# THE EFFECT OF NUTRIENT ABUNDANCE ON DISTRIBUTION OF CYANOBACTERIA AND CHLOROPHYLL-A IN SEDATI WATER, SIDOARJO

*by* Endang Dm

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# THE EFFECT OF NUTRIENT ABUNDANCE ON DISTRIBUTION OF CYANOBACTERIA AND CHLOROPHYLL-A IN SEDATI WATER, SIDOARJO

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## ABSTRACT

**Cyanobacteria are algae that are dominated by Harmful Algal Blooms group (HABs). The phenomenon of farmed fish mortality due to HABs has occurred in several Asian countries, such as Korea, Japan, and the Philippines in 2004. HABs phenomenon occurs due to the emergence of excessive nutrient pollution in the waters. One of the waters around Surabaya is Sedati waters where the waters of the estuary of the 10 rivers that in the waters around them. The results showed an average BOD value results in March (22.86 mg. $L^{-1}$) and April (23.86 mg. $L^{-1}$). Density of plankton March was 84.533 cells $mL^{-1}$ and in April 10,086,667 cells. $mL^{-1}$. A chlorophyll concentration level in March (0.05 mg. $L^{-1}$) and April (0.07). These results are expected because organic and inorganic materials that exist in waters Sedati is a nutrient for plankton growth.**

**KEY WORDS:** East Beach of Surabaya, Plankton, Estuary, Pigment

## INTRODUCTION

Cyanobacteria algae phytoplankton is included in the group Cyanobacteria Harmful Algal Blooms (HABs). Harmful cyanobacteria have a negative significant impact on socio-economic and ecological conditions of fisheries, agriculture, tourism, water quality and habitat (Gilbert, 2013; Carmichael and Boyer, 2016). Phytoplankton cyanobacteria produce toxins (cyanotoxins) that can cause acute or chronic conditions on the health of mammals (including humans) and other organisms Eigemann *et al.* (2018) and Lipi (2018) states that the poison possessed harmful algal species of marine animals to accumulate through the food chain. Toxic algae that are harmful to one is Paralytic shellfish poisoning. Paralytic shellfish toxins have toxic called anatoxin-a. The toxic is predominantly owned by the cyanobacterium *Microcystis* genus are known to produce microcystin. Another genus that has toxic cyanobacteria *Anabaena* (Fischer *et al.*, 2005).

Awareness of the impact of cyanobacteria phytoplankton increased so that research activities aimed to monitor the distribution and density of phytoplankton especially cyanobacteria produce toxins potentially harmful to the health of organisms and degrade water quality. The distribution and density of plankton in the waters are affected by

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several environmental parameters and physiological characteristics. Distribution and density of plankton change the dynamic on many levels as a response to changes in environmental conditions of physical, chemical, and biological (Suthers and Rissik, 2008).

This research was carried out in Sedati waters which have changes in environmental conditions of physics, chemistry, and biology because it is the estuary of the Dadapan river. Approximately 10 rivers flow into sedati waters, resulting in various physical-chemical, geological and biological processes that are controlled by the tidal power and run-off of fresh water from these rivers (Sari *et al.*, 2018). As a result of the process, sedati waters which are estuarine regions have a lot of organic material intake. This intake is a nutrient that is beneficial for plankton growth. Biology in sedati waters has a community structure, one of which is sea cucumber (Winarni *et al.*, 2014). The community structure has a distribution index ranging from high to low, none of which is very high.

## MATERIALS AND METHODS

### Tools and materials

The research material used was plankton while the research materials used were 4% formalin (Brataco), distilled water (Brataco), alcohol (Brataco) and lugol (Brataco).

The tool used in the research were sample bottles, bottle insulation, plastic clips, gel ice and Styrofoam which were tools for sampling equipment. The electronic devices used during sampling were GPS, refractometer, pH meter, and AZ 8402 Dissolved Oxygen Meter. Tools at the laboratory were: measuring cup, Erlenmeyer, dropper pipette, volume pipette, microscope, tissue, hand glove, mask, homogenizer, hand tally counter, 25X American autoclave, hemocytometer, Sedgwick-Rafter cell, Spectrophotometer, Hettich EBA-20 centrifuge, hot plate stirrer, Ohaus PA 2102 digital scales, OHAUS digital scales and Analytical Balance PA41.

### Method

The survey method used in this research was the method of field observations conducted in the Sedati waters, the results were analyzed in the laboratory.

#### A. Determination stations (locations)

Before performing the sampling, in specified areas or sampling site. Samples of plankton and water were done in five (five) stations and 3 points in the waters around Sedati. Sampling was conducted every month during the months of March and April to see the changes in fertility waters when rainfall is high, medium and low. Rainfall data based on information from the website of the Meteorology, Climatology, and Geophysics. The identification and measurement of chlorophyll a plankton sample that was obtained were conducted in the Laboratory of the Faculty of Fisheries and Marine Dry Airlangga University Surabaya, and water quality samples were measured at the Faculty of Public Health Airlangga University.

#### B. Sampling

Plankton and water sampling is done at each sampling site. Sampling of microalgae (phytoplankton) using a plankton net with a diameter of 10 µm. Zooplankton sampling using a plankton net with a diameter of 80 µm.

#### C. Identification and Counting Plankton Density

Plankton identification based on morphology was observed with a microscope. Identification of phytoplankton based guide the identification of plankton used Methods for the study of marine

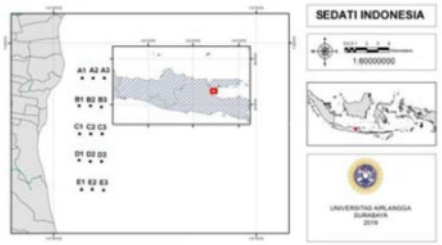


**Fig. 1.** Sampling sites in Sedati waters, Sidoarjo.

| | | |
|---|---|---|
| A1 | : | Latitude -7.361540° Longitude 112.856740° |
| A2 | : | Latitude -7.361830° Longitude 112.865816° |
| A3 | : | Latitude -7.362030° Longitude 112.874892° |
| B1 | : | Latitude -7.384980° Longitude 112.854337° |
| B2 | : | Latitude -7.385400° Longitude 112.863506° |
| B3 | : | Latitude -7.385650° Longitude 112.872581° |
| C1 | : | Latitude -7.407540° Longitude 112.854777° |
| C2 | : | Latitude -7.407730° Longitude 112.863733° |
| C3 | : | Latitude -7.408080° Longitude 112.873099° |
| D1 | : | Latitude -7.430150° Longitude 112.854275° |
| D2 | : | Latitude -7.430590° Longitude 112.863373° |
| D3 | : | Latitude -7.430840° Longitude 112.872664° |
| E1 | : | Latitude -7.453680° Longitude 112.856253° |
| E2 | : | Latitude -7.453880° Longitude 112.865259° |
| E3 | : | Latitude -7.454090° Longitude 112.874416° |

benthos (Eleftheriou, 2013), Atlas of Marine Zooplankton 1 Straits of Magellan amphipods, Euphausiids, Mysids, ostracods, and Chaetognaths (Guglielrno and Ianora, 1997), Identifying marine phytoplankton (Thomas, 1997), Plankton: a guide to Reviews their ecology and monitoring for water quality (Suthers and Rissik, 2008), and Algae (Barsanti and Gualtieri, 2014),

**D. Water quality**

Chlorophyll levels were measured its using the method of Vonshak (1997).

In addition to chlorophyll, th observed supporting were the concentration of Biochemical Oxygen Demand (BOD), dissolved oxygen (DO), temperature, pH, brightness, and salinity. Measurement of dissolved oxygen concentration and temperature of the water is done by using AZ 8402 Dissolved Oxygen Meter. The measurement of pH and salinity in a row using a pH meter and a refractometer respectively. Measurement parameters of this investigation were conducted directly in the sampling location. Water quality measured includes temperature, brightness, th, DO and pH. BODs' Measurement was done in the Laboratory of the Research and Standardization Agency (BARISTAND), Surabaya using the Indonesian National Standard (SNI) 06-6989.72: 2009.

## RESULTS

Data findings of Biochemical Oxygen Demand (BOD) Sidoarjo Sedati waters present in Figure 1. Data findings of in total plankton Sidoarjo Sedati waters are presented in Table 1. Data findings of in chlorophyll a in March and April in Sidoarjo Sedati waters are presented in Figure 2. Data findings of water quality parameters in Sidoarjo Sedati waters are presented in Figure 3.

Algae are organisms that normally is in the aquatic ecosystem. They are the producers of the food chain system. In general, large algae microscopic, but some macroscopic algae are mostly harmless. Algae become dangerous when the rate of increase of growth beyond normal limits (blooming). Algae also are dangerous when the presence of toxic algae cannot be controlled. One class of harmful algae is a group of cyanobacteria. Scale cyanobacteria problem in Asia has increased in recent decades due to the increased use of agricultural fertilizers, aquaculture development, and population growth.

The results showed lower levels of BOD

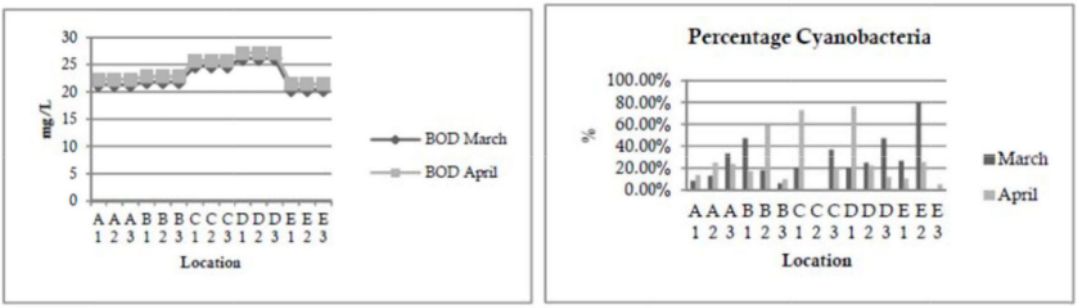


**Fig. 1**. *a*. Graph Biological Oxygen Demand (BOD); *b*. Percentage of cyanobacteria in March and April

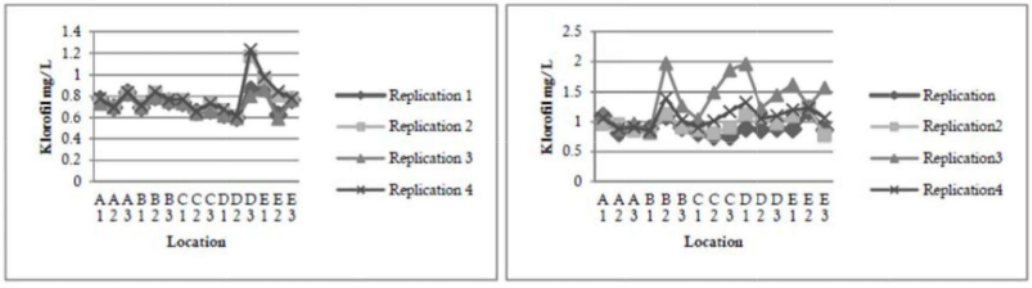


**Fig. 2**. *a*. Chlorophyll A in March; *b*. Chlorophyll A in April

**Table 1.** Total plankton

| Zone | Total Plankton × $10^2$ (cells. $mL^{-1}$) | |
|---|---|---|
| | March | April |
| A 1 | 925 | 120,000 |
| A 2 | 800 | 173,000 |
| A 3 | 525 | 60,000 |
| B 1 | 875 | 43,000 |
| B 2 | 3,530 | 98,000 |
| B 3 | 500 | 0 |
| C 1 | 550 | 13,000 |
| C 2 | 675 | 30,000 |
| C 3 | 525 | 300,000 |
| D 1 | 525 | 75,000 |
| D 2 | 450 | 280,000 |
| D 3 | 825 | 43,000 |
| E 1 | 725 | 205,000 |
| E 2 | 775 | 63,000 |
| E 3 | 475 | 10,000 |

appropriate Quality standards based on the Minister of Environment Decree No. 51 of 2004 is <20 mg / L higher than the average value of the results in March (22.86) and April (23.86). BOD is a test to determine the quality of wastewaters of both organic and inorganic. This waste is a nutrient that plays a role in the growth of plankton in general and specifically Cyanobacteria. Density of plankton in total in March of 84.533 cells / mL and April 10,086,667 cells / mL. The chlorophyll concentration level in March (0:05 mg / L) and April (0:07). These results are expected because organic and inorganic materials that exist in waters Sedati is a nutrient for plankton growth. Other water qualities such as temperature (24.6 - 36.7 ° C), Transparency (72-164 cm), pH (7.84 - 8:29) and DO (4. 3 - 13.5 $mg.L^{-1}$) are still in Quality standards based on the Minister of Environment Decree No. 51 of 2004.

Nitrogen is one of the elements needed by phytoplankton in the formation of the body structure of organisms primarily to synthesize protein (Spellman, 2003). Meanwhile, the role of nitrogen is as a molecular basis for the formation of chlorophyll, and nitrogen deficiency can even lead to the inhibition of the synthesis of chlorophyll (Riyono, 2007).

Nitrogen is absorbed in the form of nitrite, nitrate, and ammonium, nitrogen compounds are then converted into an amino group (glutamic acid) (Setiapermana, 2006; Kadim and Arsad, 2016). This amino group will be subdivided into nitrogen molecules in the manufacture of 5-aminolevulinic. The 5-aminolevulinic molecule is then converted again in some of the reactions to be Mg-protoporphyrin IX (the basic structure of chlorophyll) and finally to chlorophyll-a (Wettstein *et al.*, 1995) so that the nitrogen concentration greatly affect the concentration of chlorophyll, especially chlorophyll-a. (Magumba *et al.*, 2013). In fact, the amount of nitrogen content equal to the amount of chlorophyll (Bojovic and Markovic, 2009).

Chlorophyll-a in phytoplankton pigment is

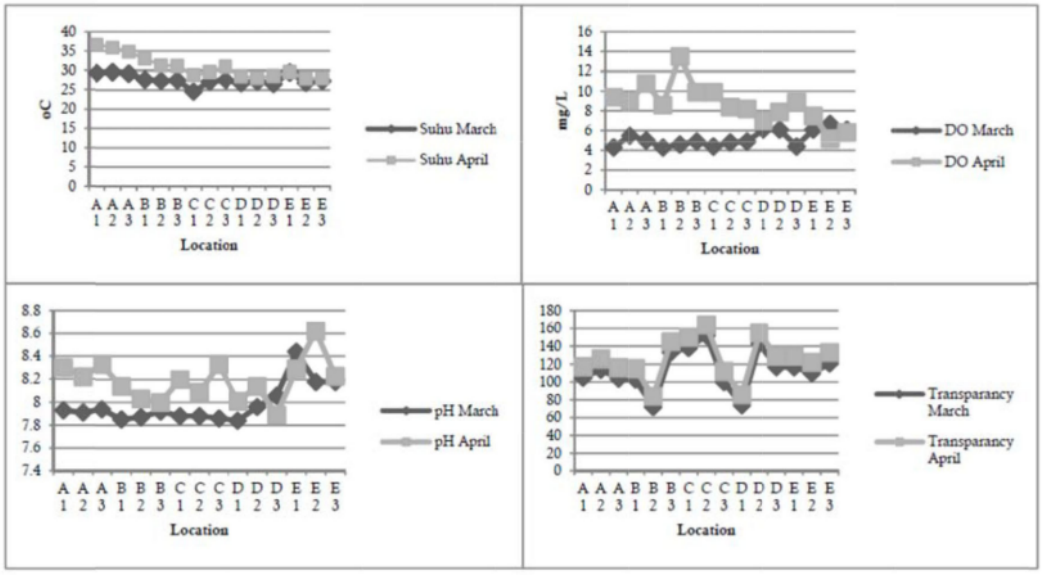


**Fig. 3.** Graph water quality indicators (Temperature, Dissolved oxygen, pH, and Transparency)

active in the process of photosynthesis (Marlian, 2016). Chlorophyll-a concentration in water can be used as a visual parameter of the amount of biomass of phytoplankton (Aryawati *et al.*, 2014). Lo izes (biomass) phytoplankton at certain water can be used as an indication of the pollution of the waters (Chen *et al.*, 2017). So indirectly chlorophyll-a may be one parameter indicator for water pollution or water primary productivity (Safitri, 2014; Effendi *et al.*, 2012).

## CONCLUSION

Cyanobacteria algae group which causes environmental, economic, or human health, an increase in the frequency, duration, and geographic area for nutrient pollution. The results showed an average BOD value results in March (22.86) and April (23.86). Density of plankton in total in March of 84.533 cells / mL and April 10,086,667 cells. $mL^{-1}$. A chlorophyll concentration level in March (0:05 mg. $L^{-1}$) and April (0:07). These results are expected because organic and inorganic materials that exist in waters Sedati is a nutrient for plankton growth.

## ACKNOWLEDGMENTS

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