Phenotypic Variation and Estimation of Genetic Distance in Bilih fish from Lake Singkarak and Lake Toba Using Morphological Analysis

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Marine Ecology is the study of the relationship or interaction between biotic and abiotic factors. Dynamic interactions will run in balance if there is no negative intervention from destructive anthropogenic activities. By understanding Aquatic Ecology, the utilization of aquatic biological resources and their environment is expected to be sustainable (Latuconsina, 2020). Indonesian waters have a very complete potential of fishery resources. All these advantages make Indonesian waters the owner of the highest biodiversity in the world. Moreover, because Indonesia is the heart of the world's coral triangle, which is an important ecosystem for the world's oceans. However, behind this abundant wealth, Indonesia still faces economic and ecological challenges in managing its marine areas. However, by conducting research that focuses on aquatic ecology, a method for preserving flora and fauna in Indonesian waters will be obtained. Genetics is a branch of biology that tries to explain the similarities and differences in inherited traits in living things. In addition, genetics also tries to answer questions related to what is passed down or inherited from parents to offspring, how the mechanism of genetic material is inherited, and what is the role of the genetic material (Effendi, 2020). Morphology is the study of the external shape of an organism. The external form of this organism is one of the characteristics that is easy to see and remember in studying organisms. What is meant by the external form of this organism is the shape of the body, including the color of the body that is visible from the outside. Basically, the external shape of fish and various other types of aquatic animals from birth to old fish can change, especially in fish and other aquatic animals that undergo metamorphosis and undergo a process of adaptation to the environment (habitat). However, in most fish the body shape is relatively fixed, so that even if there is a change, the change in body shape is relatively very small (Syamsuri 2004: 12). From the three fields of study above, when combined, it is hoped that they will find performance in the discovery of new faunal diversity and methods of estimating genetic distance using morphological analysis.

Bilih fish (Mystacoleucus padangensis) are endemic fish having economical value and present in Singkarak Lake, West Sumatra. Intensive catching and different management of water use of Singkarak Lake are assumed to be the source of problem for decreasing Bilih fish population. Many efforts have been conducted to conserve the fish population such as releasing the fish produced from hatcheries to the lake and providing artificial reserves (Kartamihardja and Purnomo, 2006). Based on a molecular study using cytochrome b DNA sequences, Roesma (2011) stated that M. Padangensis is a new synonym for M. marginatus and is considered a morphotype of M. marginatus. In 2003, Kartamihardja and Sarnita (2008) reported that the fish M. padangensis had been introduced to Lake Toba, North Sumatra. Nofrita *et al* (2019) said Many appropriate works have been conducted for the fish conservation. One of them is introducing Bilih fish population to a new habitat, Toba Lake. After nine years of releasing the fish, there was a hypothesis that these fish had undergone some changes on their morphology compared to their original population in Singkarak Lake. The changes could occur in some morphological characters and also increase or decrease their growth. This study aims to compare the morphology characters between Bilih fish introduced to Toba Lake with the original population in Singkarak Lake. Fish introduction is an act of releasing new species of fish into a water in which the same species has not been available in the water (Rahardjo, 2008). The fish can be introduced into waters accidentally or intentionally. In 2003, Bilih fish from Singkarak Lake were introduced into Toba Lake successfully. The purpose of introducing Bilih fish, besides as one of ways for conservation, it is also as an effort to increase fish production in Toba Lake (Kartamihardja and Purnomo, 2006). Within nine years after releasing, it can be expected that there have been some changes in morphological characters and the growth of Bilih fish in Toba Lake from the original population in Singkarak Lake. The objective of this study was to compare morphological characters and growth of Bilih fish between population introduced in Toba Lake and original population from Singkarak Lake.

Found that differentiated morphological characters were mainly located in the body anterior including snout length, eye diameter, postorbital distance, head length, prepelvik distance, predorsal distance, head depth, body depth, and the pelvic and pectoral fin length (Nofrita *et al*, 2015). Roesma (2011) reported that the difference in morphological characters between population of Bilih fish in Toba and Singkarak Lake was 73%. Some characters - total length, pelvic fin length, dorsal fin length, and mouth length- in the study of Roesma (2011) had not shown differences but in this study they had shown differences. The different range of time made it possible to trigger morphological variation. So many morphological characters showing differences indicate that one or more factors of environment are inducing morphological character variation in Toba Lake. The history of lake formation, age, width, depth, and elevation are factors that can cause differences in morphological characters. Whitten et al (1987) and Lehmusluoto and Mahbub (1997) stated that Singkarak and Toba Lakes had many differences, for instance, surface width, maximum depth, height, temperature, and ages of the lakes. According to Nofrita *et al* (2013), Bilih fish population in Singkarak Lake has a length ranging from 57.54-112.08 mm with a weight ranging from 1.72-14.30 g. The size of the bilih fish at this location is the smallest when compared to the populations of Lake Bawah and Lake Toba, while the population of Bilih fish in Lake Toba has the largest size. This condition can explain that the population of bilih fish in Lake Toba which is the result of the introduction can adapt optimally to new environmental factors and utilize existing resources. Meanwhile, the small size of bilih fish in its natural habitat, namely Lake Singkarak, is thought not to be caused by unsuitable environmental conditions but rather due to exploitation factors that do not provide opportunities for these fish to grow large.

This aim of the research was to study the morphological characteristic and estimating genetic distance between Bilih fish from Singkarak and Toba lake with discriminant and canonical analysis. Genetic information is needed to determine the genetic quality of an animal which will later be used as consideration in selection and crossbreeding. One of the basic studies to explore genetic information is phenotypic observations with morphological measurements, such as those performed on chickens by (Udeh et al., 2011; Ojedapo et al., 2012); in ducks (Muzani et al., 2005). Genetic distance is the degree of gene difference (genome differences) between a population or species (Nei., I987). A cheaper and simpler method of measuring genetic distance can be done by determining the pattern of phenotypic differences that can be found (Brahmantyo et al., 2003). One way ANOVA (One Way ANOVA) test was used to determine the differences in the merisitic and morphometric characters of fish between research sites, then to determine the main distinguishing factors of morphological characters, PCA (Principle Component Analysis) was used. PCA is one of the most frequently used methods for biological problems and is by far the most widely used method for morphometric analysis, while discriminant analysis is used for grouping fish populations. The results of morphometric and meristic analysis show that populations have genetic distances that are closer to each other if geographical proximity allows gene flow and environmental conditions are relatively the same (Wibowo et al. 2008).

Based on the explanation above, the three fields of biological study can be combined to study phenotypic variation and estimate genetic distance using morphological analysis with discriminant and canonical analysis. Body weight and body parameters are used as variables to be measured so that phenotypic diversity and genetic distance estimation will be obtained.

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