The Biological Aspects Comparison of Nila Tilapia (*Oreochromis niloticus*) on the Eutrophic and Oligotrophic Reservoir from Indonesia

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**Abstract** Comparison of the length, weight and condition factor of Nila Tilapia (*Oreochromis niloticus*) was studied on oligotrophic waters (Wonorejo Reservoir) conducted from July to August 2018 and eutrophic waters (Selorejo Reservoir) on February to March 2019. All of the reservoir are in the East Java, Indonesia. The total sample from Wonorejo Reservoir about 79 fish from 3 times sampling (every two weeks), but the fish Sample from Selorejo Reservoir are 35 from 4 times sampling every week. The Nila Tilapia from Wonorejo Reservoir are 15.3 ± 2.5 cm (length) and 74.6 ± 38.6 grams (weight) but fish from Selorejo are 17.8 ± 2.2 cm average length and 114 ± 35 grams for the weight. The condition factor of Nila Tilapia in both reservoirs was relatively the same, with an average value was 1.01. The Nila Tilapia caught from Selorejo Reservoir (eutrophic) is relatively heavier and bigger than in the Wonorejo Reservoir (oligotrophic) even though the hook size is smaller. Fish from the Selorejo Reservoir (eutrophic) is easier to get food so that the average fish is larger.

**Introduction**

The reservoir is commonly called an artificial lake created using a dam or lock to store water. Besides, besides the function of water storage, reservoirs can also be used as a tank for aquaculture. Tilapia is one of omnivorous fish that can be found in the reservoirs easily (Arfiati et al., 2019). Tilapia life depends on natural food availability in reservoirs such as plankton, insects, and aquatic plants.

Reservoirs have three trophic categories: oligotrophic, mesotrophic, and eutrophic. The level of tropics related to the level of nutrition in the water. Selorejo was identified as a eutrophic reservoir (Jennerjahn & Klöpper, 2013), and Wonorejo was identified as an oligotrophic reservoir (Arfiati et al., 2019). Explained that the oligotrophic lake prototype is a large deep lake with clear waters and a rocky or sandy shoreline (Environmental Fact Sheet, 2019). A eutrophic lake is typically shallow with a soft and muddy bottom. Mesotrophic is an intermediate trophic with characteristics between the other two. An oligotrophic lake describes having low amounts of nutrients; a mesotrophic lake describes having moderate levels of nutrients; and a eutrophic lake has high levels of nutrients (Tessitore, 2010).

This study focused on the differences in length, weight, and condition factor of Nila Tilapia that were caught in both reservoirs (Wonorejo and Selorejo) by using fishing rods with different trophic statuses waters. Research on different aspects of biological aspects of Nila Tilapia in eutrophic and oligotrophic reservoirs has never been carried out, so it is necessary to carry out this research to see the condition of tilapia in different waters.
Materials and Methods

Study Area

This study was conducted in two reservoirs located in East Java, Indonesia. The Selorejo reservoir originates in Selorejo Village, Ngantang District, Malang Regency, East Java. The Selorejo reservoir samples were conducted 4 times with a range once a week. Meanwhile, the Wonorejo reservoir was conducted 3 times with a range of two weeks each. The total sample in this study was 35 fish at Selorejo reservoir and 79 fish at Wonorejo reservoir. The fish sample has then measured the weight, length, and condition factor.

Water Quality Measurements

The water quality measurements were carried out in situ and ex-situ. Temperature and brightness were conducted at the moment (in situ). Meanwhile, pH and dissolved oxygen (DO) were assayed ex-situ at Reproduction Laboratory; and Hydrobiology laboratory of Faculty of Fisheries and Marine Science, University of Brawijaya, Malang.

Figure 1a. The study area of Selorejo reservoir; b. Study area at Wonorejo reservoir

Fish Captured Survey

The target Nila Tilapia examined in this study was captured using fishing rods in both reservoirs. The anglers in the Selorejo reservoir used 7-8 hook size, while the Wonorejo reservoir used 3-4 hook size. The Selorejo reservoir samples were conducted 4 times with a range once a week. Meanwhile, the Wonorejo reservoir was conducted 3 times with a range of two weeks each. The total sample in this study was 35 fish at Selorejo reservoir and 79 fish at Wonorejo reservoir. The fish sample has then measured the weight, length, and condition factor.

Results and Discussion

Water Quality in Both Reservoirs

On water quality assay in both reservoirs showed that the water quality assay was similar except on the results of the water brightness parameter (Table 1). The brightness on the Wonorejo reservoir showed much higher than the Selorejo reservoir. The water brightness was related to the trophic status of water. Wonorejo Reservoir as oligotrophic has been accused of waters with low nutrients. It caused the Wonorejo reservoir area, which is very huge and...
made an abundance of natural food less. In contrast, the Selorejo Reservoir has been suspected as eutrophic, even though the Selorejo reservoir's brightness >9.9 m but based on a previous study (Jennerjahn & Klöpper, 2013) prove that Selorejo reservoir classified as eutrophic waters. Kevern et al. (2004) reported that the average categories of water brightness are 9.9 m (oligotrophic), 4.2 m (mesotrophic), 2.45 m (eutrophic). The temperature on the Selorejo and Wonorejo reservoirs was still relatively good for tilapia growth. Explained that tilapia (O. niloticus) could live optimal in the temperature with range 24-32°C. The pH and DO also were quite good. Indonesian Government Regulation Number 82 of 2001 stated that the standard for second-class water quality is 6-9 and >4 mg/L, respectively (Nugroho et al., 2014).

| Table 1. Water Quality Assay in Selorejo and Wonorejo Reservoirs |
|---------------------------------------------------------------|
| **No.** | Parameters                | **Inlet** | **Middle** | **Outlet** |
|--------|---------------------------|-----------|------------|------------|
| 1.     | Temperature (°C)          | 27.6      | 27.8       | 28.4       |
| 2.     | pH                        | 7         | 8          | 7          |
| 3.     | Dissolved Oxygen (DO)     | 8.4       | 7.7        | 8.4        |
| 4.     | Brightness (cm)           | 23.7      | 34.1       | 38.8       |
|        | **Selorejo Reservoir**    |           |            |            |
|        | **Wonorejo Reservoir**    | **Tourist Area** | **Fishing Ground** |
| 1.     | Temperature (°C)          | 26.7      | 26.6       |
| 2.     | pH                        | 7         | 7          |
| 3.     | Dissolved Oxygen (DO)     | 7.5       | 7.7        |
| 4.     | Brightness (cm)           | 134.17    | 131        |

Data were described by average from triplicate

**Weight Estimation of Nila Tilapia**

The weight estimation in both reservoirs showed different results. The weight estimation interval followed basic statistics and was modified from (Stavrescu-Bedivan et al., 2016). The Nila Tilapia in the Wonorejo Reservoir were caught with hook size 3-4 was lighter than Nila Tilapia were caught in Selorejo Reservoir with hook size 7-8. The average weight of Nila Tilapia in the Wonorejo reservoir was 74.6 ± 38.6 gram, while in the Selorejo reservoir was 114 ± 35.6 gram. This means that Nila Tilapia growth was found in the Selorejo Reservoir was faster than the Nila Tilapia in the Wonorejo Reservoir. This happened because the availability of natural food in the Selorejo Reservoir much more than in the Wonorejo Reservoir which can be seen from the water brightness parameter assay (Table 1.). Selorejo reservoir as eutrophic waters is characterized by abundant of algal growth as a sign of nutrient enrichment on the surface waters. Meanwhile, the Wonorejo reservoir as oligotrophic is a group of the poor nutrient with low productivity of natural foods in the waters (Karydis, 2009). The form of Nila Tilapia weight data in Wonorejo Reservoir showed on (Figure 2a and 2b) with a ratio of 53 male fish and 26 female fish, and (Figure 3a and 3b) showed that on the Selorejo Reservoir, the total of male fish was caught were 22 and female fish were 13 fish.
Figure 2a. Weight estimation of male Nila Tilapia which captured at Wonorejo reservoir; b. Weight estimation of female Nila Tilapia which captured at Wonorejo Reservoir

Figure 3a. Weight estimation of male Nila Tilapia which captured at Selorejo reservoir; b. Weight estimation of female Nila Tilapia which captured at Selorejo reservoir

Length Estimation of Nila Tilapia

In line with the fish’s weight, the length of Nila Tilapia caught in the two reservoirs also showed different results (Figure 4a and 4b; 5a and 5b). The interval of length estimation followed basic statistics and was modified (Stavrescu-Bedivan et al., 2016). The length of Nila Tilapia caught in the Selorejo reservoir was longer than Nila Tilapia in the Wonorejo Reservoir. However, anglers used the hook size in the Wonorejo Reservoir was smaller than was used in the Selorejo Reservoir. This phenomenon is caused by the availability of natural food in the Selorejo Reservoir more than in the Wonorejo Reservoir. Besides, natural food functions were to gain the bodyweight of Nila Tilapia. It was also useful for its growth process. So that Nila Tilapia was longer due to great growth condition. Craig & Helfrich (2002), explained that fish feed affected the energy levels for weight gain and their energy requirements for growth.
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Figure 4a. Length estimation of male Nila Tilapia which captured at Wonorejo Reservoir; b. Length estimation of female Nila Tilapia which captured at Wonorejo Reservoir

Figure 5a. Length estimation of male Nila Tilapia which captured at Selorejo reservoir; b. Length estimation of female Nila Tilapia which captured at Selorejo reservoir

Condition Factor of Nila Tilapia

Analysis of Nila Tilapia's condition factors was intended to determine the biological condition of Nila Tilapia which were caught by anglers with fishing line. Stavrescu-bedivan et al. (2017), explained that the condition factor is used to provide information on the state of well-being of individuals in their habitat. The condition factor in both reservoirs showed the same results was 1.01 with flat and thin categories. This condition could explain that although there were differences in length and weight size of Nila Tilapia were caught in the two reservoirs, the characteristics of Nila Tilapia were reasonably similar. The length and weight of Nila Tilapia in both reservoirs have no affected on its condition factor.
Conclusion

The different trophic levels of water in the Selorejo and Wonorejo Reservoir affect the biological status of Nila Tilapia captured. The Selorejo Reservoir (eutrophic) caught the bigger and heavier Nila Tilapia than the Nila Tilapia in the Wonorejo Reservoir (oligotrophic), indicating that Nila Tilapia obtain food easily in the eutrophic waters than oligotrophic waters.

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