

Length-Weight Relationship, Condition Factor and Otolith shape of Marble Goby (*Oxyeleotris marmorata*) at Sermo Reservoir, Yogyakarta

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Abstract. This research aimed to know the length-weight relationship, condition factor, and otolith shape of marble goby (*Oxyeleotris marmorata* Blkr.) at Sermo Reservoir Yogyakarta. In total 211 samples (95 males and 116 females) were collected using gillnet and folded trap (bubu). Each sample was observed for sex determination, and then measured its total length, body weight, and otoliths diameter. The data were analyzed to determine the length and weight distribution, length-weight relationship, condition factor, and length-otolith diameter relationship. The result showed that the total length of the male was ranged 12.0-38.2 cm and female was ranged 12.2-44.5 cm. The weight of the male was ranged 21.0-704.8 g and female was ranged 21.1-1593.7 g. Both male and female have positive allometric growth with the equation $W=0.0056L^{3.2894}$ for male and $W=0.0051L^{3.311}$ for female. Condition factor was ranged 0.787-1.313 for male and 0.800-1.379 for female, and the majority of fish has a good condition ($Kn \geq 0.95$ more than 50%). The shape of otolith edge was sinuate surrounded with regular wave-like curves, the diameter was increased in line with increasing of total body length by an equation of $Y=0.2335+0.0248X$ ($r=0.938$).

1 Introduction

Sermo Reservoir, the first artificial lake in Yogyakarta, has several important roles such as agriculture water supply, sources of clean water and fisheries. To increase fish population, several species of fish were introduced and restocked during the initial stage of inundation. Marble goby (*O. marmorata*) is one of the freshwater fish that can be found from Thailand to Indonesia [1]. The species was introduced in Sermo Reservoir at an unknown period and process. Marble goby catch in Sermo Reservoir was still below other species, such as tilapia or red devil. Marble goby (*Oxyeleotris marmorata* Blkr.) was predatory fish, feed mainly small fishes and crustacean [2]. Marble goby is a carnivore at the top of pyramid hence fewer number compare to other organisms at lower trophic levels [3]. Therefore, it might have

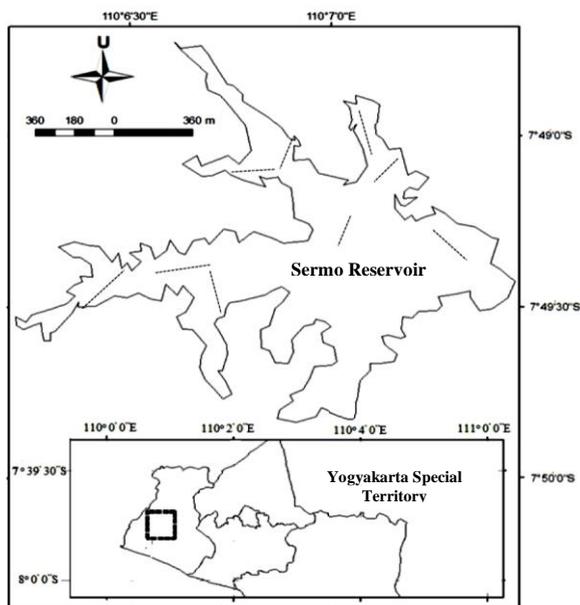
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potential as a natural predator to control other fish populations. Previously, tilapia was dominant fish species, comprised of more than 50 % of fish catches in Sermo Reservoir [4], but shifted over by red devil (*Amphilophus labiatus*) which was fast growth and become dominant species, however, it has low economic value. As the red devil population is expected to be increasing annually, it was necessary to control their population.

The length-weight relationship, condition factor, and growth are required for fish population study, and as basic fundamental data for fishery resources management. Length-weight data is beneficial to measure the total weight of caught fish, while length-frequency might indicate survival rate or the health of the fish population, particularly to determine the fish relative condition [5]. Condition factor or ponderal index was used to measure the fitness and physical capacity of fish for their survival and reproduction. Fish age and growth are part of the population dynamic parameter which important to measure fish stock, required as a basic consideration in fisheries resources management.

2 Research Method

Fish samples were taken from fishers from December 2013 to May 2014 in Sermo Reservoir (Figure 1), caught using gill net at various mesh sizes (1-2.5 inches) and fish trap.



Note: ----- : sampling location

Fig 1. Location of Sermo Reservoir and Sampling Location

The data were analyzed to determine the length and weight frequency distribution, length-weight relationship, and condition factor. Length-weight relationship analysis was performed using linear regression correlation previously used by Biswas [6]. Calculation of b value was performed using t-test at 0.05 significance to ensure the significant difference of fish growth from isometric growth, by which the result was used to measure those two parameters, hypothesized as $b=3$ to indicate isometric pattern that the weight increase with length; and $b \neq 3$ represents allometric pattern that the growth of length and weight increase not in

concomitant pattern. Fulton’s condition factor was used for isometric fish growth type, calculated using formula as follows [7]:

$$K = (W/L^3) \times 100$$

with:

- K = Fulton’s condition factor,
- W = fish weight (gram),
- L = total fish length (cm).

The condition factor of allometric fish growth was calculated in relative by the formula described previously [8] as follows:

$$Kn = (W/aLb) \times 100$$

with:

- Kn = relative condition factor,
- W = fish weight (gram),
- L = total fish length (cm),
- a and b = constant

3 Results

3.1 Length and weight frequency distribution

The total length of marble goby ranged from 12.0 to 44.5 cm. Most of the male marble goby (75.79%) sized 14.1-24.0 cm, while most of the female (93.96%) sized 14.1-26.0 cm. Only a few fish have a total length of more than 30.0 cm (< 7.5 %) (Fig. 2).

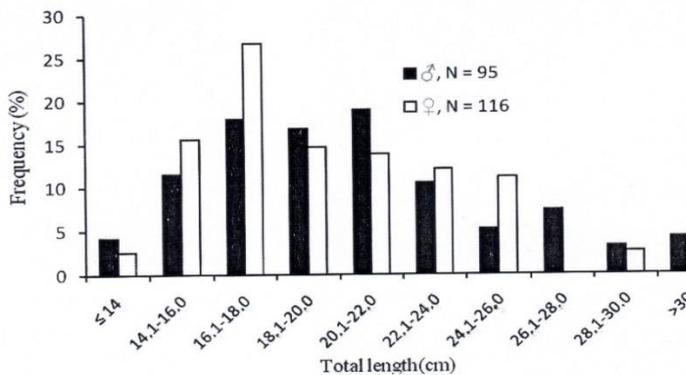


Fig. 2. Length distribution of *O. marmorata* in Sermo Reservoir.

The weight of marble goby ranged from 21.0-704.8 g for the male, and 21.1-1593.7 g for the female, respectively. Most of the male and female fish, 66.32% and 74.14%, respectively, had a weight range at 40.01-160.00 g, and no fish was found lower than 20.0 g. (Fig. 3).

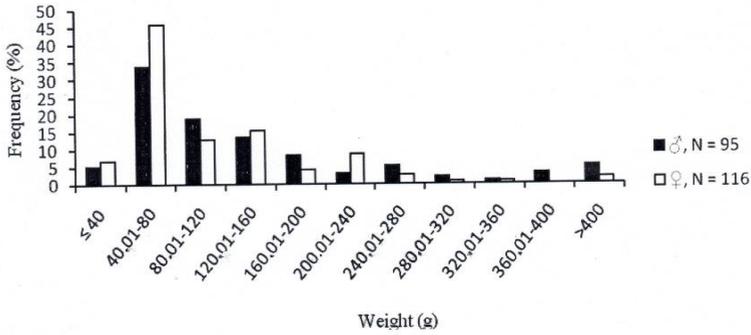


Fig. 3. Weight distribution of *O. marmorata* in Sermo Reservoir.

3.2 Length-weight relationship

Length-weight relationship of male and female fish followed equation of $W=0.0056L^{3.2894}$ ($r=0.992$) and $W=0.0051L^{3.311}$ ($r=0.988$), respectively. Data analysis using t-test indicated marble goby in Sermo Reservoir had an allometric growth pattern with $b \neq 3$ ($\alpha=5\%$), and determination coefficient (R^2) for the male of 0.9834 and female of 0.9769 (Fig. 4).

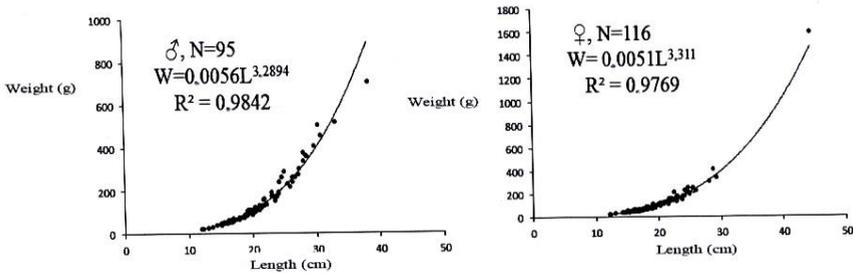


Fig. 4. Length-weight relationship of *O. marmorata* in Sermo Reservoir

3.3 Condition factor

Relative condition factor (K_n) of male and female fish was different each month, ranged at 0.787-1.313 with a mean of 0.999 for male and 0.800-1.379 with a mean of 1.005 for female (Fig. 5).

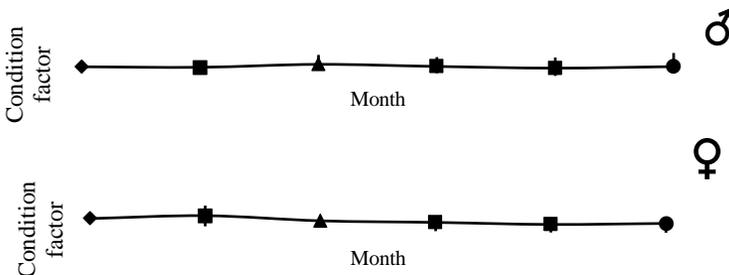


Fig. 5. Condition factor of *O. marmorata* caught in Sermo Reservoir

There was a slight fluctuation of the mean of Kn for male and female fish during observation, which is 0.966-1.053 and 0.972-1.154, respectively. The lowest Kn was found in April for both male and female fish; however, the highest Kn was found in a different time, i.e. February for male and January for female. Kn was classified into three groups; <0.95 for fair condition, 0.95-1.05 for good condition, and >1.05 for very good condition represented Kn proportion based on sex (Figure 6).

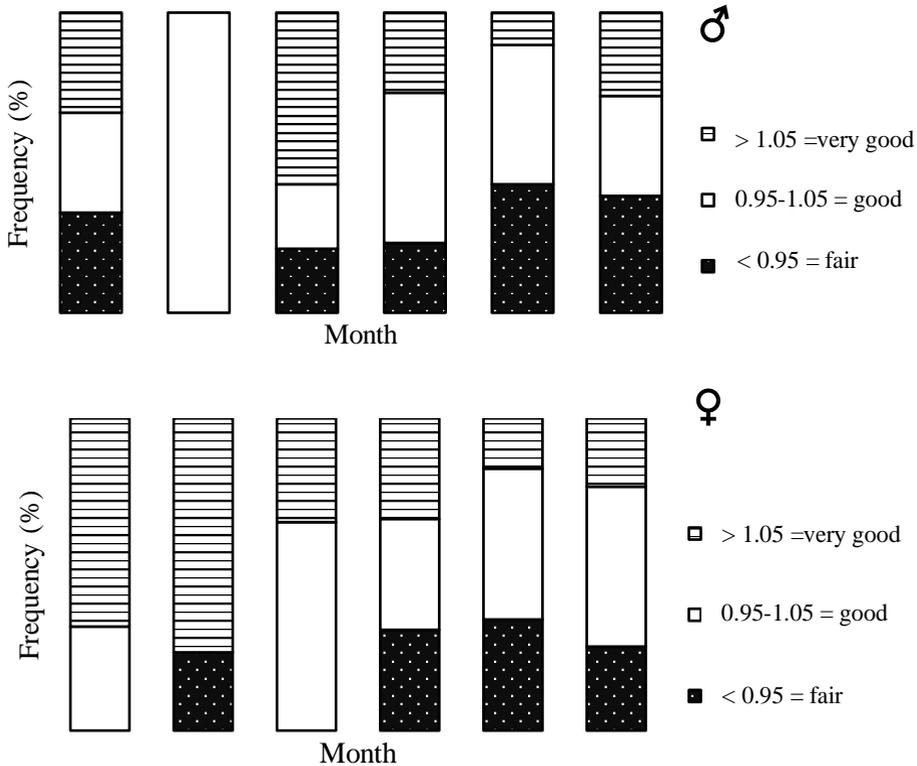


Fig. 6. Distribution of condition factor of *O. marmorata* in Sermo Reservoir.

Relative condition factor data showed that the highest proportion of male and female in fair condition ($Kn < 0.95$) occurred in April of 42.86% and 35.48%, respectively, while their highest percentage in good condition ($0.95 \leq Kn \leq 1.05$) occurred in January for male (100%) and February for female (66.67%). The highest proportion of Kn in very good condition ($Kn > 1.05$) was obtained in February for male (57.14%) and January for female (75%).

3.4 Otolith shape and total length-otolith diameter relationship

The diameter of otolith ranged from 0.49-1.22 cm and a mean of 0.73 cm. The shape was similar to the ovate type and medium thickness. The shape of otolith edge was sinuate surrounded with regular wave-like curves (Figure 7).



Fig. 7. Otolith of *O. marmorata* (bar=2mm)

Marble goby otolith was ovate shaped with sinuate edge and moderate thickness, the diameter was increased in line with increasing of total body length by an equation of $Y=0.2335+0.0248X$ ($r=0.938$). The total length was linearly followed by larger otolith diameter ($R^2= 0.8799$) (Figure 8).

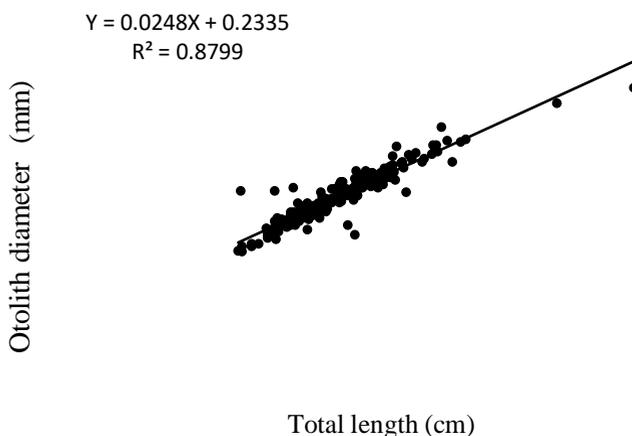


Fig. 8. Total length-otolith diameter relationship of *O. marmorata* in Sermo Reservoir

4 Discussion

Marble goby caught in Sermo Reservoir varied in size that is 12.0-38.2 cm for the male and 12.2-44.5 cm for the female. In comparison, male and female marble goby in Rawa Jombor has a maximum length of 34.3 cm and 42.7 cm, respectively [9]. Feed availability and water quality are considered as an important factor in fish growth. A high growth rate might indicate abundant feed and adequate living environment conditions. Fish that less than 12 cm was not caught due to their size that enable them to hide in dense vegetation and escape from the net [3].

The length-weight relationship of male and female marble goby in Sermo Reservoir represented positive allometric growth ($\alpha=0.05$ and $b\neq 3$), indicated a faster weight increase than length (Fig.4). The condition factor represents fish corpulence in numbers based on the length and weight data. Overall, marble goby condition in Sermo Reservoir was good as more

than 50% of the fishes had $Kn \geq 0.95$ (Figure 6), indicated the fish's ability to survive and to utilize feed in its surroundings. Condition factor can also serve as an indicator for fish growth in the aquatic region, to measure environmental suitability, as well as to compare various habitats. The results confirmed that Sermo Reservoir was suitable for marble goby. The relative condition factor of female fish was higher than the male, which might indicate a better condition of female than male. The relative condition factor of marble goby in Sermo Reservoir was lower than those found in Rawa Jombor, Klaten, ranged at 0.273-2.256 (mean=1.016) for male and at 0.128-1.765 (mean=1.019) for female [9]. The higher relative condition factor of marble goby in Rawa Jombor was probably due to higher productivity and feed availability caused by shallow water and denser vegetation which facilitates the growth of marble goby. The deficient condition factor of marble goby ($Kn < 0.95$) in April was probably caused by a lower rainfall rate which reduces Sermo Reservoir water volume. Lower water surface might affect the availability of small fish as marble goby main feed. Spawning also occurred around this month hence body weight decreased. January and February is the rainy season, thus fish biomass rapidly increases during high water surface [10], during which spawning period occurred for marble goby and certain fish, that small fish as marble goby main feed become abundant. The peak season for spawning for most tropical fish species occurred when water is abundant or flooded [11]. The peak for Kn was also caused by a high level of fish gonadal maturity ready for spawning. Marble goby is able to spawn throughout the year with the peak at the start of the rainy season when water surface increase [12].

Otolith was used to measure fish development as otolith length growth linear to fish length. The total length-otolith diameter relationship of marble goby was modeled in $Y=0.0248X+0.2235$ equation, indicated that fish length increase was followed by a larger otolith diameter. Correlation among length-otolith diameter relationship was strong ($r=0.8779$), which showed that the increase of otolith diameter was closely related to body length growth, suggested strong indication that otolith can be used to predict age and growth of marble goby. Increasing otolith diameter is caused by calcium carbonate accumulation as fish metabolic product [13]. Beside fish length growth, temperature also plays an important factor that affects fish growth and the increase of otolith daily circle. The daily circle of fish otolith and fish growth might be inhibited and even stopped by the low temperature of habitat [14]. Length-weight relationship and length-otolith diameter relationship can be used to predict fish length from otolith diameter and fish weight from length using the obtained model equation.

5 Conclusion

Male and female marble goby in Sermo Reservoir had positive allometric growth, modeled by the equation of $W=0.0056L^{3.2894}$ for male and $W=0.0051L^{3.311}$ for female. Marble goby in Sermo Reservoir was generally in good condition ($Kn \geq 0.95$; 70.14%), with the highest proportion of relative condition factor ($Kn > 1.05$) in February male and January female. Marble goby otolith was ovate shaped with sinuate edge and moderate thickness. Length – otolith diameter relationship in marble goby was linear, modeled in equation of $Y=0.2335+0.0248X$ ($r=0.938$).

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