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Correlation of Temperature, pH and DO with Phytoplankton Abundance in the Maubesi River, East Nusa Tenggara

Hernur Yoga Priyambodo*[1], Made Santiari[2], Mohamad Fajar Farid Amrulloh[3]

[1,2,3]Biology Education, Faculty of Education and Teacher Training, Timor University
*[1]hernuryoga@unimor.ac.id

Abstract

Maubesi River is one of the rivers on Timor Island. Its clear water makes the river a source of water for the surrounding population. However, the condition of the river is unknown based on the presence of phytoplankton. Phytoplankton can be an indicator for these waters. This study aims to determine the effect of temperature, pH and DO on phytoplankton in these waters. The method used in determining the research station is purposive random sampling. The results of the study showed that the abundance of phytoplankton in the Maubesi River is relatively low, namely at 417 -1792 Ind / L and according to existing literature, based on its abundance, the Maubesi River is classified as Oligotrophic. Meanwhile, through simple linear regression analysis, the three environmental factors, namely Temperature, pH and DO, do not have a strong effect on the abundance of Phytoplankton, thus the abundance of Phytoplankton is influenced by other factors besides Temperature, pH and DO.

Keywords: *Maubesi River, Phytoplankton, Abundance, Temperature,pH, Dissolved Oxygen*

INTRODUCTION

Freshwater ecosystems such as rivers are one of the important components in the environmental system that provides various ecosystem services, both directly and indirectly. Rivers act as a source of water and habitat for biodiversity. However, changes in the physical-chemical conditions of waters due to natural and anthropogenic activities can have an impact on the biotic communities in them. One indicator that is very sensitive to changes in water quality is phytoplankton.

Phytoplankton are microscopic photosynthetic organisms that live floating in the water column and play an important role as primary producers in aquatic ecosystems. The existence and composition of phytoplankton communities are greatly influenced by various environmental factors such as temperature, pH and dissolved oxygen (DO) concentration.

These factors directly or indirectly determine the rate of photosynthesis, metabolism, reproduction and survival of phytoplankton (Wetzel, 2001)

Water temperature affects the metabolic rate of aquatic organisms including phytoplankton. An increase in temperature can increase the rate of photosynthesis to a certain limit, but if it exceeds the tolerance threshold it will cause physiological stress (Reynolds, 2006). On the other hand, temperature is also related to the solubility of gases in water, including oxygen. The higher the temperature, the lower the ability of water to dissolve oxygen and ultimately affects the availability of oxygen for all aquatic biota.

Dissolved oxygen (DO) is an important indicator in assessing water quality because it reflects the ability of an ecosystem to support the life of aerobic organisms. Phytoplankton directly contribute to DO levels through the process of photosynthesis. However, the phytoplankton community itself is also greatly influenced by the availability of oxygen, because low DO levels can cause mass plankton deaths and affect the dominance of certain species that are more tolerant of anaerobic conditions (Boyd, 1990).

The pH parameter of water describes the level of acidity or alkalinity of the aquatic environment. The optimal pH range for phytoplankton life is generally between 6.5 and 8.5. pH values that are too low or too high can interfere with enzymatic activity and reduce photosynthesis efficiency (Goldman & Horne, 1983). In addition, pH also affects the solubility of nutrients and the availability of heavy metals that can be toxic to aquatic organisms.

The Maubesi River is one of the rivers in the East Nusa Tenggara region that plays a vital role for the surrounding community, both as a source of clean water, irrigation, and for other domestic activities.

Research on phytoplankton abundance studies in the Maubesi River is still very limited, especially in relation to environmental parameters such as pH, DO and temperature. In fact, this study is important to obtain an overview of water conditions based on the presence of aquatic organisms such as phytoplankton.

This study aims to see how pH, DO and Temperature affect the abundance of phytoplankton. The abundance of phytoplankton can describe the trophic status of waters.

RESEARCH METHODS

This study was conducted in April 2025 in the Maubesi River, East Nusa Tenggara. Phytoplankton sampling was carried out at three stations. Measurement of environmental parameters includes temperature, pH and DO. Measurement of environmental factors was carried out directly at the research location.

Phytoplankton sampling used a plankton net with a size of 20 microns to filter 50 liters of water. Phytoplankton samples were then given a preservative using 4% formalin. Phytoplankton enumeration and identification used *Sedgewick Rafter* and an Olympus microscope. Calculation of phytoplankton abundance using the following formula:

$$F=\frac{A}{B}x\frac{C}{D}x\frac{1000}{E}xN$$

Description:

F = Number of individuals per liter

A = Area of *Sedgewick Rafter*

B = Area of field of view

N = Number of phytoplankton obtained

C = Volume of filtered sample

D = Volume of sample taken

E = Volume of sample studied

Data analysis in this study used simple linear regression to determine the correlation between temperature, pH and DO on phytoplankton abundance.

RESULTS AND DISCUSSION

a. Phytoplankton Abundance

Based on observations and identification at three stations in the Maubesi River, a number of phytoplankton were obtained, including *Chaetoceros* sp, *Cocconeis* sp, *Fragilaria* sp, *Gomphonema* sp, *Grammatophora* sp, *Gyrosigma* sp, *Navicula* sp, *Pinnularia* sp and *Synedra* sp. The abundance of each station was 667, 1792 and 417 Ind/L, respectively. At the first station, the phytoplankton with the highest amount is *Fragilaria* sp, then at the second station, the phytoplankton with the highest amount is *Synedra* sp while at the last station is *Pinnularia* sp. All types of phytoplankton obtained were classified into the Bacillariophyceae class. This is because the Bacillariophyceae class is able to adapt to its surroundings compared to other classes (Aryawati, 2021; Yanti et al., 2024).

Bacillariophyceae is included in the type of phytoplankton that is cosmopolitan and has high adaptability. This causes this class to be dominant in various water conditions so that its number is greater than other types of phytoplankton (Ainalyaqin & Abida, 2024; Lubis et. al,

2023). In addition, the Bacillariophyceae class has a fast reproductive ability when compared to phytoplankton from other classes (Anas et al., 2022).

Table 1. Phytoplankton Composition and Abundance

Phytoplankton Genus	Station 1	Station 2	Station 3
Chaetoceros sp	*0*	*292*	*0*
Cocconeis sp	*0*	*0*	*42*
Fragilaria sp	*333*	*333*	*42*
Gomphonema sp	*0*	*42*	*0*
Grammatophora sp	*0*	*208*	*0*
Gyrosigma sp	*125*	*83*	*42*
Navicula sp1	*0*	*125*	*0*
Navicula sp2	*0*	*42*	*0*
Nitzschia sp	*0*	*083*	*125*
Pinnularia sp	*0*	*0*	*167*
Synedra sp	*208*	*583*	*0*
Total number (Ind/L)	*667*	*1792*	*417*

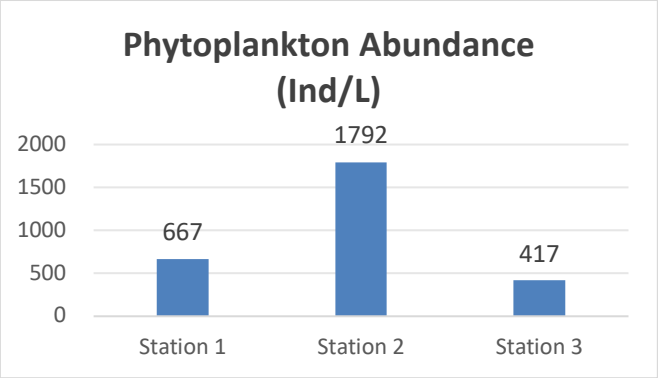

Figure 1. Phytoplankton Abundance at Each Station

Based on calculations of phytoplankton abundance, the highest abundance was found at station 2, that is 1792 Ind/L and the lowest abundance was at station 3, that is 417 Ind/L. According to Sofyan and Zainuri (2021); Rahmah et. al., (2022a), an abundance of 0 to 2000 Ind/L is classified as Oligotrophic waters. This is in accordance with the data on the types of phytoplankton obtained. Only a few phytoplankton were obtained in the Maubesi River. This is possible because the Maubesi River is not used as a waste disposal site, for example by factories or household industries. Thus, its waters are always protected from pollution. Based on its physical appearance, the water in the Maubesi River is also relatively clear. This opinion is also in accordance with research conducted by Anas that oligotrophic waters have a small number of phytoplankton (Anas et al., 2022)

Another factor that causes the small amount of phytoplankton obtained is due to the limitations of the microscope used to identify certain types of phytoplankton (Cetinić et al., 2024). According to Varmlandia and Hadisusanto, (2023), rainfall can affect plankton dynamics due to an increase in water volume which can then cause dilution so that factors such as temperature become low when compared to the dry season.

b. Water Conditions

The results of environmental factor measurements are shown in Table 2. At station 1 the average DO is 3.47 mg/L, the average pH is 7.4 and the average temperature is 30^0C. At station 2 the average DO is 6.27 mg/L, the average pH is 8 and the average temperature is 32.67^0C. While at station 3 the average DO is 6.2 mg/L, the average pH is 8.23 and the average temperature is 34.83^0C.

Table 2. Environmental Parameters of the Maubesi River

Station	Measurement	DO	pH	Temperature
1	1	3,4	7,4	30
	2	3,5	7,4	30
	3	3,5	7,4	30
	average	**3,47**	**7,4**	**30**
2	1	6,2	8	33
	2	6,3	8	32,5
	3	6,3	8	32,5
	average	**6,27**	**8**	**32,67**
3	1	6,2	8,3	35
	2	6,2	8,2	35
	3	6,2	8,2	34,5
	average	**6,2**	**8,23**	**34,83**

Based on the comparison graph of the average water quality parameters between the three stations, the following data were obtained:

1. DO (Dissolved Oxygen) increased significantly from station 1 to stations 2 and 3.
2. pH also showed an increase from station 1 (neutral) to station 3 (slightly alkaline).
3. Temperature tended to increase from station 1 to station 3

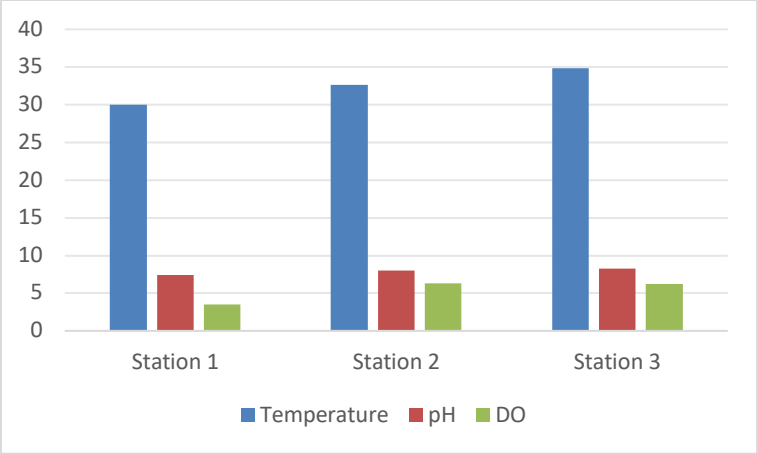

Figure 2. Comparison of DO, pH and Temperature

Low DO at station 1 indicates that the water conditions are less supportive of aerobic organisms, such as several types of phytoplankton. This can be caused by a lack of light intensity which causes a lack of phytoplankton photosynthesis. Low DO indicates that waters are polluted (Ainalyaqin & Abida, 2024).

Based on the available data, only station 1 has low DO. This is possible because the waters at station 1 are covered by dense trees, therefore the sunlight is blocked by the existing trees, so that phytoplankton does not get enough sunlight to photosynthesize. As a result, dissolved oxygen at the station is low.

Stations 2 and 3 have higher DO, indicating healthier waters and more photosynthetic activity that supports the diversity of aquatic organisms. All pH values in the Maubesi River are still within the tolerance range for aquatic life (around 6.5 – 8.5) (Astriana et al., 2022; Leidonald et al., 2022).

The increase in pH is in line with the increase in DO and Temperature. This indicates biologically productive conditions. The increase in temperature from station 1 to station 3 can be caused by the geographical location which is more open to sunlight. The optimum temperature value for plankton life is between 20 - 30^{0}C (Kurniawati et al., 2015; Rahman, 2016).

Meanwhile Leidonald et al., (2022) stated that the optimal temperature for phytoplankton growth is between 23-31^{0}C. So the temperature at stations II and III is in the range of 32.67^{0}C and 34.83^{0}C which is less in accordance with the needs of phytoplankton. The high temperature is caused because the water conditions at stations II and III are not covered by the canopy of the surrounding plants, thus increasing the temperature in the waters (Pambudi et al., 2017).

c. Correlation Analysis

Environmental factors measured in this study include pH, DO and Temperature. These three parameters have their respective roles in the abundance of phytoplankton in waters.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.365[a]	.133	-.733	964.20823

a. Predictors: (Constant), DO (X1)
b. Dependent Variable: Kelimpahan (Y)

Figure 3. Correlation of DO and Abundance

Based on the R Square value obtained from the calculation of simple linear regression, a value of 13.3% was obtained, which means that the abundance of phytoplankton is influenced by oxygen solubility of 13.3% while the rest is influenced by other factors.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.080[a]	.006	-.987	1032.47068

a. Predictors: (Constant), pH (X2)
b. Dependent Variable: Kelimpahan (Y)

Figure 4. Correlation of pH and Abundance

Meanwhile, the R Square value of the water pH is only 0.6% and is the lowest R Square value, which means that in this study the correlation of abundance to pH can be ignored because of its small value. Based on Table 2. the existing pH value tends to be alkaline which can be caused by phytoplankton not optimally carrying out photosynthesis (Armiani & Harisanti, 2021). This is related to sampling carried out in the morning before the sun shines brightly. Thus, phytoplankton have not carried out photosynthesis optimally. Research conducted by Afifah & Purnomo (2025), shows that pH at certain locations can have a weak correlation with abundance. Under certain conditions, low pH interferes with the growth of microalgae by reducing the role of enzyme activity, limiting cell motility, and disrupting the photosynthesis process.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.544[a]	.296	-.408	869.22987

a. Predictors: (Constant), Suhu (X3)
b. Dependent Variable: Kelimpahan (Y)

Figure 5. Correlation of Temperature and Abundance

Figure 5 explains the magnitude of the effect of temperature on phytoplankton abundance. In this case, the R Square value of 29.6% is influenced by temperature and the remaining 70.4% is influenced by other factors. Based on the values obtained through linear

regression, the value is not significant, which means that phytoplankton abundance is not strongly influenced by DO, pH and temperature factors. However, table 2 shows a high temperature value of 34.83^0C. According to Rahmah et. al. (2022a) and Rahmah et al., (2022b) Water temperature can increase due to the hot sun and lack of cloud cover. This is in accordance with the high temperature value at station 3 (Zainuri et al., 2023). Although simple regression analysis does not show a strong correlation.

CONCLUSION

Based on the correlation analysis through the R value, it can be concluded that pH, DO and Temperature have a low correlation with the abundance of phytoplankton. This is also seen based on the low number of phytoplankton per individual at each station. The abundance shows that the waters of the Maubes River are classified as Oligotrophic.

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