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Comparison of growth pattern, condition factor, gonadosomatic index of *Glossogobius giuris* and *Ophieleotris aporos* in Limboto Lake, Gorontalo, Indonesia

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Abstract. *Hasim, Tuheteru J, Fazrin DN. 2021. Comparison of growth pattern, condition factor, gonadosomatic index of* Glossogobius giuris *and* Ophieleotris aporos *in Limboto Lake, Gorontalo, Indonesia. Biodiversitas 22*: *3388-3393. Glossogobius giuris* (*manggabai*) and *Ophieleotris aporos* (payangka) are decreased native fishes in Limboto Lake due to continuous degradation in the lake. In addition, silting lake along with its area that continues to narrow can threaten the life of both fishes although the government has stipulated restoration of Limboto Lake as the ecosystem of the fishes. However, the current information on the fishes remains considerably limited in terms of making it as a conservation strategy. This study aims to analyze the relationship between the total length and weight of *O. aporos* and *G. giuris*. Furthermore, it analyzes the condition factors and the gonadosomatic index of the two fishes. The research method integrates survey and laboratory techniques. The fishes are collected by using trap made of bamboo and motorcycle tires that are installed for three days and the catches are 60 fishes including 30 ind. of *G. giuris* and 30 ind. of *O. aporos*. Then the total length and weight of the fish and their gonad weight were measured. Data analysis used mathematical formulation of the relationship between total weight and length, condition factor, and gonadosomatic index. The result of the analysis shows that the growth pattern of *G. giuris* was negative allometric whereas *O. aporos* was positive allometric. The condition factor for both types is generally less than 1.7. The gonadosomatic index of *G. giuris* ranges from 4.10-20.00% and *O. aporos* ranges from 0.05-1.98%. These conditions indicate that differences in growth pattern, condition factor, and gonadosomatic index are different forms of response to environmental conditions and in the spawning season of both types of fish.

Keywords: Condition factor, *Glossogobius giuris,* gonadosomatic index, growth pattern, Limboto Lake, *Ophieleotris aporos*

INTRODUCTION

Limboto Lake, which is the largest and also plays a significant role in Gorontalo Province, is included in the ten national critical lakes, which are a priority to be restored. The multi-function of this Lake and others include an economic source, a center of ecological wealth, a source of clean water, and a tourist destination (Gownaris et al. 2018; Joniak et al. 2013). Furthermore, its ecological pressure continues as indicated by the depth, the decreasing area of the lake, and the polluted water quality (Lihawa and Mahmud 2017; Hasim 2012). According to Hasim et al. (2017), the impact on the lake is that the area which has a level of suitability for the application of the floating net cage system is only 0.36% (8.03 ha) while the rest are not suitable. Therefore, it goes against the fact that the fishery activities on the lake are the primary economic source for coastal communities (Hasim and Mopangga 2018). Consequently, ecological damage will threaten the fish's survival and, in turn, affect the welfare of community.

Two of the popular fish are *Glossogobius giuris* (Hamilton, 1822) or *manggabai* and *Ophieleotris aporos* (Bleeker, 1854) or *payangka*, which are known as the native fishes of Limboto Lake. Even Soeroto (1988) stated that *O. aporos* in Tondano Lake was the introducer of Limboto Lake in 1902, and they were the local fishes of the lake acclaimed by some residents. The existence of *O. aporos* in Gorontalo as an endemic fish was also conveyed by Tweedley et al. (2013). *O. aporos* has a rounded tail with black spots extending from the pectoral to the base of the caudal fin with a superior mouth position. However, *G. giuris* has a tapered tail fin, with several black spots, and a terminal mouth position. They both have important economic values as consumption fish for the Gorontalo people. Similarly, (Hossain et al. 2009; Dinh and Tran 2017; Dana et al. 2019) reported that, in some places, *G. giuris* is a source of animal protein that has high economic value. Meanwhile, the increase in demand for both fishes in Gorontalo has signified an increase in fishing activity too.

According to (Suryandari and Krismono 2011), in 2006, the fish caught in the lake reached 19.8 tons and increased in 2007 to 26.3 tons, and enormously increased to 30.4 tons in 2008. Most of these fish species are *O.aporos* and *G. giuris*. Based on interviews with Limboto Lake fishermen and Gorontalo Fisheries Service officers, it found that there was a reduction in fish production. For example, the present number of fish caught and their sizes have relatively reduced compared to several years ago.

However, the condition of the waters of the lake tends to decline. Based on fertility, it is classified as a eutrophication lake (Hasim 2012) due to the massive growth of macrophytes and microphytes. Liu et al. (2017) and Scavia et al. (2014) stated that eutrophication is one of the problems in lakes, which is caused by high concentrations of phosphate and nitrogen. Furthermore, changes in these limnological parameters affect the presence as native fish in the lake.

A study covering their aspects of food, habitat, and water quality has been carried out by several researchers (Fazrin et al. 2020; Suryandari and Krismono 2011). However, detailed information comparing the two fish, including aspect of the relationship between length and weight, condition factor, and gonads, are not available yet, especially in Limboto Lake. Additionally, information in relation to the length and weight, condition factor, and gonads are highly significant to describe the ecological and physiological factors for management purposes (Rosli and Isa 2012; Jumawan et al. 2016). The two fishes are taken into consideration as they are native fishes from the lake that experiencing ecological pressure.

MATERIALS AND METHODS

Study area

The study was conducted in Limboto Lake, Gorontalo, Indonesia, which is in the geographic position 0^{O}31'58'-0^{O}34'50' N and 122^{O}57'40'-123^{O}02'14' L. It is located at an altitude of 25 m above sea level with an area of 3000 ha and an average depth of 2.5 m. Furthermore, its area is located in Gorontalo District and Gorontalo City (Lukman 2010). It has 25 rivers and tributaries that enter its waters and one tributary as an outlet.

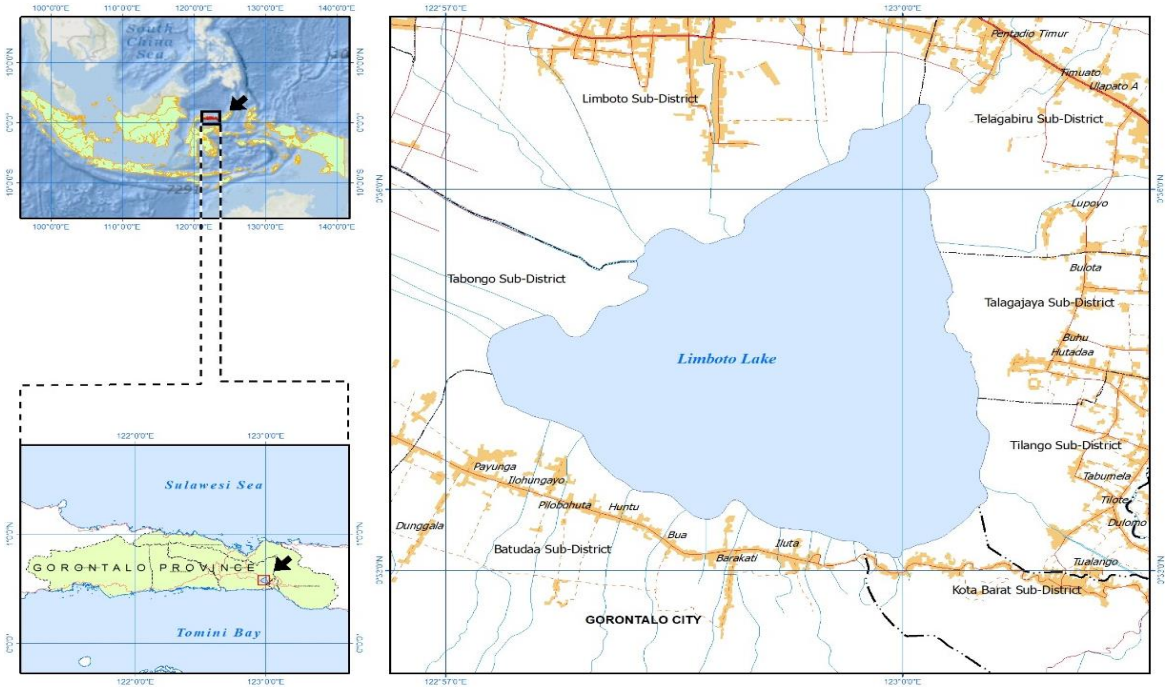

Figure 1. Map of research site in Limboto Lake, Gorontalo, Indonesia

Figure 2. Fishing gear used by fishermen

Procedure

The samples in this study were *G. giuris* and *O. aporos*. The number of samples was 60 fishes and each species comprises 30 fish. The samples were obtained from the catch of fishermen who lived around Limboto Lake using traditional fishing gear made of motorcycle tires and bamboo (Figure 2). The samples that have been stored in a cold box were transported to the laboratory of the Faculty of Fisheries and Marine Sciences, State University of Gorontalo to be analyzed its weight, gonad, and total length using analytical scales and a caliper, respectively following the procedure (Alavi-Yeganeh et al. 2018). Meanwhile, the treatment of the gonads followed the procedure of Mazzoni et al. (2019).

Data analysis

The result of the length and weight relationship follows the equation $W = a L^b$, where W= Fish Weight (g), L = Total length (cm), a and b constants (Madhavan et al. 2020; Alavi-Yeganeh et al. 2018). The condition factor uses Fulton's equation (Suleiman et al. 2018) that is $K = W.100/L^{-3}$, where K is the condition factor, while W is the fish weight (g), L is the total length (cm) and -3 is the length coefficient. Meanwhile, the equation proposed by Ekawaty et al., (2018) states that gonadosomatic index (GSI) = (GW/ BW) X100%; GW is gonad weight, BW is body weight was used to compare the GSI values of both fish using the T-test carried out upon two independent sample groups and the assumption of different variants using Microsoft excel.

RESULTS AND DISCUSSION

In reference to the data collection in the lake, 60 fishes were captured that 30 of them were *G. giuris* and the rest 30 were *O. aporos* and this result confirmed data revealed by local fishermen that the population of both fishes has been greatly reduced, particularly for *O. aporos*. Additionally, the population of both native fishes, particularly *O. aporos*, has been declining due to excessive fishing and a worsening water quality in the lake (Krismono et al. 2018; Paramata 2014). The fish sizes illustrated the variation based on the total length as presented in Figure 3, which showed that *G. giuris* is dominated by a length of 12-13 cm by 43%. Meanwhile, the dominant length of the *O. aporos* fish ranged from 8.2-8.9 cm by 30%. Figure 3 shows the trend that the total length of the two fish species is at the lower interval. The result showed that the *O. aporos* and *G. giuris* had an average length of 9.39 cm and 13.6 cm respectively and were relatively the same as that reported by Suryandari and Krismono (2011). However, some of the factors that affect the abundance of *G.giuris* are water quality, such as contamination from intensive fish farming activities and wild fishes (Lagbas et al. 2017).

Growth pattern

Analysis of the relationship between length and weight of both fishes is presented in Figure 4, and based on this, the value of b is obtainable. The fish growth pattern is determined from the value of b, when b> 3, b <3, or b = 3, the growth pattern is called positive allometric, negative allometric, or isometric growth pattern, respectively (Isa et al. 2012).

The data analysis signifies that the relationship between total length and weight of both fishes are extremely strong in which is indicated by the value of the coefficient of determinant (R^2) for both of which were 0.9352 for *O. aporos* and 0.9328 for *G. giuris*. This suggests that the increase in total length is able to explain the weight gain of fish through regression relationships. The value of b for the relationship between weight and total length of *O. aporos* was 3.2214, the growth pattern was positive allometric, while *G. giuris* had value of b < 3 for 2.7356 and its growth pattern was negatively allometric, which was the same as reported by (Suryandari and Krismono 2011).

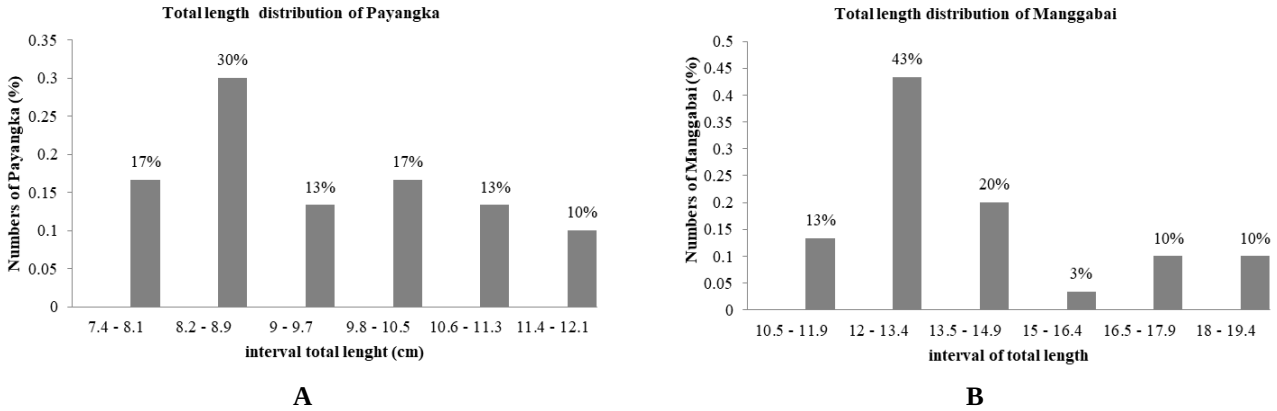

Figure 3. Total length distributions of *Ophieleotris aporos* (A) and *Glossogobius giuris* (B) in Limboto Lake , Gorontalo, Indonesia

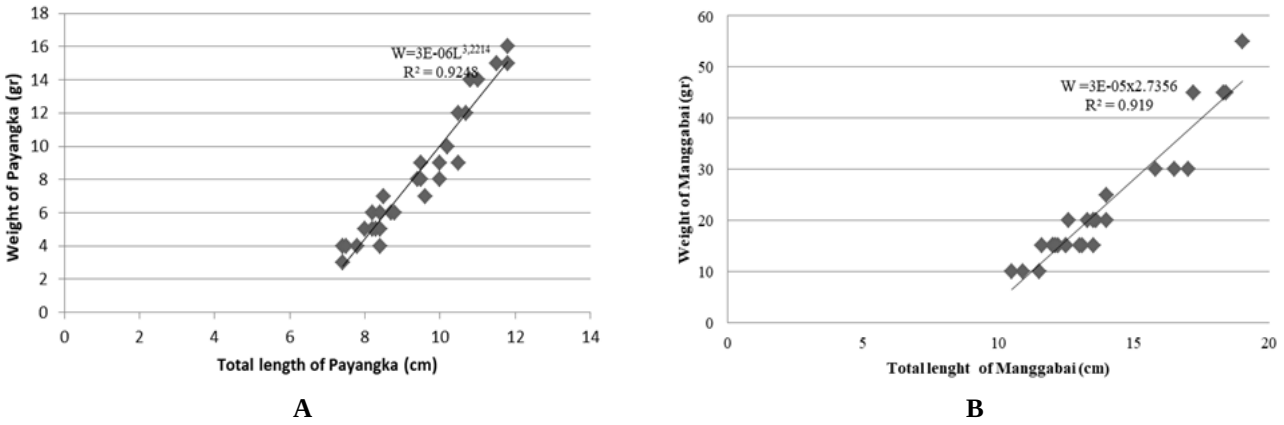

Figure 4. Relationship between length and weight of *Ophieleotris aporos* (A) and *Glossogobius giuris* (B) in Limboto Lake, Gorontalo, Indonesia

Lihawa and Sutikno (2009) stated that Limboto Lake is the estuary of rivers and tributaries whose water flows carry sediment into the lake. The sediment then becomes the main factor of silting in the Limboto Lake and reduces the area of the lake column. On the other hand, there have been many aquaculture activities that are not environmentally friendly, such as intensive pellet feeding for a long time in Limboto Lake. Pellet feed that is not utilized becomes waste which settles to the bottom of the lake by 30% (McDonald et al., 1996). At the same time, in Limboto Lake, there is *Bibilo* fishery activity. When the harvest time and the *Bibilo* is no longer functioning, the fishermen let it settle to the bottom of the lake so that it becomes garbage (Hasim and Akbar 2020). These various things have an impact on environmental factors in the demersal zone of the lake as the habitat of *O. aporos* and *G. giuris*. For example, the dissolved oxygen content especially at the bottom of the lake is low, the high suspended solids, the air temperature increases, the feed is limited (Hermanto et al. 2013; Krismono et al. 2018; Lihawa and Mahmud 2017; Paramata 2014). According to the report of Froese (2006); Muchlisin et al. (2010); Das and Bordoloi (2014), many factors that affect the magnitude of the value of b include food availability, aspects of water quality, fish behavior, the maturity of gonads, habitat, and sex.

Condition factor

The fish condition factor is generally influenced by their internal and external environmental conditions, and according to the reports of Gomiero and De Souza Braga (2005); Radkhah and Eagderi (2015); Faradonbe et al. (2015), there are some factors that affect the condition of fish, which include, sex, maturity of gonads, climate, and availability of sufficient feed. Furthermore, its value depicts the fish's biological status in relation to its well-being. Based on this calculation on *O. aporos*, the value ranged from 0.74 to 1.11 and 0.67 to 1.14 for males and females, respectively. Meanwhile, for *G. giuris*, it is from 0.61 to 0.91 and 0.67 to 1.00 in male and female, respectively. Furthermore, it indicates that the two types of fish's condition number were less than 1.7, which is relatively low, and also that the lake's ecosystem is not optimal for the growth of both fish. In addition, it is consistent with the report of (Hasim et al. 2017), which stated that the lake waters have experienced a significant decrease in quality, however, based on interviews with fishers at the research location, it was stated that the size of both fish caught was smaller, and the number obtained was less than in previous years. It showed that the exploitation of these two types of fish is very high in the lake. The fishing gear used by fishermen in Limboto Lake varies including gillnet, casting net, fishing rods, sero, trawl, ring nets, dayahu, motorcycle tires, and *bunggo* (Krismono et al. 2018; Makmur et al. 2019). According to (Paramata 2014) some of these fishing gears are not selective towards the target so that they have an impact on overfishing. Based on the report of Suleiman et al. (2018), several factors that influence condition factors are the quality control parameters of physics, chemistry, biology, natural food collection, and fish exploitation. The T-test on the condition factor between both fishes showed that the t count value is greater than the t table for two directions (5.24> 2.00, and p-value <0.005). This explains that the condition factors for the two types of fishes are significantly different. In addition, it elucidates that the condition factor of both fishes is significantly different in which according to (Alam et al. 2013), the difference is caused by different behavior of fish species towards the environment.

Gonadosomatic index

Based on observation, the gonadosomatic index of *G. giuris* varied between 4.10-20.00%, while *O. aporos* varied between 0.05-1.98% (Figure 5). The gonad maturity index value below 4.44% indicates that the fish are not ready to spawn or are in the process of gonad development (Suryandari and Krismono 2011). However, the *O. aporos* is not ready to spawn as indicated by the GSI value for <4.44%, while *G. giuris* has a higher gonad maturity index. Furthermore, this difference was supported by the results of the T-test analysis (p <0.05), meaning that there was a significant difference between the gonadosomatic index of *O. aporos* and *G. giuris*.

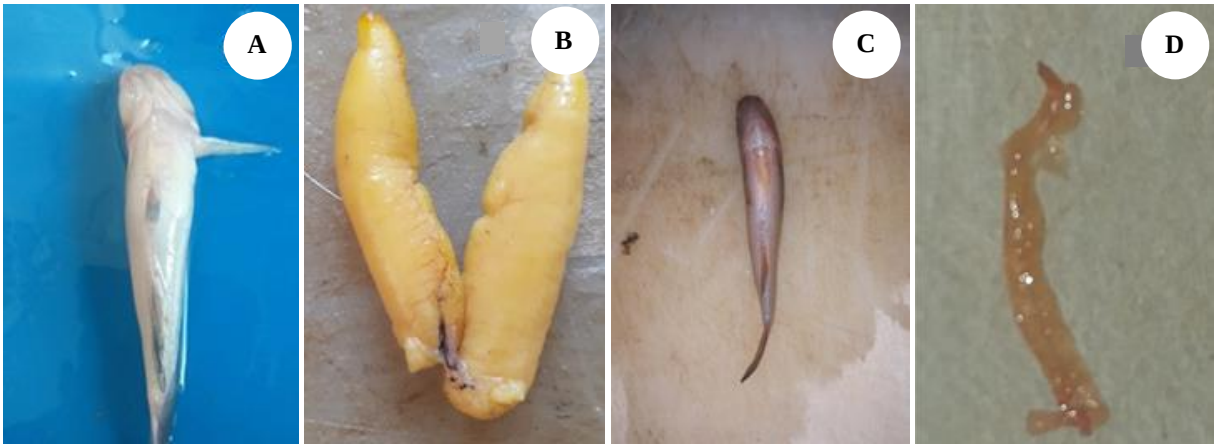

Figure 5. Ventral part (A) and gonad (B) of *Glossogobius giuris* (*manggabai*), and ventral part (C) and gonad (D) of *Ophieleotris aporos* (*payangka*).

According to (Qambrani et al. 2016) *G. giuris* in Manchar Lake experience gonad maturity throughout the year and its peak is in April-June. Meanwhile, according to Sulistiono (2012), *G. giuris* in Ujung Pangka waters, East Java, has a peak spawning season in July-August. This means that the maturity of the *G. giuris* gonads in Limboto Lake reflects the same conditions as in other places. Meanwhile (Putra et al. 2020) stated that *O. aporos* in Bolanu Sau Lake experiences spawning season in August-October. It is shown that when the research was carried out in Limboto Lake (April), the gonads of *O. aporos* were not mature yet. In addition, that environmental factors, season, and availability of feed are factors that affect the maturity of the gonads (Sulistiono 2012).

In conclusion, based on the research results it is concluded that: the relationship pattern of total length and weight between *G. giuris* and *O. aporos* is different; the value of the condition factor for the two types of fish is relatively low for < 1.7; the gonadosomatic index of *G. giuris* is > 4.44% which means it is ready to spawn, while the gonadosomatic index of *O. aporos* is < 4.44% which means it is not ready to spawn. Therefore, in conformity with this condition, one of recommendations for conservation strategy of the two types of fish is paying attention to the spawning season aspect.

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