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Morphological variation of Bada fish (*Rasbora maninjau*, Lumbantobing) in Maninjau Lake, West Sumatra

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Abstract
Morphological variation study of Bada fish (*Rasbora maninjau*, Lumbantobing) from Maninjau Lake has been conducted. There are two types of *R. maninjau,* the study was aimed to determine the morphological variation between them. The data was analyzed with the Mann Whitney U test. The result showed that there is a morphological variation between *R. maninjau* type-1 and type-2. The characters are Head behind eye length (HBEL), Eye diameter (ED), Depth of caudal peduncle (DCP), Length of caudal peduncle (LCP), Predorsal distance (PDD), Preanal distance (PAD), Dorsal fin length (DoFL), Anal fin length (AFL), Pelvic fin length (PeFL), Pectoral fin length (PFL), Caudal fin upper length (CFUL) and Caudal fin lower length (CFLL).

Keywords: morphological variation, *Rasbora maninjau,* morphometric, meristic

1. Introduction

Maninjau Lake is located in West Sumatra (Indonesia) at an elevation of 461.50 meters above sea level (0 ° 19'LS 100 ° 12'BT), has a surface area of around 96 km2 with a depth of 1 to 175 m [1, 2]. With such extensive, it is possible that the lake will have locations with different conditions. There are many spesies of fish in that lake. According to Roesma [3] one of them is *Rasbora* n.sp with two types, one with nebulous black spot on the anal fin base while the other one with clear black spot but both of them with no genetic differences and decided as new species. Local people named it as Bada fish. Lumbantobing [4] named it as *Rasbora maninjau*.
Although the description of morphological and molecular was done by Roesma [3], information of morphological variations of *R. maninjau* type-1 and type-2 is not avalaible. It is important to know the difference of the characters between those two types in different locations which are assumed to be an adaptation to ecological changes in Maninjau Lake. According to Franssen, Rutaisire and Skoglund [5-7] variation and differentiation of morphological characters in population can be influenced environmental conditions during ontogeny, availability of foods and predators, spawning areas, pollution intensity, depth of water and the level of anthropogenic pressure.

2. Material and Methods

The study was conducted from April to October 2015. Sampling was done in five locations in Maninjau Lake according to Cailliet [8], using cast fishing nets. The locations are Sarojo, Muko-muko, Muara Antokan, Bayur and Sungai Batang (Figure 1). The 10% formalin was used to preserve all the samples, after which they were taken to the laboratory of Genetics and Cell Biology, Department of Biology, Faculty of Mathematics and Natural Sciences, Andalas University, Padang, West Sumatera Indonesia. All specimens were later preserved in 70% ethanol. Measurement and analysis of samples were carried out in the laboratory.
Morphological measurements were conducted with reference to some researchers [8-11,] with accuracy of 0.01 mm. The observation consist of 45 characters morphometric and meristic. The morphometric characters are Total length (TL), Standard length (SL), Head length (HL), Head width (HW), Head depth(HD), Head behind eyes length (HBEL), Internares distance (ID), Snout length (SL), Eye diameter (ED), Interorbital distance (ID), Body depth (BD), Body width (BW), Depth of caudal peduncle (DCP), Length of caudal peduncle (LCP), Predorsal distance (PDD), Prepelvic distance (PPD), Preanal distance (PAD), Dorsal fin base length (DFBL), Dorsal fin length (DoFL), Anal fin base length (AFBL), Anal fin length (AFL),

Pelvic fin base length (PeFBL), Pelvic fin length (PeFL), Pectoral fin base length (PFBL), Pectoral fin length (PFL), Caudal fin Upper length (CFUL), Caudal fin middle length (CFML), Caudal fin lower length (CFLL). The meristic characters are Scale along lateral line (SALL), Scales above lateral line (SabLL), Scales below lateral line (SBLL), Dorsal fin rays (DFR), Dorsal fin soft rays (DFSR), Pectoral fin rays (PFR), Pectoral fin soft rays (PFSR), Pelvic fin rays (PeFR), Pelvic fin soft rays (PeFSR), Anal fin rays (AFR), Anal fin soft rays (AFSR), Caudal fin rays (CFR), Scales before dorsal fin (SBDF), Scales after dorsal fin (SADF), Scales around caudal (SAC), Circular scales caudal peduncle (CSCP), Scales base dorsal fin (SBDF).

All of the data were subjected to the Mann-Whitney *U* test to identify the morphological differentiation between two different types of *R. maninjau* by using the SPSS ver.16 [12].

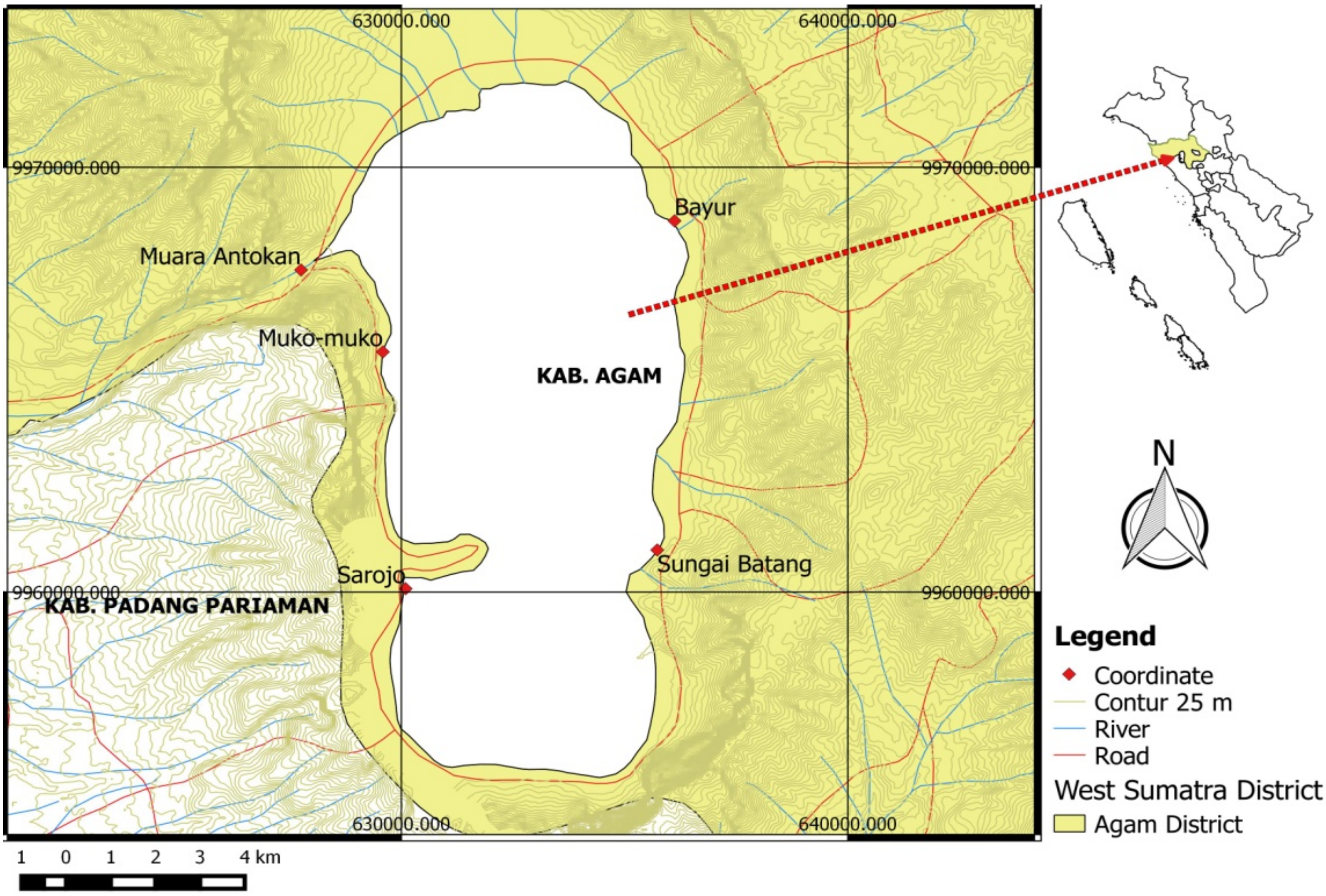

Fig 1: Location of study area in the Maninjau Lake

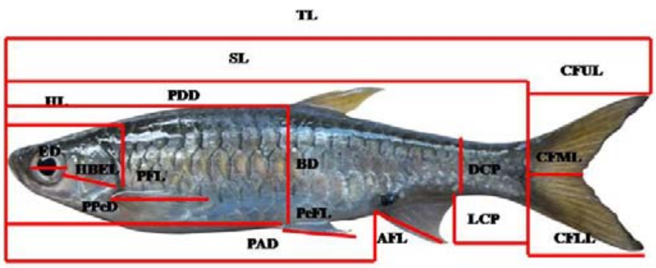

Fig 2: Most of morphometric characters.

3. Results and Discussion

The total of 240 individuals *R. maninjau* were collected at five locations in Maninjau Lake, consisting of 185 individuals of type-1 and 55 type-2. Based on the number of samples we obtained, it was found that the type-1 is more common than type-2. There are two possibilities that may occur. First, the population of type-1 is greater than type-2. Secondly, type-1 is being preferred in the area near the surface of the water while the type-2 in the deeper part of the lake so, there are much more individuals of the type-1 obtained. The body color of type-1 lighter as well as nebulous black spot on the anal fin base while the type-2 darker and clear black spot. According to Mboko [13], an area which has a little bit of light intensity or shade can affect the color of the fish to be dark.

The results of Mann Whitney *U* test showed that 12 characters were significantly different between *R. maninjau* type-1 and type-2 (Table.1). Those characters are Head behind eye length (HBEL), Eye diameter (ED), Depth of caudal peduncle (DCP), Length of caudal peduncle (LCP), Predorsal distance (PDD), Preanal distance (PAD), Dorsal fin length (DoFL), Anal fin length (AFL), Pelvic fin length (PeFL), Pectoral fin length (PFL), Caudal fin upper length (CFUL) and Caudal fin lower length (CFLL). In general those characters (eye diameters, caudal peduncle and fins) are related to the eye and motion The difference in depth and intensity of light may affect to the size of the eyes. The fish that living in shallow waters usually have large eyes, it used to detect the predators [14, 15]. Based on the intensity of light, some cichlids of Victoria Lake are also found differ in diameter of eyes [16]. An adaptation response in a population to its environment can be detected from the variation of morphological characters [17]. Environmental differences during ontogeny, availability of foods and predators, spawning areas, pollution intensity, depth of water and the level of anthropogenic pressure will result in the variation and differentiation of morphological character [5-7, 18]. In addition, there were morphologicals variation observed in three sympatric morphs of Arctic Charr (*Salvelinus alpinus*) that are ecologically diverged along the shallow-, deep- water resource axis in a subarctic postglacial lake (Norway) [7].

Table 1: The Mean, Standard deviation, Maximum, Minimum and Mann-Whitney U test of the 45 morphology characters *R. maninjau* at Maninjau Lake.(p significance ≤0,05; N: numbers of sample; ns: non significance test result; *:significance test result)

Characters	*R. maninjau* Type-1 N= 185	*R. maninjau* Type-2 N= 55	Mann-Whitney U Test
TL	1,29 ± 0,03 1,41 – 1,21	1,28 ± 0,02 1,33 – 1,22	4.664 P = 0.348ns
SL	69.82 ± 10.32 100.97-42.35	70.17 ± 5.94 81.58 – 59.47	4.782 P = 0.499ns
HL	0,24 ± 0,02 0,35 – 0,17	0,24 ±0,01 0,26 – 0,22	4.331 P = 0.094ns
HW	0,11 ± 0,01 0,15 – 0,05	0,11 ± 0,01 0,13 – 0,10	4.204 P = 0.051 ns
HD	0,14 ± 0,01 0,23 – 0,08	0,15 ± 0,01 0,17 – 0,12	4.232 P = 0.058ns
HBEL	0,10 ± 0,01 0,16 – 0,05	0,10 ± 0,01 0,12 – 0,08	3.936 P = 0.011*
ID	0,06 ± 0,01 0,11 – 0,04	0,06 ± 0,00 0,07 – 0,04	4.550 P = 0.235 ns
SnL	0,06 ± 0,01 0,11 – 0,05	0,06 ± 0,01 0,08 – 0,04	4.410 P = 0.134ns
ED	0,07 ± 0,01 0,10 – 0,06	0,07 ± 0,00 0,08 – 0,06	3.554 P = 0.001*
IOD	0,09 ± 0,01 0,11 – 0,06	0,09 ± 0,00 0,10 – 0,08	4.268 P = 0.070ns
BD	0,21 ± 0,02 0,24 – 0,16	0,21 ± 0,02 0,25 – 0,17	4.561 P = 0.244ns
BW	0,11 ± 0,01 0,14 – 0,08	0,11 ± 0,01 0,14 – 0,09	4.744 P = 0.448ns
DCP	0,12 ± 0,01 0,14 – 0,09	0,12 ± 0,01 0,14 – 0,11	4.187 P = 0.046*
LCP	0,21 ± 0,01 0,25 – 0,17	0,21 ± 0,01 0,24 – 0,17	4.188 P = 0.047*
PDD	0,51 ± 0,02 0,58 – 0,46	0,51 ± 0,01 0,55 – 0,46	4.023 P = 0.019*
PPD	0,49 ± 0,02 0,57 – 0,44	0,49 ± 0,02 0,54 – 0,46	4.221 P = 0.055ns
PAD	0,68 ± 0,02 0,76 – 0,60	0,68 ± 0,02 0,72 – 0,64	4.096 P = 0.028*
DFBL	0,10 ± 0,01 0,12 – 0,04	0,10 ± 0,01 0,13 – 0,07	4.389 P = 0.122ns
DoFL	0,21 ± 0,01 0,26 – 0,18	0,21 ± 0,01 0,23 – 0,18	3.550 P = 0.001*
AFBL	0,10 ± 0,01 0,12 – 0,07	0,10 ± 0,02 0,24 – 0,08	4.242 P = 0.061ns
AFL	0,18 ± 0,01 0,22 – 0,13	0,17 ± 0,01 0,20 – 0,14	3.710 P = 0.002*
PFBL	0,03 ± 0,01 0,05 – 0,02	0,03 ± 0,01 0,12 – 0,02	4.930 P = 0.727ns
PeFL	0,17 ± 0,01 0,20 – 0,12	0,16 ± 0,01 0,18 – 0,14	3.628 P = 0.001*
PFBL	0,04 ± 0,01 0,07 – 0,03	0,04 ± 0,01 0,06 – 0,03	4.560 P = 244ns
PFL	0,20 ± 0,01 0,23 – 0,16	0,19 ± 0,01 0,22 – 0,16	3.754 P = 0.003*
CFUL	0,28 ± 0,02 0,33 – 0,22	0,28 ± 0,02 0,32 – 0,22	4.106 P = 0.030*
CFML	0,12 ± 0,01 0,18 – 0,09	0,13 ± 0,02 0,18 – 0,08	4.347 P = 0.101ns
CFLL	0,29 ± 0,02 0,35 – 0,18	0,28 ± 0,03 0,32 – 0,13	3.577 P = 0.001*
SLL	27,60 ± 0,53 29 – 27	27,51 ± 0,57 29 – 26	4.694 P = 0.317ns
SabLL	4,02 ± 0,11 4,50 – 4,00	4,01 ± 0,07 4,50 – 4,00	4.932 P = 0.322ns
SBLL	1,01± 0,05 1,50 – 1,00	1 ± 0 1 – 1	5.032 P = 0.440ns
DFR	1 ± 0 1 – 1	1 ± 0 1 – 1	5.088 P = 1ns
DFSR	6,99 ± 0,13 8 – 6	6,98 ± 0,13 7 – 6	5.023 P = 0.520ns
PFR	1 ± 0 1 – 1	1 ± 0 1 – 1	5.088 P = 1ns
PFSR	9,05 ± 0,66 11 – 8	8,91 ± 0,52 10 – 8	4.548 P = 0.166ns
PeFR	1 ± 0 1 – 1	1 ± 0 1 – 1	5.088 P = 1ns
PeFSR	7,11 ± 0,44 9 – 6	7,04 ± 0,19 8 -7	4.934 P = 0.431ns
AFR	1 ± 0 1 – 1	1 ± 0 1 – 1	5.088 P = 1ns
AFSR	5,03 ± 0,19 6 – 4	5 ± 0 5 – 5	4.950 P = 0.297ns
CFR	18,98 ± 0,19 20 – 17	18,96 ± 0,19 19 – 18	4.960 P = 0.295ns
SBDF	11,40 ± 0,56 13 – 10	11,45 ± 0,54 12 – 10	4.808 P = 0.478ns
SADF	11,96 ± 0,62 13 – 11	12,05 ± 0,41 13 – 11	4.686 P = 0.287ns
SAC	5,42 ± 0,50 6 – 5	5,36 ± 0,49 6 – 5	4.792 P = 0.443
CSCP	11,98 ± 0,71 13 – 11	11,95 ± 0,58 13 – 11	4.972 P = 0.778ns
SBDI	3,05 ± 0,22 4 – 3	3,02 ± 0,13 4 – 3	4.932 P = 0.322ns

The morphological characters that varies is a form of adaptation within a population to their environment [17]. The phenotype of variation can occur without being followed by the genetic changes but only a form of plasticity as a manifestation of ecological differences such as geographical isolation and environmental factors [19, 20].

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