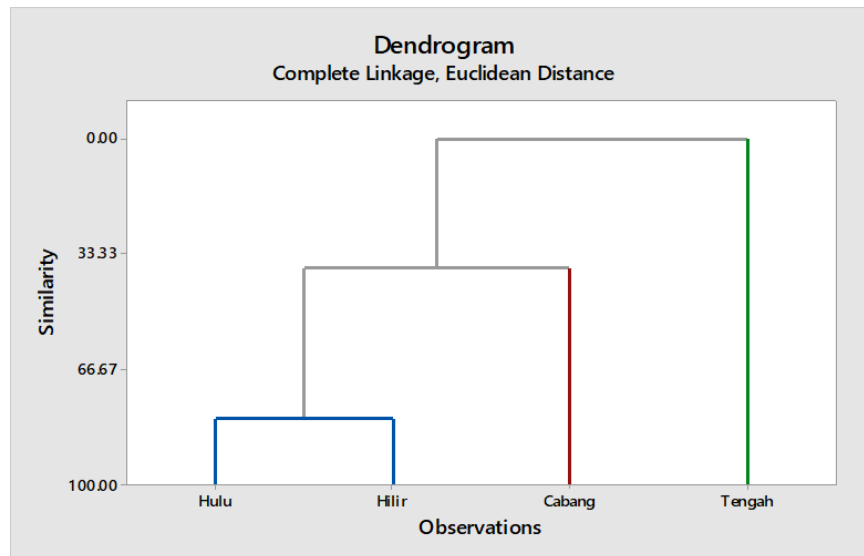

Figure 2. Dendogram of four *Rasbora lateristriata* populations based on morphometric variation

3.2 Discussion

The morphometric similarity value of *Rasbora lateristriata* has a value of close to 80%, which is 77.5% due to environmental influences and there is a tendency for the similarity of shapes of some *Rasbora lateristriata* fish in groups 2, 3 and 4. The only group 1 do not have the same body shape as the other groups, causing sub-population formation. The morphometric distribution of individual *Rasbora lateristriata* fish showed that the differences in the growth of the fish studied were not far between each other in the morphometric distribution. Based on the results of the analysis of the main components, a dendrogram can be made which groups *Rasbora lateristriata* based on the level of morphometric similarity between populations (Figure 2). Based on the dendrogram grouping above *Rasbora latersitriata* population in the upstream has a relatively high similarity with the *Rasbora lateristriata* population in the downstream and is relatively different from the *Rasbora lateristriata* population in the branch and middle. Analysis of grouping using a dendrogram is consistent with the results of the scatter diagram analysis. The relatively high similarity in the upstream and downstream can be caused by the population of *Rasbora lateristriata* in the downstream which has environmental conditions such as temperature, BOD, TSS, Ammonia, Phosphate which exceeds the quality standard can morphometrically adapt from the water quality exposure. The upstream temperature is still following the *Rasbora lateristriata* habitat, but adaptation also occurs due to the very low of phytoplankton. In addition to genetic factors, morphometric diversity is also caused by several factors such as differences in environmental conditions, topography, and different habitats (Hossain *et al.* 2010; Solomon *et al.* 2015; Sidik *et al.* 2016). Increased water temperatures can affect fish behavior such as decreased food behavior even though natural food is available. In upstream the phytoplankton are low but the temperature is following the life of *Rasbora lateristriata.*

4 Conclusion

The morphometric characters *Rasbora lateristriata* based on Truss network analysis found their closeness between the characters four fish populations *Rasbora lateristriata* namely the degree of similarity between populations that upstream populations similarity value is 100%, branch is 60%, middle is 75% and 75% in downstream (Sajina *et al.,* 2011; Mohaddasi *et al.,* 2013; Sen *et al.,* 2011). Morphometric similarity value *Rasbora lateristriata* in the Sungi river area of 77.5%, with a value of approximately 80% that have the same shape of fish *Rasbora lateristriata* on a branch, middle, and downstream, while upstream groups do not have an equal shape with the other. Morphometric character is influenced by the quality of water has exceeded the quality standard that is the temperature, pH, Phosphate, Ammonia, Nitrate, BOD, COD and TSS so as the process of *Rasbora lateristriata* adaptation to environmental changes.

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Biography of Authors

	Dra. Sang Ayu Made Putri Suryani, M.Si. was born in Denpasar, 28 April 1967. She is a doctoral student, Agricultural Science Study Program, Udayana University. She lives at Jl. Narakusuma Gang VI No. 4 Denpasar. *Email: suryanip@rocketmail.com*
	Prof. Dr. Ir. I Gede Putu Wirawan, M.Sc., Ph.D. was born in June 27, 1958. He is professor in Udayana University. He lives at Jl. Pulau Pinang No. 21, Denpasar.
	Prof. Dr. Ir. Rindang Dwiyani, M.Sc. was born in Denpasar, 7 May 1962. She lives at Jalan Tunjung II No. 23 Denpasar.
	Prof. Dr. Dra. Made Sritamin, MS. Was born in Denpasar, 21 October 1952. She is professor in Udayana University. She lives at Jl. Raya Sesetan No. 5 Denpasar.

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