FECUNDITY AND EGG DIAMETER OF ENDEMIC FISH (Paratherina striata AURICH, 1935) FROM MAHALONA LAKE, SOUTH SULAWESI, INDONESIA

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Abstract

Paratherina striata fish, one of the 16 endemic fish species found in Lake Mahalona, East Luwu Regency, South Sulawesi. Currently, these fish have been listed as threatened species in the red list since 2019. The aim of this study was to analyze the fecundity and egg diameter of P. striata in Mahalona Lake. The research was conducted at Mahalona Lake from November to December 2021 and February 2022. Samples were collected using gill nets and were separated by sex based on morphological characteristics of the body and gonads. The gonads were preserved in Gilson solution. The relative fecundity of P. striata varied between 177 and 1271 eggs. The analysis of regression coefficients for the relationship between fecundity and body length (0.194) and fecundity and body weight (0.169) indicated a weak relationship between them. The diameter of the eggs inside the gonads varied. The spawning type of P. striata was categorized as a partial spawner.

Keywords: *Paratherina striata, mahalona lake, fecunditas, egg diameter*

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1. Introduction

Mahalona Lake is included in the ranks of ancient lakes in South Sulawesi. This lake is home to endemic fish species. About 16 endemic fish species from 4 families have been identified (Hadiaty et al., 2004; Nasution et al., 2007). One of them is the Paratherina striata fish, which belongs to the family Telmatherinidae and the genus Patatherina (Nasution, 2011; Umar et al., 2012). This fish has economic value as a consumption fish that is used by the people around Lake Mahalona.

Paratherina striata fish, which has the local name bonti-bonti fish, is reported to have experienced a threat due to overfishing (Nasution, 2008). In more detail (Lumbantobing, 2019) explains that Lake Mahalona has experienced pressure due to mining activities around the lake and uncontrolled land clearing. Mining activities can have erosion and sedimentation impacts on the surrounding waters (Azevedo-Santos et al., 2021). These processes can have direct or indirect negative effects on fish, such as reduced water quality, loss of environmental diversity, and changes in habitat (Lopes et al., 2019; Pegg et al., 2022). In addition, non-native fish also have a role in the pressure on the existence of endemic fish. The presence of foreign fish has a high potential risk for the survival of native fish in the waters. Generally, foreign fish have better adaptability than native fish in these waters (Gentili et al., 2021; Herder et al., 2012; Sentosa & Hedianto, 2017). Currently, these fish have been included in the threatened category on the red

list of threatened species since 2019 (Lumbantobing, 2019).

The aspect of reproductive biology is the main thing in carrying out conservation planning, management strategies, fishery resources, domestication, to cultivation planning. Information on the reproductive aspects of boletus has been carried out by Nasution (2008) and Nasution et al. (2007) on Lake Towuti. However, information on bonti-bonti in D. Mahalona is rare, almost non-existent.

Information regarding fecundity and variation in egg diameter of Paratherina striata is very important because it is related to the survival of this fish. Knowledge of fecundity can also be used to evaluate spawning stocks, while information about spawning seasons forms the basis of knowledge about the life history and conservation of the species. Therefore, the aim of this study was to evaluate the fecundity and egg diameter variation of P. striata in Mahalona Lake.

2. Methods

Description of the study area

The study was conducted at six stations in Lake Mahalona, Towuti District, East Luwu Regency. The location consist of six research stations 1: Benu (121o29'58.16" E and 2o35'38.47" S); 2: Tompa Lala (121o28'59.77" E and 2o36'39.45" S); 3: Bubuta (121o28'28.56" E and 2o35'28.52" S); 4: Pombang (121o29'13.68" E and 2o34'38.78" S); 5: Lengko Pombala (121o30'22.72" E and 2o34'28.83" S); and 6: Tondu Mata (121o30'28.03" E and 2o35'02.66" S).

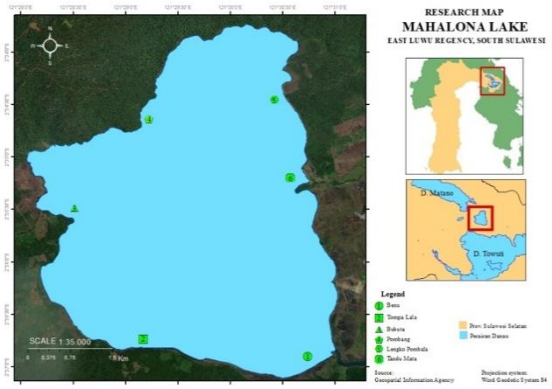

Figure 1. Map of the research location in Mahalona Lake, South Sulawesi, Indonesia

Collection of fish samples

Sampling was carried out every month from November-December 2021 and February 2022. Fishing gear used to catch fish is gill nets with a mesh size of ¾ inch and ½ inch. The observation of the sample was performed at Fisheries Biology Laboratory of the Faculty of Marine Sciences and Fisheries, Hasanuddin University. The sex of each specimen was identified by external and internal sexual characteristics to determine of male and female.

The sampled were measured of total length, body weight and gonad weight. Fish samples were performed surgically on the abdomen using a scalpel and scissors to remove the gonad. Furthermore, the gonads were preserved in Gilson solution for analysis of fecundity and egg diameter.

Determination of fecundity

The number of fish used to determine fecundity was 30 fish consisting of TKG III and IV. Absolute fecundity is calculated using the following formula (Andy Omar, 2013):

$$\boldsymbol{F = \frac{B_G}{B_S}\ X\ F_S}$$

Information: F = total fecundity (items), Bg = weight of all gonads (g), Bs = weight of gonad subdivisions (g), Fs = number of eggs in gonad subsections (items).

The relationship between fecundity and total length using the following formula:

$$F = a\ L^{\,b}$$

Information: F = total number of eggs (grain), L = total length of fish (mm), a and b = constants

The relationship between fecundity and body weight using the following formula:

$$F = a + bW$$

Information: F = total number of eggs (grain), W = weight of fish (g), a and b = constants

Table 1. Correlation coefficient value relationship indicator (Andy Omar, 2013)

The value of the correlation coefficient (r)	Criterion
0,00 – 0,19	Very weak correlation
0,20 – 0,39	Weak correlation
0,40 – 0,69	Simple correlation
0,70 – 0,89	Strong correlation
0,90 – 1,00	The correlation is very strong

Measure of egg diameter

Egg diameter was measured by taking eggs at gonadal maturity level III and IV. The number of eggs observed was 300 eggs per gonad. Observation of eggs using a microscope equipped with a micrometer.

3. Results and Discussion

Absolute Fecundity

Estimation of fecundity was performed for the last maturity stage of P. *striata* by counting fully ripped oocytes. Absolute fecundity ranged from 4978 to 44287 eggs with a mean value of 18636±10325,67 oocytes per fish based on 30 females examined. Relative fecundity ranged 171 to 5868 oocytes per gram body weight (Tabel 2). The relationship of fecundity with total length was: $F = 3791{,}1^{123{,}44L}$, r = 0,1940 (Figure 2) and the relationship of fecundity with body weight was: F = 22949 - 226,56W, r = 0,1688 (Figure 3). The correlation between fecundity and body weight, as well as the correlation between fecundity and total length, is very weak.

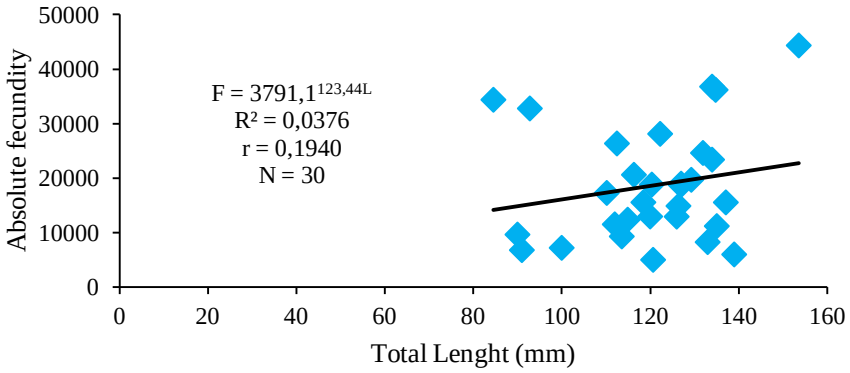

Figure 2. Fecundity-total length relationship of P. *striata*

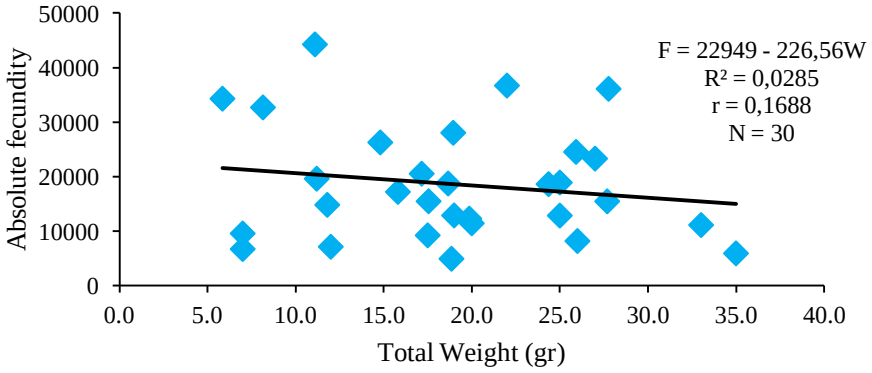

Figure 3 Fecundity-total weight relationship of P. *striata*

Table 2. Descriptive statistics of absolute and relative fecundity of P. *striata*

Fecundity	Number	Mean	Min	Max	S.D
Absolute Fecundity	30	18636	4978	44287	10325,67
Relative Fecundity	30	1271	171	5868	1249,04

Egg Diameter

The number of sampel to measure the egg diameter was 30 fish. The distribution of egg diameter at stage III was 0.08 to 0,43 mm while in stage IV was 0,08 to 0.90 mm (Figure 4). The peak distribution of egg diameter in stage III was 0,22 to 0,28 mm (44%) while the peak distribution of egg diameter at stage IV was 0,36 to 0,42 (31%).

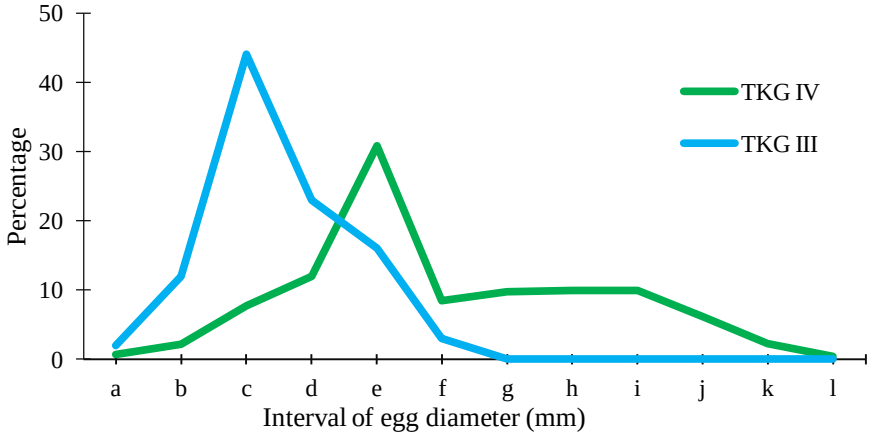

Figure 4. Distribution of egg diameter in maturiry stage III (n: 3000 eggs) and IV (n: 6000 eggs) P. *striata.* Horizontal line caption: a (0,08 - 0,14 mm), b (0,15-0,21 mm), c (0,22-0,28 mm), d (0,29-0,35 mm), e (0,36-0,42 mm), f (0,43-0,49 mm), g (0,50-0,56 mm), h (0,57-0,63 mm), i (0,64-0,70 mm), j (0,71-0,77 mm), k (0,78-0,84mm), l (0,85-0,91mm)

Fecundity is the number of eggs present in the ovary before spawning. Based on this definition, fecundity was calculated for TKG III and TKG IV female fish. Calculation of the number of eggs in the ovaries aims to estimate the addition of individual stocks in a population (Bradshaw & McMahon, 2008; Wang et al., 2019). Variations in the number of eggs produced by fish can be caused by differences in food (Shafi, 2012), habitat (Arantes et al., 2013), age, weight (Yuniar, 2017), and fish standard size (Desrita et al., 2017) . Jusmaldi et al. (2022) explained that the diameter of fish eggs also affects fecundity, where larger egg diameters generally have a low fecundity value, whereas fish with smaller egg diameters have high fecundity.

The results of the regression coefficient analysis of the relationship between fecundity and body length (0.194) and fecundity with body weight (0.169) indicate that there is a weak relationship between the two. These conditions indicate that standard length and body weight cannot be used as estimators of the fecundity value of bonti-bonti endemic fish. This indicates that every increase in gonad weight of bonti-bonti fish, the number of eggs or fecundity will also increase. Conversely, the increase in body weight in bonti-bonti fish cannot be used as a reference for the amount of fecundity. The lack of correlation between fecundity and body weight is thought to be due to the presence of muscus or fat in the abdominal cavity covering the gonads. The thickness of fat in the abdominal cavity varies for each individual. A weak correlation between fecundity and standard length and body weight also occurs in several fish endemic to fresh waters of South Sulawesi, including Telmatherina bonti in D.

Towuti (Nursyahran et al., 2021), Marosatherina ladigesi in S. Pattunuang and S. Batu Puteh (Nasyrah et al., 2020), Telmatherina sarasinorum in D. Matano (Nilawati, 2012), Glossolepis incises in D. Sentani, Papua (Siby et al., 2009) and Garra tibetana in the Yarlung Tsangpo River, China (Gong et al ., 2022).

Egg diameter is the diameter of a fish egg which is observed under a microscope and measured using a pre-calibrated micrometer scale. Analysis of egg diameter is used to determine fish spawning patterns (Nur, 2015). The spawning pattern of fish is divided into two types, namely the semelparity or total spawner type, where the fish only spawn once in their life cycle, such as salmon which will die after spawning and the iteroparity or partial spawner type, where the fish will spawn repeatedly. throughout the year (Nasution et al., 2007; Katiandagho & Marasabessy, 2017). Most tropical fish have a partial spawning pattern. This is due to the difference in seasons, namely the rainy season and the dry season which makes fish metabolism, especially in the process of gonad development faster (Fairchild et al., 2007; Gaikwad et al., 2009; Hasan et al., 2015).

The distribution pattern of bonti-bonti egg diameters in Mahalona Lake was found to vary from the smallest to the largest (0.08–0.91 mm) at each level of gonadal maturity (TKG) of fish, which was not evenly distributed. The uneven diameter of the eggs indicates the spawning pattern used by the fish. Nasution et al. (2007) reported that the diameter of bonti-bonti fish eggs did not develop simultaneously, so it can be concluded that these fish spawn more than once a year or are partial spawners. The same thing was also found in Telmatherina antoniae in D. Matano (Tantu, 2012), Ophiopcara porocephala and Glossgobius giurus in Lake Limboto (Satria & Kartamihardja, 1996).

Spawning time is indicated by the different egg sizes in each ovary, so it can be said that the egg diameter at each gonadal maturity level will reflect the spawning pattern. Long and continuous spawning times are indicated by the number of different egg sizes in the ovary, so that it can be said that the egg diameter at each gonadal maturity level will reflect the spawning pattern (Nursyahran et al., 2021).

4. Conclusion

The relative fecundity of P. striata was varied between 177 to 1271 eggs. The relationship between fecundity and weight negatively. The diameter of the eggs inside the gonads varies. The type of P. striata spawning was categorized of partial spawner.

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