Original Research Article

Structure Community PhytoplanktonIn Cikidang River, PangandaranCity,Indonesia

ABSTRACT

This research aims to determine the structure of the phytoplankton community in the waters of the Cikidang River, which can be used as a bioindicator to determine the quality of the waters. The study began in November 2021-February 2022. This research uses survey method. Sampling was carried out at 4 stations. The determination of the stations was carried out by considering land use and river orders.The water parameters analyzed are transparency, temperature, Salinity, pH, Carbon Dioxide (CO_2), Biochemical Oxygen Demand(BOD), Dissolved oxygen (DO),Nitrate (NO^{3-}), Phosphate(PO_4^{3-}), NitrateNH^3, phytoplankton abundance, diversity index and dominance index. The results showed that 21 genera from 6 classes and 4 phyla such asChrysophyta, Cyanophyta, Chlorophyta, and Euglenophytawere identified. Abundances index ranging from 17.2-104.6 Ind/L. The diversity index, ranged from 0.49 to 0.72. While the dominance index ranges from 0.28 to 0.51 and belongs to the category of low to moderate dominance. The water quality in the Cikidang River generally meets the requirements of class II and Class III quality standards, according to Government Regulation Number 22 of 2021 concerning Water Quality Management and Water Pollution Control.

Keywords:Pangandaran, River, Phytoplankton, Structure Community

1. INTRODUCTION

A river is a container or flow of natural or artificial water in the form of a water drainage network and the water in it, starting from the upstream to the estuary, which is limited to the right and left by a borderline (Law No. 38 of 2011). In Pangandaran there is one river, namely the Cikidang River, this river plays an important role in community activities. Especially for people who live on the outskirts of the river, the community uses the river for agricultural irrigation activities, and as a place for disposal of household (domestic) waste such as bathing, washing, and latrines (MCK). These activities produce a variety of highly organic and inorganic materials that can pollute the river. Organic materials in the form of nitrogen (proteins, polypeptides, amino acids, urea), phosphorus (particulates), detergents, phenols, and fecal coli bacteria (Salim 2002). Inorganic materials in the form of water runoff from inorganic fertilizers from agriculture. As time goes by, the pollutant input load will increase resulting in physical, chemical, and biological changes in river waters and eventually causing pollution (Sihombing et al. 2015).

The existence of aquatic organisms that will be directly affected by a load of pollutant inputs, namely phytoplankton because of their short life cycle, and having a very fast response to changes in the environment and species composition and their presence can be used to indicate water quality (APHA 1995 in Nugroho 2006). In waters that have experienced pollution, phytoplankton organisms usually have lower diversity and the dominance of certain species (Muchlisin 2000 in Andriani et al. 2015).

2. MATERIAL AND METHOD

2.1 Study Area

This research was conducted in the Cikidang River, Pangandaran, West Java, Indonesia from November 2021-February 2022. Observations for sampling used purposive sampling (Amelia et al., 2012; Rumanti et al., 2014; Setiawan., and R. Mohadi 2018) which is divided into four stations. The determination of the stations was carried out by considering land use and river orders (Rahman et. al. 2016; Zahidah 2017). (Fig. 1).

Station 1: The upstream area of the river is located in Sidomulyo Village, and the spring is located in the agriculture.

Station 2: River flow used for agricultural irrigation and located around residential areas.

Station 3: Located in Pananjung Village, is a river located near residential areas and used for agricultural irrigation.

Station 4: The estuary area is affected by the tides.

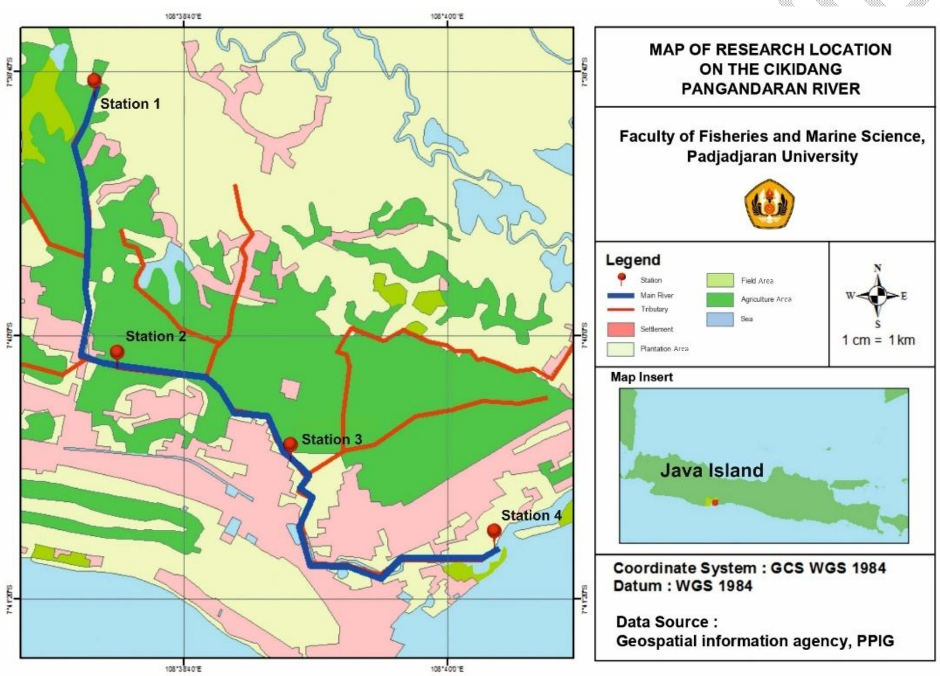

Figure 1. Map of Cikidang River Research Station

2.2 Sampling And Measurement

A sampling of water and phytoplankton was carried out over fourteen days four times of the sampling. A sampling of water and phytoplankton at the four stations was carried out on the surface of the water to a depth of ± 35 cm. Phytoplankton samples were taken by filtering 10 liters of water, then filtered using plankton-net No. 25 (Andriani et al. 2015). The sample obtained was transferred to a sample bottle with a volume of 50 ml and given 10% Lugol 10-15 drops or until brownish.Identification was done followingSachlan (1982), Sulastri (2018) and Bellinger and Sigee (2010). Physico-chemical parameters measured in the field include water, temperature, light transparency, salinity, pH, DO, CO2 BOD, NO^{3-} and $PO_4{}^{3-}$.

2.3 Sample Analysis

Phytoplankton data analysis was performed in a comparative descriptive method with the following observational parameters.

2.3.1 Phytoplankton Abundance

Phytoplankton abundance is the number of phytoplankton individuals per unit volume. Plankton abundance quantitatively is based on abundance expressed in individuals/liters. Plankton abundance is calculated according to the following formula (APHA 1989).

$N = N \times (Vr / Vo) \times (1 / Vs)$

Information:

N = Abundance (Ind /L)
N = Number of phytoplankton observed
Vr = Filtered phytoplankton volume (ml)
Vo = Volume of water at Sedgewick rafter chamber (SRC)
Vs = The volume of filtered water

2.3.2 Diversity Index

This diversity index analysis is used to determine the diversity of aquatic organisms. The equation used to calculate this index is the Simpson equation.

$D = 1 - C$

Information:

D = Simpson diversity index

C = Simpson dominance index The Simpson

The diversity index value ranges from 0 to 1. If the index value is close to 1 then the distribution of individuals is evenly distributed, and the stability of the aquatic ecosystem is said to be good if it has a value Simpson's diversity ranges from 0.6 to 0.8 (Odum, 1993).

2.3.3 Dominance Index

Dominance index is used to determine the extent of dominance of a species or genus in other groups. The calculation method used is the Simpson dominance index formula.

$C = \sum [(PI)]^2$

Information:

C = Dominance
Pi = ni / N
Ni = Number of individuals in one type
N = Total number of individuals of all

The domination index criteria are:

$0 < C < 0.5$	= Low dominance
$0.5 < C < 0.75$	= Moderate dominance
$0.75 < C < 1$	= High dominance

3. RESULTS AND DISCUSSION

3.1 Physical And Chemical Parameters Of Water

Table 1. Physical-Chemical Parameters of Waters

Parameters	Station				Unit
	1	2	3	4	
Physical Parameters					
Temperature	26,75±1,5	27,57±1,65	28,5±1,73	29,57±1,89	^{0}C
Transparency	16,37±8,67	16,12±6,3	22,25±10,98	135,75±59,48	cm
Salinity	0±0	0,5±0,57	2±2	9,5±4,12	ppt
Chemical Parameters					
pH	7,43±0,12	7,48±0,34	7,44±0,31	7,38±0,11	-
CO_2	47,3±6,6	23,65±4,87	19,8±11,5	28,05±12,23	mg/L
BOD	14,75±1,52	16,36±3,32	10,41±0,9	11,48±4,37	mg/L
DO	5,06±0,88	4,92±0,5	5,02±0,53	4,38±0,45	mg/L
Phosphate	0,009± 0,00	0,0135± 0,003	0,015± 0,006	0,0297± 0,0035	mg/L
Nitrate	0,37±0,02	0,25±0,04	0,31±0,08	0,32±0,02	mg/L

Based on the measurement results of water quality parameters, the average water temperature at the four stations ranging between 26,75^{0}C-29.57^{0}C can be seen (Table 1).

The lowest temperature is at station 1 at 26,75^{0}C while the highest temperature is at station 4 at 29,57^{0}C. The range of temperature values obtained is still within the tolerance limit of deviation 3 according to Government Regulation No. 22 of 2021. Temperature measurement is important because phytoplankton has an optimum temperature with a certain tolerance range (Zahidah 2017). The optimum temperature range for the growth of phytoplankton in the waters is 20-30^{0}C (Effendi 2003).

Waters that has a transparency of 30-50 cm are considered optimal for supporting plankton life (Boyd 1990). The results of the measurement of light transparency in the Cikidang River have an average transparency value ranging from 16.12 cm-135.75 cm which can be seen (Table 1). The low light transparency value is at station 2 at 16.12 cm, the highest light transparency is at station 4 at 135.75 cm. The value of light transparency can be influenced by several factors such as the time of measurement, weather conditions, turbidity, suspended solids, and the accuracy of the person taking the measurement (Effendi 2003).

The average salinity value in the Cikidang River has an average range of 0 ppt-9.5 ppt (Table 1). The low salinity value of 0 ppt is at station 1 and the highest salinity value is at station 4 of 9.5 ppt. The obtained salinity value of 9.5 ppt indicates a good value for the survival of phytoplankton organisms in the waters. This is to Effendi's (2003) salinity values for fresh waters are usually less than 0.5%0, brackish waters are between 0.5%0-30%0, and marine waters are 30%0-40%0.

Research results show that the average pH value in the Cikidang River ranges from 7.38-7.48, which can be seen(Table 1). The highest degree of acidity (pH) is at station 2 of 7.43 while the lowest pH is at station 4 of 7.38. The range of suitable pH values for Fisheries, according to Government Regulation No. 22 of 2021 is between 6-9 at all research stations following class II and III quality standards.

Based on the data obtained, the highest average value of carbon dioxide concentration was at station 1 at 47.3 mg/L. The lowest carbon dioxide was found at station 3 at 19.8 mg/L (Table 1). The higher the carbon dioxide, the more oxygen is needed. The high carbon dioxide in the waters will cause dissolved oxygen in the waters to become so that it will cause the death of organisms, a good carbon dioxide value for aquatic organisms is approximately 12 mg/L. If the carbon dioxide content is more than this value, it can be dangerous because of the binding of oxygen (O_2) (Idrus 2018).

The results of the BOD measurement ranged from 10.41 mg/L-16.36 mg/L. The highest BOD value came from station 2 of 16.36 and the lowest BOD value came from station 3 of 10.47 mg/L (Table 1). According to Government Regulation No. 22 of 2021, the range of BOD values at all stations is not following the class II and III quality standards.

The average value of dissolved oxygen in the Cikidang River has a range of 4.38 mg/L-5.06 mg/L can be seen (Table 1). The highest DO value is at station 1 of 5.06 mg/L while the lowest DO value is at station 4 at 4.38. Oxygen concentrations from the five stations are still within the limits of class II and III water quality standards in PP 22 of 2021. Aquatic organisms, namely phytoplankton, can live in the range of DO values of > 3 mg/L (Wijayanti 2008 in Utami 2020).

The results of nitrate measurements at the five stations averaged from 0.25 mg/L-0.37 mg/L. The highest nitrate content comes at station 1 at 0.37 mg/L and the lowest nitrate content is at station 2 at 0.25 mg/L can be seen(Table 1). According to PP 10 class I and 20 class III. According to Karyono and Pandi (1977) in Sidaningrat et al. (2018b) nitrate value content >, 0.03 mg/L is the optimum content for phytoplankton growth.

The results of phosphate measurements at the five stations showed an average value ranging from 0.009 mg/L-0.029 mg/L. The highest results coming from station 4 of 0.029 mg/L and the lowest phosphate content coming from station 1 of 0.009 mg/L can be seen(Table 1) in class I and II Government Regulation No. 22 of 2021. The optimum phosphate value content for the growth of phytoplankton is 0.09-1.80 mg/L Malaha (2004) in Sidaningrat et al. 2018b).

3.2 Abundance Of Phytoplankton

Phytoplankton identified during the research were 21 genera, 6 classes, and 4 phyla Chlorophyta, Cyanophyta, Chrysophyta, and Euglenophyta. Phytoplankton from the phylaChrysophyta is the most commonly found phytoplankton with a percentage of 94% of the total phytoplankton found. Based on (Figure 2), phytoplankton from the Bacillariophyceae class were the most commonly found phytoplankton with a percentage of 92% of the total phytoplankton found, in this class identified in the genera *Synedra, Stauroneis, Chaetoceros, Bacteriastrum, Nitzschia*, *Cyclotella, Gyrosigma, Navicula, Surirella, and Gomphonema.*

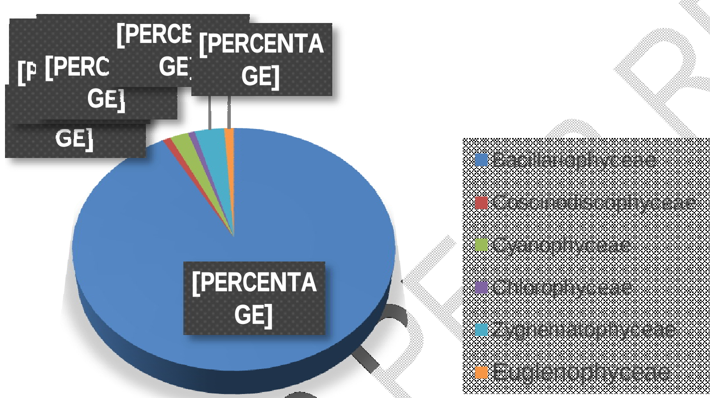

Figure2. Phytoplankton Composition of the Cikidang River

The highest abundance of phytoplankton was found at station 1 as much as 104.6 Ind/L, with the most abundant phytoplankton class, Bacillariophyceae at 102.3 Ind/L (Figure 3). At station 1, there are already agricultural activities that can contribute input loads, such as nitrate and phosphate to the waters. Nitrate content in waters can be affected by discharges from agricultural activities (fertilization), industrial activities, and explosives (Effendi 2003). In water the presence of nitrate and phosphate is needed to meet the nutritional needs of phytoplankton, so that phytoplankton can produce energy (Sidaningrat *et al.* 2018). In addition, other physical and chemical parameters such as carbon dioxide, and the transparency of light entering the waters are sufficient. to carry out photosynthetic activities so that the growth of phytoplankton is faster than in other stations (Utami 2020).

The lowabundance was at station 3 with an abundance of 17.2 Ind/L. The dominant class is Bacillariophyceae at 14.2 Ind/L. This class can adapt well in adapting to the environment and its breeding is relatively faster (Pambudi *et al,* 2016). Phytoplankton from the phylum Bacillariophyta is commonly found in waters because they generally have rod-like cells that have a role as the first producer which is a source of food for zooplankton (Hurtabat& Evans, 1986 in Setyowati 2017).

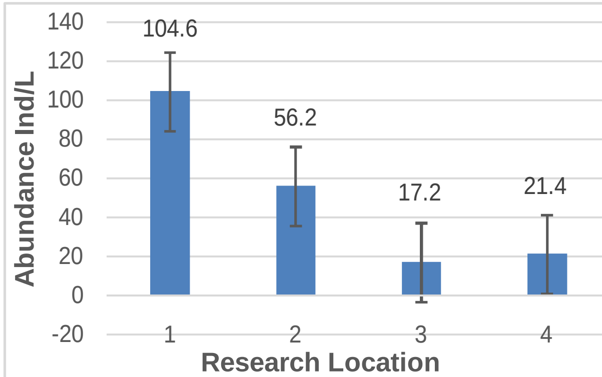

Figure 3. Cikidang River Phytoplankton Abundance Chart

3.3 Phytoplankton Diversity Index The Phytoplankton

The phytoplankton diversity index in the Cikidang River has an average range of 0.49-0.72, with the highest value at station 3 of 0.72 which indicates high diversity and even distribution of individuals (Figure 16). The lowdiversity index value is at station 1 of 0.49 which indicates moderate diversity. Simpson's diversity index value ranges from 0-1. If the diversity index value is close to 1, then the distribution of individuals is said to be even, and the stability of the ecosystem is good if it has a Simpson diversity index value between 0.6-0.8 (Odum 1993).

A community can be said to have high diversity if there are many species with a relatively even number of individuals. Meanwhile, if a community consists of only a few species with an unequal number of individuals, then the community has a relatively low diversity index (Barus 2004).

A high diversity index value is usually indicated by the formation of a stable environmental ecosystem. In an environment that has been under pressure or disturbance, it is usually marked with a moderate diversity index value. A low diversity index value indicates that the environment has experienced disturbances that impact the structure of the organism (Shabrina *et al*. 2021).

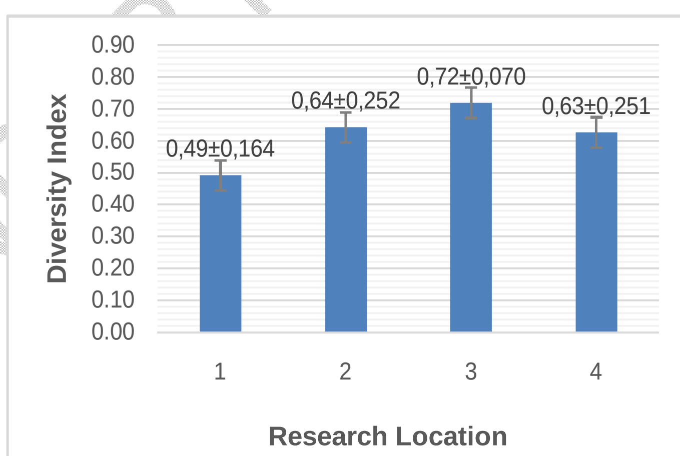

Figure 4. Phytoplankton Diversity Index of Cikidang River

3.4 Phytoplankton Dominance

Index Simpson's dominance index ranges from 0-1 as shown in Figure 5). Phytoplankton dominance index values ranged from 0.28 to 0.51. At Station 1 location the dominance index value is in the moderate category 0.5 <C< 1, with the dominance of *Synedra* (Odum 1998). Phytoplankton of the *Synedra* genus is known to be able to adapt well in unfavorable environmental conditions, this adaptability occurs because *Synedra* has a characteristic diatom shape, equipped with layered wrapping cells (Conradie 2008 in Huda and Laily 2015).

According to Sulastri (2018), *Synedra* is tolerant of extensive water quality conditions, occupying oligotrophic (low in nutrients), mesotrophic, and eutrophic (rich in nutrients) waters with low nitrogen and phosphate concentrations. This is because *Synedra* can accumulate nutrients (nutrients) and store them as food reserves in the form of insoluble polymers (Venter 2003 in Huda and Laily 2015).

At stations 2, 3, and 4, the phytoplankton dominance index value in the low category 0 <C< 0.5 indicates that there are no dominant phytoplankton species at that location. The dominance index value close to 0 indicates that in the phytoplankton community structure, there are no species that extremely dominate other species. All types of phytoplankton have the same ability and opportunity to utilize resources in their environment and the condition of the community structure is in stable condition (Shabrina et al. 2021).

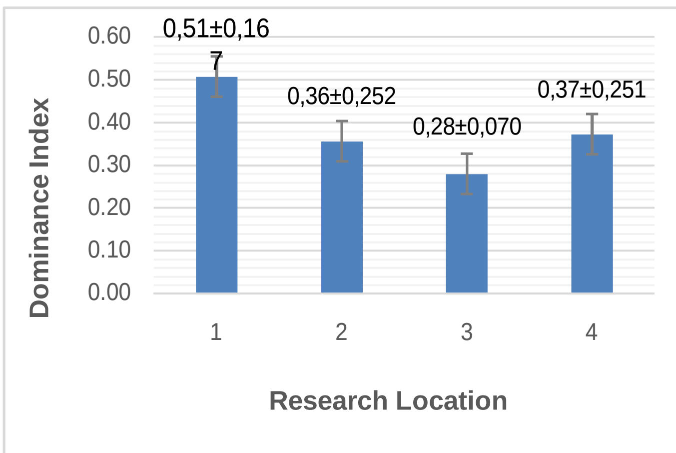

Figure 5.Phytoplankton Dominance Index Of Cikidang River

4. CONCLUSION

Phytoplankton identified in the Cikidang River consists of 21 genera from 6 classes and 4 phyla such asChrysophyta, Cyanophyta, Chlorophyta, and Euglenophyta with phytoplankton abundance ranging from 17.2-104.6 Ind/L. The phytoplankton diversity index ranged from 0.49 to 0.72. While the dominance index of phytoplankton ranges from 0.28 to 0.51. The water quality in the Cikidang River generally meets the requirements of class II and Class III quality standards, according to Government Regulation Number 22 of 2021 concerning Water Quality Management and Water Pollution Control.

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