ABUNDANCE AND COMPOSITION OF PHYOTOPLANKTON IN JATIGEDE RESERVOIR

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ABSTRACT

The study was conducted in the Jatigede Reservoir from August to October 2019 the purpose of this study was to determine the abundance and composition of phytoplankton in the Jatigede Reservoir. The method used is a survey method with primary and secondary data collection. Sampling was carried out 5 times with a span of 7 days at 4 stations which were divided based on water input. The results showed that the abundance of phytoplankton ranged from 6978 ind/L – 150697 ind/L with a composition consisting of 49 genera, 22 orders, 11 classes and 5 phyla. Physical and chemical parameters of the waters obtained temperature ranged from 26.58-27.48oC, 168 – 0.238 mg/L, brightness 0.28 – 0.93 meters, pH 7.96 – 8.30, nitrate 0.168 – 0.238 mg/L , phosphate 0.148 – 1.61 mg/L.

Keyword : *Abundance, Phytoplankton, Jatigede reservoirs*

1. INTRODUCTION

Reservoirs are waters formed or modified by human activities for specific purposes, to provide reliable and controlled resources (Thompton et al. 1992). The Jatigede Reservoir is located in the Sumedang Regency area which includes Jatigede District, Jatinunggal District, Wado District, Darmaraja District, and Cisitu District with the main water input coming from the Cimanuk River. The input of water from the Cimanuk River to the Jatigede Reservoir can affect the quality of the waters.

The increase in population settlements, industrial activities, and agricultural activities around the watershed can affect the conditions in these waters (Subarma et al. 2014). Changes in water conditions can occur due to the dynamics of the ecosystem which is influenced by several ecological aspects of the waters. According to Pratiwi et al. (2015), ecological aspects include morphology, physico-chemical parameters of waters, community structure of biota, and trophic status. Based on these several aspects, one aspect that affects this ecosystem is the structure of a biota or organism that lives in an ecosystem waters. One of the biota community structures that affect the dynamics of the ecosystem in the waters is plankton as a biological parameter of a waters. Rudiyanti (2009) states that as a biological parameter, plankton, especially phytoplankton, which have an important role in the food chain in aquatic ecosystems, are often used as indicators of stability, fertility and water quality.

Phytoplankton has an important function in the waters because it is autotrophic (produces its own organic food), can absorb solar energy into oxygen and become a source of energy for aquatic biota that flows through the food chain so that phytoplankton are often referred to as primary producers (Nontji 2008). The existence of phytoplankton that can be seen through the composition, abundance, distribution, and community in a waters. The distribution or distribution of phytoplankton can be seen temporally and spatially.

The increasing content of organic matter N and P in the waters of the Jatigede Reservoir originating from community activities around the reservoir causes an increase in the phytoplankton population which can exceed normal limits. The purpose of this study was to determine the abundance and composition of phytoplankton in the waters of the Jatigede Reservoir.

2. MATERIALS AND METHOD

The research was carried out in Jatigede Reservoir, Sumedang Regency, West Java. The method used is a survey method with four locations and five sampling times, carried out from July to September 2019. The determination of observation data collection stations is based on considerations of water input, anthropogenic activities and BOD5 values so as to describe the different characteristics of each station.

The study was conducted in August – October 2019. Sampling was carried out in Jatigede Reservoir in a time series every seven days with five replications for each station. Sampling was carried out at four stations at three different depths including surface layer, half depth compensation and compensation depth. Sampling of plankton was carried out using a plankton net with a mesh size of 20 m. The filtered plankton sample was then put into a sample bottle and given a 1% Lugol solution. Furthermore, analysis and identification was carried out at the Laboratory of Water Resources, Faculty of Fisheries and Marine Sciences, Padjadjaran University using a binocular microscope.

3. RESULTS

Abundance of Phytoplankton in Jatigede Reservoir

The graph of the average abundance of phytoplankton in the waters of the Jatigede Reservoir during the study is shown in Figure 1.

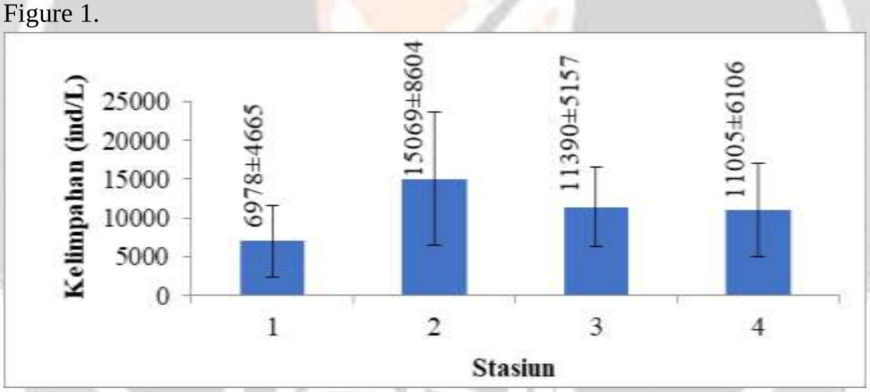

Figure 1. Average Phytoplankton Abundance in Jatigede Reservoir

The graph of the average abundance of phytoplankton based on depth is shown in Figure 2. Based on the graph, stations 1, 2, and 3 show that the greater the depth of the waters, the lower the abundance of phytoplankton. Meanwhile, station 4 has the highest abundance of phytoplankton at a depth of 0.5 compensation of 8462 ind/L and the lowest abundance on the surface of 11372 ind/L.

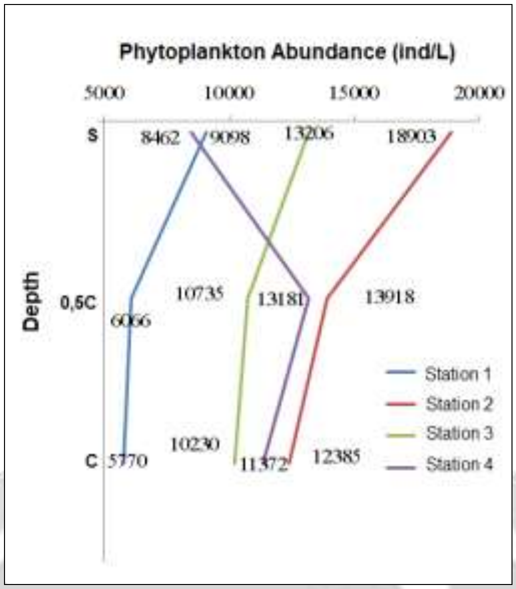

Figure 2. Average abundance of Phytoplankton in Jatigede Reservoir by depth

Alpine and Cloern (1988) stated that brightness is the main factor controlling the growth of phytoplankton. The low abundance of phytoplankton at station 1 was caused by the low intensity of light entering the water column. This is also influenced by the condition of the waters of station 1 which is more murky than other stations, so that the condition of the waters at this station has not been able to support the life of phytoplankton optimally.

The high abundance of phytoplankton at station 4 at a depth of 0.5 is compensated because the water conditions at this point are optimal for the survival of phytoplankton. This condition occurs because the intensity of the incoming light has increased. The temperature also increases at the surface of the waters along with the increasing intensity of light entering the waters. The increasing light intensity and temperature on the surface of the waters makes the phytoplankton unable to carry out the photosynthesis process optimally. The high intensity of light absorbed by the chlorophyll pigment will damage the chlorophyll itself and make the process of photosynthesis inhibited (photoinhibition) (Pulz 2001). Thus, it can be said that the 0.5 compensation depth at station 4 has sufficient temperature and light intensity for the growth of phytoplankton.

This varied abundance of phytoplankton is influenced by several factors. Factors supporting the growth of phytoplankton are very complex and interact with physical and chemical factors in the waters, namely dissolved oxygen, temperature, brightness and the availability of nitrogen and phosphorus nutrients (Goldman and Horne 1983 in Veronica 2012). The abundance of phytoplankton that increased at station 4 at a depth of 0.5 compensated was also indicated by increased pH and DO and decreased phosphate concentration at this depth. Makarewicz et al. (1998) also stated that changes in the relative abundance of phytoplankton according to size and species composition were more influenced by environmental factors such as NO3 and PO4.

Phytoplankton Composition in Jatigede Reservoir

The composition of the abundance of phytoplankton in the waters of the Jatigede Reservoir shows that phytoplankton from the phylum Chrysophyta is the most abundant phytoplankton found with a percentage of 60% of the total phytoplankton identified (Figure 3). The identified phylum Chrysophyta consists of two classes, namely, Mediophyceae and Bacilariophyceae. Meanwhile, phytoplankton from the phylum Cyanophyta is the least identified phytoplankton with a percentage of only 7% of the total identified phytoplankton. Phytoplankton of the phylum Cyanophyta consists of the classes Cyanophycea and Hormogonea. This is different from the research by Annisa et al (2019) in the same waters, that phytoplankton from the phylum Pyrrophyta is the phytoplankton with the highest abundance. This difference is caused by fluctuations in water conditions that affect the physical and chemical factors of the waters as a living medium for phytoplankton.

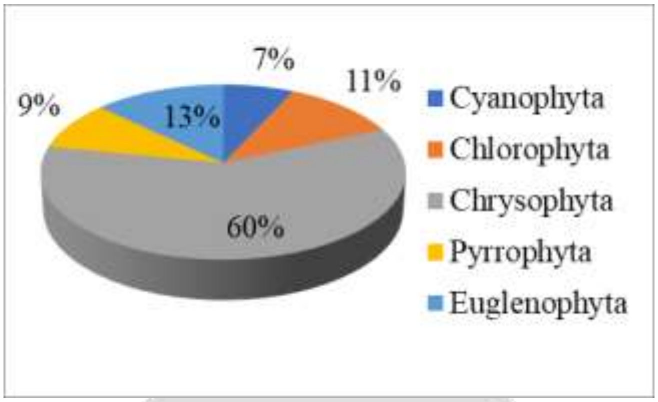

Figure 3. Composition of Phytoplankton Abundance in Jatigede Reservoir Waters by Phylum

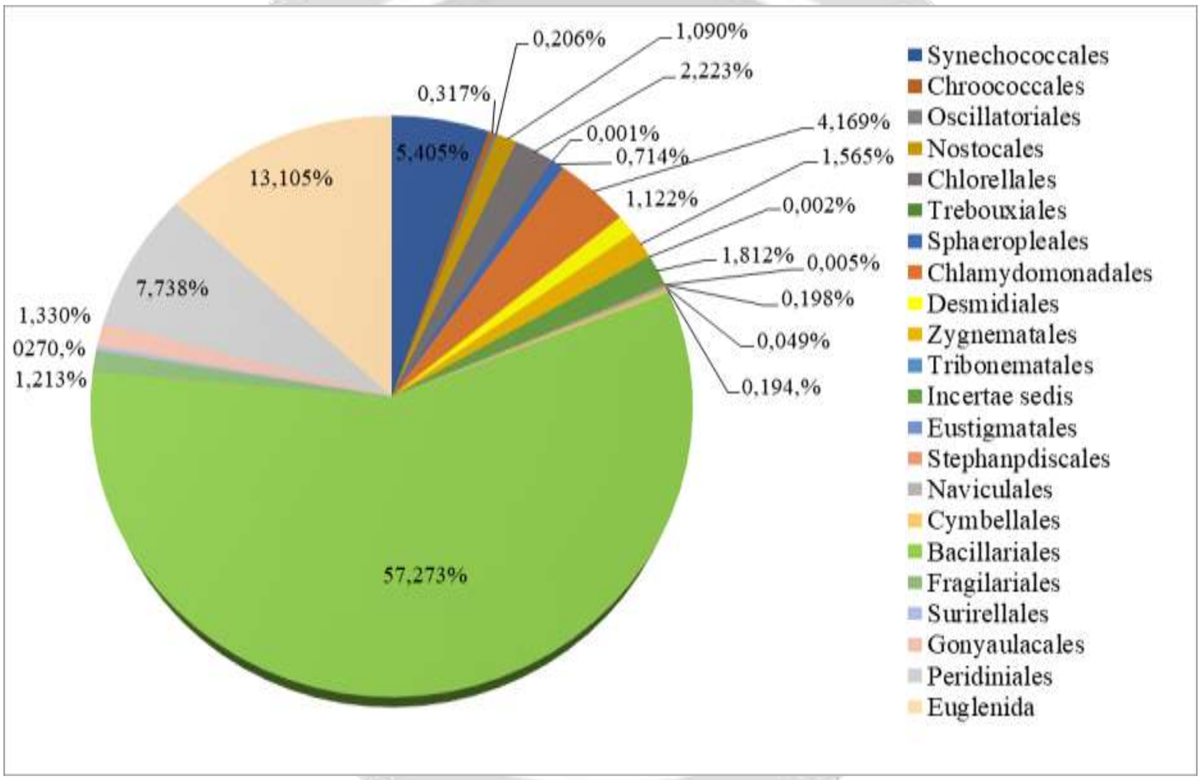

Figure 4. Phytoplankton Composition in Jatigede Reservoir Waters Based on Order

Based on the order, 22 phytoplankton orders have been identified as shown in Figure 4. The Bacillariales order is the most identified phytoplankton order with a significant percentage of 57.273% of the total identified phytoplankton (Figure 5). One genus from this order was found which at the same time has the highest abundance compared to other phytoplankton, namely the genus Nitzschia. Meanwhile, the phytoplankton with the least order was found from the order Tribonematales which only identified the genus Tribonema. In addition, there is one genus with an unidentified order from the genus Crucigenia and from the Treubouxiophyceae class, so it is called Trebouxiophyceae ordo incertae sedis (Guiry et. al. 2020).

Physical and Chemical Parameters

The average temperature obtained during the study showed that the water temperature of the Jatigede Reservoir was still within the normal range for phytoplankton life in the waters with a range of 26.58-27.48oC. Raymont (1980) stated that the optimum temperature for phytoplankton growth in tropical waters ranges from 25˚C–32˚C. Station 1 has the highest average surface temperature of 27.48±0.54˚C, while the lowest average surface temperature is at station 3 of 26.72±1.06˚C. The temperature distribution in this water column is influenced by other factors besides light intensity. According to Brehm and Melfring (1990), the temperature pattern of aquatic ecosystems is influenced by various factors including the intensity of sunlight, heat exchange between water and the surrounding air, and geographic altitude.

The value of transparency obtained during the study shows that the transparency of the waters of the Jatigede Reservoir varies. The lowest average transparency was obtained at station 1 with a value of 0.28±0.08 m. This is because station 1 is a reservoir inlet that has direct water input from the Cimanuk River and is still in the riverine zone, so the water observed at station 1 looks cloudier than other stations. The cloudy water at station 1 causes a lack of light penetration into the water column. The highest transparency value was obtained at station 4, namely, 0.93±0.18 m. The high value of transparency at station 4 is because station 4 is the outlet of the Jatigede Reservoir and has entered the lacustrine zone which has clearer water conditions because mud and sediment particles have settled at the bottom of the water. The value of transparency is also influenced by several factors. According to Indaryanto and Saifullah (2015) the value of transparency is strongly influenced by weather conditions, measurement time, turbidity, and suspended solids. According to Boyd (1990), the optimal light transparency for plankton life is in the range of 30-50 cm or 0.3-0.5 m.

The average range of pH obtained at the time of the study was 7.96 – 8.30, the average pH observed during the study at each station and depth was still within the appropriate range. The suitable pH range for the life of aquatic organisms is 6.5-9 (Boyd 1990). Overall, the acidity value measured during the study tends to decrease at the compensation depth. According to Barus (2004), the high or low pH value of water depends on several factors, including the condition of gases in the water such as CO2, as well as the decomposition process of organic matter.

The average Dissolved Oxygen (DO) concentration in the waters of the Jatigede Reservoir during the study ranged from 6.1 mg/L to 7.1 mg/L. dissolved oxygen concentration at station 2 and station 3 tends to decrease with increasing depth. The vertical distribution of dissolved oxygen at these two stations is classified as a clinograde type. Dissolved oxygen in this type decreases with increasing depth, and this decrease is caused by the decomposition process of organic matter by microorganisms (Goldman and Horne 1983). In contrast to station 2 and station 3, station 1 and station 4 have dissolved oxygen concentrations that tend to increase with increasing depth. This increase in dissolved oxygen is assumed because oxygen is not utilized properly by aquatic organisms at that depth, nor has it been used properly by decomposer organisms. The vertical distribution of dissolved oxygen at station 1 and station 4 is classified as an orthograde type. Based on Goldman and Horne (1983), the orthograde type is the type that occurs in unproductive (oligotrophic) lakes or lakes that are poor in nutrients and organic matter.

Overall, the nitrate concentration in the waters of the Jatigede Reservoir has met the requirements of class II water quality standards of no more than 10 mg/L and class III of no more than 20 mg/L. However, the observed nitrate concentration has not been included in the optimal category for phytoplankton life. According to Mackentum (1969) in Yuliana (2008), for optimal growth of phytoplankton requires nitrate concentrations in the range of 0.9 - 3.5 mg/L. Furthermore, the overall ammonia concentration in the waters of the Jatigede Reservoir is still relatively good.

The phosphate concentration obtained during the research ranged from 0.148 to 1.61 mg/L, at station 1 during the study was the station with the highest phosphate concentration, besides that the concentration of phosphate at station 1 increased with increasing depth. The high concentration of phosphate at station 1 is due to station 1 being the reservoir inlet which is the direct water input from the Cimanuk River. According to Patty et al (2015), the main source of phosphate and nitrate nutrients comes from the waters themselves, namely through weathering decomposition processes or the decomposition of plants and the remains of dead organisms. In addition, it also depends on the surrounding conditions including donations from the mainland through river flows which consist of various industrial wastes containing organic compounds. Based on PP No. 82 of 2001, the concentration of phosphate in the waters of the Jatigede Reservoir is still in a good range, which is still in the class II category with a maximum threshold of 0.2 mg/L and class III with a maximum threshold of 1 mg/L.

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4. CONCLUSIONS

Based on the results of the study, it was found that the abundance of phytoplankton ranged from 6978 – 150697 ind/L and the composition of phytoplankton obtained at the time of the study found 49 genera consisting of 22 orders, 11 classes and 5 phyla. Bacillariophyceae class is the most identified phytoplankton with a percentage of 59.65%. The order Bacillariales of the Bacillariophyceae class is the most identified phytoplankton order, with 57.273% of the total identified phytoplankton orders.

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