The Dynamic of Density and Diversity of Cyanophyta in Different Pond Bases in Educational Pond of Faculty of Fisheries and Marine Universitas Airlangga

by Endang Dm

The Dynamic of Density and Diversity of Cyanophyta in Different Pond Bases in Educational Pond of Faculty of Fisheries and Marine Universitas Airlangga

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Abstract. This study was conducted in tarpaulin and soil base educational pond in the Faculty of Fisheries and Marine Universitas Airlangga. This study is aimed to know the dynamics of density and variety of Cyanophyta in ponds of different bases at educational ponds of Faculty of Fisheries and Marine Universitas Airlangga. The research employed survey method, which is intended to describe the existing phenomena, regardless the period of occurrence. The results were presented in descriptive form. The result of observed density of Cyanophyta at 14.00 in the tarpaulin pond ranged between 868,000 and 1,569,000 ind / l., while the one in the soil pond ranged from 331,000 to 372,000 ind / l. The result of observed dynamics in the tarpaulin pond included the species of Ghomphosphaeria, *Anabaena circularis, Anabaena raciborskii, Anabaena sphaerica, Microcystis sp*., and *Spirulina sp*. On the other hand, in the soil pond were *Anabaena circularis, Anabaena raciborskii, Microcystis sp*., and *Spirulina sp*. *Spirulina* sp was the dominant species in the tarpaulin and soil ponds.
Keywords. Density, diversity, cyanophyta, pond.

1. Introduction

Fish cultivation is an activity to maintain, raise and breed fish and harvest the results in a controlled environment (Law No. 31/2004). Common activities include fish farming, shrimp farming, oyster cultivation and seaweed cultivation (algae). In Indonesia, aquaculture is carried out through various means. The most common cultivation activities are carried out in ponds, ponds, tanks, cages, and floating cages. According to Biggs et al. (2005) in Hani'ah et al (2016) ponds are permanent or seasonal water bodies measuring 1 m to 2 ha, which are naturally or man-made. One of the functions of ponds for aquatic ecosystems is the enrichment of types of aquatic biota. The increase in the type of biota comes from the introduction of cultivated biota.

Optimal utilization of resources in water requires a good management of the aquatic environment, including the function of ecosystems in the water. The interaction between constituent components of the ecosystem will affect the presence of aquatic nutrients. Plankton is the main component of food chain for aquatic biota so that the presence of nutrients and plankton is one indicator of aquatic fertility. Therefore, the abundance of plankton in water plays an important role (Simanjuntak, 2009).

Phytoplankton has chlorophyll, which plays a role in photosynthesis to produce organic substance and oxygen in water, which is used as a chain link in the food cycle in water. However, certain phytoplankton functions to reduce the quality of marine water if the amount is excessive (blooming) (Anderson ea al., 2008). The high population of toxic phytoplankton in water can cause various negative consequences for aquatic ecosystems, such as reduced oxygen in water which can cause the death of various other aquatic creatures.

Cyanophyta commonly called Cyanobacteria or blue green algae is a group of prokaryotic algae. This organism has a role as the producer of nitrogen compounds in water. Some Cyanobacteria are also known to produce toxins (poisons). Microcystis aeruginosa, Cylindrospermopsis raciborskii, and Planktothrix agardhii are species that have led to Cyanobacteria blooms in Indonesia (Mowe et al., 2014).

2. Materials and Method

2.1 Location and time of research

This research was carried out in the educational pond of the Faculty of Fisheries and Marine Universitas Airlangga, Surabaya. The study was conducted in April 2017. The calculation of plankton was carried out in the Wet Laboratory, Faculty of Fisheries and Marine Universitas Airlangga, and the nitrogen and phosphorus test at the Surabaya Health Laboratory Center.

2.2 Materials and equipment

The tools used in this study are DO meter, thermometer, Sedwigck rafter, microscope, handtally counter, bucket, pH meter, plankton net, volumetric pipette, sample bottle, secchi disk, and sample bottle.
The materials used in this study include water samples from the educational pond of Faculty of Fisheries and Marine Universitas Airlangga Surabaya.

2.3 Method

2.3.1 Measurements of water quality

The measurement of water quality carried out consists of the main parameters and supporting parameters. The main parameters were Cyanophyta density, Cyanophyta diversity, diversity index, and dominance index. The N / P ratio was measured once every four days, nitrogen (N) and phosphorus (P) using the spectrophotometric method. DO parameters were measured with DO meters, pH parameters with pH pen, and salinity with a refractometer.

2.3.2 Plankton sampling abundance

Plankton sampling was done using plankton net with a mesh size of 20 microns. This was so because the size of phytoplankton is 20,200 microns. The use of plankton net with mesh size can filter phytoplankton types such as diatoms, dinoflagellates and other types of net plankton, and zooplankton can also be filtered with the plankton net. In addition, with the mesh size, the water can still pass through the plankton net hole (Nontji, 2008).

Sampling of plankton in shallow water with ± 1 m depth could be done using a container (bucket) with known volume. The volume of plankton water samples taken was adjusted to water conditions such as very fertile water ± 5 liters, medium water ± 30 liters and poor water ± 100 liters (Asriyana and Yuliana, 2012). In this study, the filtered water samples were approximately 50 liters.

The water samples obtained were filtered with standard plankton net, and the sample volume was 100 ml. Samples were labeled containing the information of dates and retrieval positions. Plankton samples obtained were immediately observed using a binocular microscope magnification of 100-1000x.

2.3.3 Plankton density

Calculation of density was conducted by using rafter sedwigck and handtally counter to facilitate calculations. Taking phytoplankton density data was carried out every day for a period of four days.

The population count was done using a microscope with 10x magnification. Plankton abundance was calculated based on the formula (Fachrul, 2017) as follows:

$$N = n \times \frac{Vr}{Vo} \times \frac{1}{}$$

Index:

N Abundance (ind/ml)
n Observed cells (ind)
Vr Filtered water volume (ml)
Vo Observed water volume (ml)
Vs Filtered water volume (ml)

2.4 Diversity index

To analyze the diversity of phytoplankton, the Shannon-Weaver diversity index was used. The Shannon-Weaver diversity index is a mathematical calculation that describes the analysis of the number of individuals in each species, the number of species and the total number of individuals in a community. Diversity is heterogeneity found in genera of individuals taken randomly from a population. The more types there are, the greater the heterogeneity. The magnitude of the diversity index (H ') is formulated as follows (Wilhm and Dorris 1968 referenced in Mason, 1980):

$$\mathbf{H' = -\sum_{i=1}^{n} pi \log pi}$$

Index:

H' = Diversity index of Shannon-Weaver

Pi = ni/N

Ni = total number of individual type i

N = total number of individual with H' value with the following criteria:

H' < 2,3062 : low diversity and low community stability 2,3062 < H' > 6,9078 : low diversity and medium community stability H' > 6,9078 : low diversity and high community stability

2.5 Dominance index

Dominance index was calculated based on Legendre and Legendre (1983), which was applied to analyze phytoplankton communities in waters, namely by using the following calculations:

$$\mathbf{C = E\,[ni / N]^2}$$

Index: C = Simpson domination index
ni = total number of individual type i
N = total number of individual

Dominance index (C) ranges from 0 - 1 with the following criteria:

If the value of C approaches 0.0, then no species dominates the other species in the phytoplankton community that are observed to be extreme. This shows that the community structure is stable. However, if the value of C approaches the value of 1.0, then there are species that dominate other species in the phytoplankton community structure. This shows that the phytoplankton community structure is unstable (Odum, 1971).

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2.6 Identification of plankton

Identification of plankton was conducted using direct observation method. Water sample originating from tarpaulin and soil ponds of the educational pond of the Faculty of Fisheries and Marine, Universitas Airlangga was directly observed with a microscope. The types of plankton were observed with a magnification of 10x40. Then, the images obtained were identified using the identification books of Biggs and Kilroy, New Zealand Streams and Rivers (2001) Identification Guide to Common Peryphyton, Phytoplankton Identification Catalog (2001) by comparing morphological characteristics between the results of research and reference book identification with literature as reference (Junda et al., 2011).

2.7 Parameter of research

The main parameters in this study were Cyanophyta density and diversity, diversity index and dominance index. Supporting parameters carried out were water quality consisting of temperature, pH, dissolved oxygen, N, P and N/P ratio. Supporting parameters were used to complete the main parameter data.

3. Result and discussion

3.1 Density of Cyanophyta

The total density of Cyanophyta in tarpaulin ponds at points 1, 2, 3, 4 and 5 respectively is 1.569,000 ind / l, 1,395,000 ind / l, 868,000 ind / l, 1,270,000, ind / l, and 1,050 .000 ind / l. Whereas the total density of Cyanophyta in soil ponds at points 1, 2, 3, 4 and 5 respectively is 372,000 ind / l, 331,000 ind / l, 342,000 ind / l, 350,000 ind / l, and 369,000 ind / l. The highest density in tarpaulin ponds and soil ponds is found in point 1. Cyanophyta species dominate in tarpaulin ponds and soil ponds, namely Spirulina sp. The dynamic of the total density of Cyanophyta in tarpaulin ponds is presented in Figure 1 and the soil ponds in Figure 2.

Tarpaulin ponds

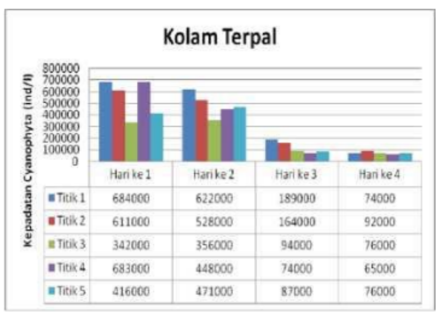

Figure 1. Overall total of Cyanophyta (ind/l) in tarpaulin ponds (Time 14.00 WIB).

Soil ponds

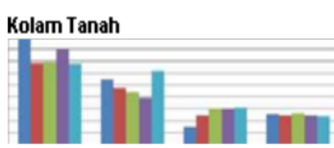

Figure 2. Overall Density of Cyanophyta (ind/l) in soil ponds (Time 14.00 WIB).

The highest total density of Cyanophyta was found in tarpaulin ponds of 6,152,000 ind / l and the lowest in soil ponds of 1,764,000 ind / l. The high density was due to Cyanophyta being able to grow optimally during that period. Moreover, in the tarpaulin ponds were fish that were cultivated, whereas in the ponds, there were no cultivated fish.

Density in tarpaulin ponds was higher than that of ground ponds because there was no fish farming in the soil pond. This is in accordance with the opinion of Boyd in Amin (2010) that the remaining food, fish feces and other organic materials are decomposed by microorganisms into inorganic nutrients such as phosphate, ammonia and carbon dioxide. Cyanophyta density in Figure 5 and Figure 6 is in line with phosphorus levels in tarpaulin ponds and soil ponds. Phosphorus levels in tarpaulin ponds ranged from 0.01-0.04 while in soil ponds phosphorus levels were 0.00. For phosphorus levels in tarpaulin ponds, these levels are fairly low and not optimal in cultivation activities. This is in accordance with Government Regulation (PP No. 82 of 2001), which states that the threshold for good phosphorus in water that can be used in cultivation is 0.2-1 mg / l.

3.2 Diversity of Cyanophyta

Diversity index (H ') is a systematic statement that describes community structure and can facilitate in analyzing information about the number of organisms in a community (Revelente and Gilmartin, 1980).

Diversity index in tarpaulin ponds ranged from 0.12-0.66, while in soil ponds the range was between 0.26 and 0.48. In the tarpaulin pond there were Gomphosphaeria species, Anabaena circularis, Anabaena raciborskii, Anabaena sphaerica, Microcystis sp., and Spirulina sp., while in the soil ponds there were species of Anabaena circularis, Anabaena raciborskii, Microcystis sp., and Spirulina sp. In the tarpaulin and soil ponds, the dominant species was Spirulina sp.

Based on the Shannon-Weaver Diversity Index, diversity and stability in tarpaulin and soil ponds (<2.3062) were included in the low category with a low number of species and even distribution of the number of individuals per species was low. Low diversity and stability were the result of the absence of treatments such as fertilization to grow natural feed in the pond. According to Turner et al., (2009), fertilization can fertilize the water by improving water quality and increasing the supply of natural feed in the form of plankton.

3.3 Quality of supporting water

Parameters of temperature, pH, DO, nitrogen and phosphorus are supporting parameters, which were also used to measure water quality in tarpaulin and soil ponds. The temperature in tarpaulin ponds ranged from 33.1 to 38.9 ° C, while in soil ponds it ranged from 30.5 to 35.8 ° C. The water temperature in both ponds was a good temperature range for Cyanophyta's optimal growth. Temperature is directly influential in controlling the rate of various metabolic processes in microalgae cells. The rate of metabolic processes will increase as temperature increases. The optimum rate of metabolic processes can be achieved at a temperature range of 25-40 ° C (Reynolds in Prihantini, 2008).

According to Rukminasari et al (2014), fluctuating temperature level can be influenced by several factors such as the intensity of sunlight, rain and heat exchange between water and nutrients. According to Reksnono (2012), temperature has an important role in determining the growth of cultivated fish, a good temperature range to support cultivation is 26-31.6 ° C.

The pH of the tarpaulin ponds ranged from 7.4-7.83, while in the soil pond, it ranged from 8.01 to 8.65. The pH data are in accordance with the water pH needed for optimum growth of Cyanophyta. Cyanophyta generally lives in neutral water or tend to be alkaline. According to Brock in Prihantini (2008), the Cyanophyta group is generally not found in water with pH less than 4. Based on Government Regulations (PP No. 82 of 2001) water quality standard, pH is good for freshwater fish farming activities, ranging from 6-9.

Based on the range of pH values above, it can also be categorized as an optimal water for phytoplankton life. According to Muhidin (2011), water with a pH between 6-9 is water with high fertility, which in these conditions can encourage the process of dismantling organic matter and become new elements that phytoplankton can use for its growth.

The value of dissolved oxygen (DO) in tarpaulin and soil ponds ranged between 8-9.7 and 8.1-10.8 mg / l. Dissolved oxygen content during the day was high because of the maximum photosynthesis process. At night and in the evening, the dissolved oxygen content dropped because there was no sunlight, while all aquatic organisms carried out the respiration process which consumes oxygen and releases carbon dioxide. The dissolved oxygen values in the tarpaulin and soil ponds were still in the water category, which was quite good for cultivation. Based on Government Regulations (PP. No. 82 of 2001), water quality standards with a range of dissolved oxygen for fish farming activities are> 4 mg / l.

Nitrogen content in tarpaulin and soil ponds ranged from 0.10 to 0.14 mg / l and 0.02-0.04 mg / l. In tarpaulins and soil ponds, this land was not optimal for cultivation activities. This is in line with the Government Regulation (PP. No. 82 of 2001), stating that the threshold for good nitrogen in water that can be used in cultivation is 1-2 mg / l. According to Lestari (2013), the form of nitrogen compounds in water is nitrate. The more the yield of organic matter changes, the higher the value of N.

Phosphorus levels in tarpaulin and soil ponds ranged from 0.01 to 0.04 mg / l and 0.00 mg / l. These levels are considered fairly low and not optimal in aquaculture activities. This converges with the Government Regulation (PP No.82 of 2001), stating that the threshold for good phosphorus in water that can be used in cultivation is 0.2-1 mg / l. Phosphate is a form of phosphorus that can be utilized by plants and is an essential element for high-level plants and algae so that it can affect the level of productivity of the water (Bahri, 2006 in Markatita, 2012).

Phosphorus is one of the important elements that support life in a waters region. Phosphorus has functions such as constituents of proteins, cell nuclei, cell walls, ATP, DNA and RNA. The availability of phosphorus in the ecosystem can be maintained because of the continuous cycle. The presence of phosphorus in the water is also a limiting factor for an ecosystem life (Aryati et al., 2005).

Nitrogen and phosphorus play an important role in the process of eutrophication in a water ecosystem where phytoplankton needs nitrogen and phosphorus as the main source of nutrition for growth (Mas'ud, 2014). Phosphorus is a limiting factor for phytoplankton. Comparison of nitrogen and phosphorus is not the same because nitrogen is needed in large quantities by phytoplankton as a source of protein and phosphorus is needed in small amount for energy sources (Haarcorryti, 2008).

The N/P ratio in tarpaulins and soil ponds ranged from 3.71 to 11.33 and 0. This figure was fairly low and not optimal for aquaculture activities. This is in accordance with the Government Regulation (PP No.82 of 2001) which states that the content threshold of a good N/P ratio in water is more than 20.

The results of the N/P ratio were inversely proportional to the yield of phosphorus. This is in accordance with the opinion of Lagus (2004) who stated that the greater the N/P ratio, the smaller the phosphate level and vice versa the smaller the N/P ratio, the greater the phosphate level. The increase in the N/P ratio was caused by a decrease in the value of phosphorus in the waters. According to Budi (2006), the decrease in phosphorus might be caused by the binding of phosphate ions by calcium ions.

4. Conclusion and recommendation

The conclusion that can be drawn from the research is that the density of Cyanophyta in tarpaulin ponds is higher, at 6,152,000 ind/l compared to the Cyanophyta density in soil ponds of 1,764,000 ind/l. The types of Cyanophyta found during the study were Gomphosphaeria, Anabaena circularis, Anabaena raciborskii, Anabaena sphaerica, Microcystis sp., and Spirulina sp. In the future, further research may be conducted on Cyanophyta density and diversity in tarpaulin and soil ponds.

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