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Analysis of Community Structure of Plankton as Bioindicator Of Water Quality in Cikapundung River, West Java

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ABSTRACT

The Cikapundung River is a sub-river of the Citarum River that is heavily polluted with waste. The presence of waste in the Cikapundung River can cause various environmental problems. Research on plankton community structure analysis needs to be conducted in the Cikapundung River to determine community structure, its relationship with physical and chemical parameters, and water quality conditions. This research was conducted in May-June 2023 using a purposive sampling method at 3 stations with different characteristics. Sampling was done 3 times in each station with an interval of 1 week. The parameters of COD, BOD, Nitrate, and Phosphate were tested at the sampling location and LPKL PDAM. Plankton sampling was done by filtering 6L of water into a plankton net and preserved using 70% alcohol. Plankton identification was carried out at the Integrated Laboratory of UIN Sunan Gunung Djati based on morphological characteristics under a microscope observation. Data on physical and chemical parameters obtained were analyzed using IBM SPSS software version 25.0.0. Then continued with the Spearmann correlation test between physical and chemical parameters and plankton communities. The results showed that there were 46 genus of plankton in Cikapundung River.The highest diversity and evenness values were found at station 3 with mean values of 1.847 and 0.618. The highest dominance value is found at station 1 with a mean value of 0.381. The mean values of the probity index SI and TSI in Cikapundung River are 0.419 and 0.425. There is no real correlation between physical and chemical parameters in the plankton community. The probity index indicates that the Cikapundung River belongs to the β/α mesosaprobic water group with a moderate level of pollution.

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1. INTRODUCTION

A river is a form of water that flows on the earth's surface that can be shaped due to various factors. Rivers are one of the important factors in sustaining life on Earth. River ecosystems have complex interactions between organisms and inorganic matter within them. The presence of nutrients and minerals such as phosphate, nitrate, and sulfate in waters is very important for the survival of aquatic organisms.

In addition, rivers are widely used by humans for bathing, tourism areas, aquaculture, and sports facilities, so damage to the river ecosystem will also have an impact on humans as well. Some examples that can be caused by damage to river ecosystems include eutrophication and the emergence of various diseases. These impacts are devastating for economic activities and human health welfare [30].

The Citarum River has a bad reputation in the eyes of the world and was named the world's dirtiest river in 2018 according to the World Bank (35). The abundance of waste that contaminates the Citarum River is the result of domestic pollution from residential areas along the riverbanks and waste from the textile industry located in the nearby Citarum River [23]. Continuous pollution of river bodies can cause a decrease in the quality of river water. This is also happening to the Citarum River. Based on previous research, the condition of the Citarum River waters in terms of physical and chemical parameters has exceeded the quality standards set by the government, at PP No.82 Tahun 2001 [34].

Peraturan Gubernur Jawa Barat No. 78 Tahun 2015 explained that the West Java Provincial government is trying to restore the Citarum River watershed with the "Clean, Healthy, Beautiful and Sustainable Citarum Movement" which then gave rise to the "Citarum Harum" movement, with the implementation of the program will indirectly have an impact on the Cikapundung River.The Citarum River has a bad reputation in the eyes of the world and was named the world's dirtiest river in 2018 according to the World Bank [35]. The abundance of waste that contaminates the Citarum River is the result of domestic pollution from residential areas along the riverbanks and waste from the textile industry located in the nearby Citarum River [23]. Continuous pollution of river bodies can cause a decrease in the quality of river water. This is also happening to the Citarum River. Based on previous research, the condition of the Citarum River waters in terms of physical and chemical parameters has exceeded the quality standards set by the government, at PP No.82 Tahun 2001 [34].

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The quality of aquatic system is very important to studied because it is an essential factor for human and aquatic organisms. Bad-quality aquatic systems will have a negative impact on the economy, ecology, and aesthetics. Several methods can used to understand the quality of aquatic systems such as physical, chemical, and biological aspects. These three parameters are linked to one another [16]. The Government of the Republic of Indonesia has set quality standards for these three parameters, which are then categorized based on their designation (Peraturan Pemerintah No. 20 Tahun 1990 Tentang Pengendalian Pencemaran Air, 1990).

Microorganisms have an important role in maintaining the balance of nature, one example of them is plankton. Plankton is an organism that plays an active role in the biogeochemical cycle, especially in balancing the accumulation of carbon dioxide in the atmosphere [5]. Carbon dioxide is a chemical compound that is widely produced from the metabolic activities of aerobic organisms and the burning of fossil fuels. The large amount of carbon dioxide in the atmosphere can have a negative impact on human health and the environment [31]. In addition, plankton also plays an important role in the food chain in aquatic ecosystems. They function as producers (phytoplankton) and consumers (zooplankton) that channel energy to higher trophic levels[16]. Therefore, the existence of plankton is very important for the sustainability of nature and other living things.

The role of plankton in the waters as a stabilizer of the chemical content of the waters, plankton can be used as a bioindicator to see the condition of a body of water. Ferdous & Muktadir (2009) said that plankton has a high potential to be used as environmental bioindicators. Polluted waters generally have a different plankton community structure and composition than waters exposed to less pollution [11]. This is inseparable from the ability of plankton which has sensitivity in responding to changes in nutrients in waters and various other environmental factors shown through changes in the composition, abundance, and distribution of plankton [15].

According to Adey & Karen (2007) which is quoted from reaserch by Sabrina, et al. (2020), The term "community structure" is commonly used in the context of ecological studies to describe the presence or abundance of certain organisms in an ecosystem. Differences In community composition can be caused by physical and biological factors present. These factors play an important role in shaping community characteristics at multiple levels. At the local level, interactions between physical and biological factors influence patterns of community structure in a specific location, including predation interactions between organisms and environmental impacts on a community that can vary in different locations [18]. Reid et., (2000) Said that the structure of the plankton community in a water body is influenced by various factors, including fishing and the release of fish into nature. This directly impacts the abundance of the plankton community at that location. Community structure can be assessed through the use of ecological indexes such as dominance, abundance, diversity, and evenness. In the context of plankton, its community structure can serve as an indicator of aquatic ecosystem balance.

Based on the above background, there is a threat of pollution in the Cikapundung River. So far, data on water quality in the Cikapundung River is only limited to physical and chemical testing, so it is necessary to conduct water quality research using plankton as a bioindicator that is quite influential on the continuity of the river ecosystem. It is expected that this research will raise awareness and efforts from the government and the community around the Cikapundung River in order to maintain the health of the Cikapundung River ecosystem.

2. METHOD

The research was held during May- June 2023. Sampling was taken in the Cikapundung River watershed with a purposive sampling method. The sampling location was carried out at 3 stations. Station 1 is located in Cikapundung Terrace which has a lot of vegetation around the river, station 2 is located in Cikapundung Riverspot which is a tourist spot, and Station 3 is located in Regol Square which is a residential area. Water sampling is done only at the surface of the river. This is because at the sampling location, the depth of the river is relatively shallow. Water samples were taken as much as 6 L which was then filtered with a plankton net. The filtered samples were then identified at the Integrated Laboratory of UIN Sunan Gunung Djati.

3. RESULT AND DISCUSSION

3.1. Analysis of the Diversity of Plankton Genus in Cikapundung River

Based on the results of the study, there were 46 genera of plankton in the Cikapundung River consisting of 38 genera of phytoplankton and 8 genera of zooplankton. Data on the genus and abundance of plankton in each observation are presented in Table 1.

Tabel 1. Total abundance of plankton (individuals/L)

Class	Order	Familly	Genus	Station 1	Station 2	Station 3	Total
Gymnolaemata	Cheilostomatida	Electridae	Cyphonautes	0	2,9	14,6	17,5
	Centroles	Chaetocerotaceae	Chaetoceros	2,9	0	0	2,9
	Thalassiosirales	Stephanodiscaceae	Cyclotella	382,1	205,7	135,2	723
	Licmophorales	Licmophoraceae	Licmophora	0	8,8	0	8,8
	Melosirales	Melosiraceae	Melosira	17,6	20,5	382,1	420,2
	Naviculales	Naviculaceae	Navicula	0	0	1061,2	1061,2
	Fragilariales	Fragilariaceae	Synedra	8763,5	0	0	8763,5
Bacillariophyceae	Thalassiosirales	Thalassiosiraceae	Thalassiosira	2,9	0	20,5	23,4
Branchiopoda	Anomopoda	Daphniidae	Daphnia	0	5,8	0	5,8
	Chlorealles	Chlorellaceae	Actinastrum	244	2,9	20,5	267,4
	Sphaeropleales	Scenedesmaceae	Coelastrum	0	2,9	8,81	11,71
	Desmidiales	Desmidiaceae	Cosmarium	94	58,7	61,7	214,4
	Incertae sedis	Incertae sedis	Crucigenia	0	82,3	2,9	85,2
	Desmidiales	Desmidiaceae	Euastrum	2,9	5,8	23,5	32,2
	Chlamydomonadales	Volvoceae	Eudorina	23,5	8,8	29,3	61,6
	Podocopida	Cyprididae	Heterocypris	0	0	2,9	2,9
Chlorophyceae	Sphaeropleales	Selenastraceae	Kirchnereilla	0	17,6	11,7	29,3

There are 15 classes found in Cikapundung River, namely *Cheilostomatida, Bacillariophyceae, Branchiopoda, Chlorophyceae, Cilliata, Crustaceae, Crysophyceae, Cyanophyceae, Dinophyceae, Euglenophyceae, Eurotatoria, Imbricatea, Xanthophyceae, Zygnematophyceae*, and *Scypoza*. Based on the results of the study, it is known that Synedra is the most genus found at station 1 with an abundance of 8763.5 individuals/L. However, this genus was only found in station 1 and not found in other locations. Station 1 area is an area that has more dissolved oxygen content, and has a relatively low level of chemical pollution compared to other locations. This can be attributed to the low BOD and COD values at the Station 1 location. Which indicates low pollution at that location [3].

Synedra is a genus of the Bacillariophyceae class that is commonly found in freshwater habitats. The high abundance of Synedra in waters can occur due to several supporting factors. The richness of nutrients in the waters is a factor that can cause a surge in the Synedra population, especially in waters rich in nitrates and phosphates [28]. In general, the ideal temperature for synedra growth ranges from 15-25oC and sufficient sunlight is available [33]. Water conditions with low pollution levels are the favorite habitat of the Synedra genus. In addition, the availability of sufficient silica in the water is essential for Synedra's life [33]. Silica is an essential component of the Synedra cell wall structure and requires adequate amounts to thrive and reproduce. Therefore, the water must contain silica-rich sources within the environment, such as siliceous rocks or sediments, which will provide the necessary substrate for Synedra to develop.

The genus Navicula is another genus of the bacilllariophyceae class that is quite dominant at station 3. The presence of the genus Navicula in freshwater habitats is also a useful indicator of environmental conditions. Some species in this genus are very sensitive to changes in water quality, especially to pollution and increased nutrient levels [4]. Therefore, their abundance and diversity can be used as biomonitoring tools to assess the health of freshwater ecosystems. A decrease in Navicula population may indicate degradation or pollution in the water, while an increase in its abundance may indicate eutrophication or nutrient enrichment.

The Bacillariophyceae class is one of the most common classes found in Indonesian waters, both freshwater and seawater [19]. Bacillariophyceae commonly known as diatoms have an important role in the food chain cycle in aquatic ecosystems. The size of diatoms varies from microscopic to macroscopic. The main characteristic of this class is that it has a silica shell that functions in the carbon cycle and balances chemical factors in the water [32]. Under certain conditions, some types of diatom classes can develop a way to survive by making shells of calcium carbonate. Over some time, the calcium carbonate shell will settle in the water to form a layer. When water acidification occurs due to various factors, the carbonate shell layer of diatoms will release carbonate ions that react with water to produce a neutral pH. This also occurs in some other types of organisms such as mollusks, but in other organisms on a smaller scale [4].

Bacillariophyceae, also known as diatoms, are single-celled organisms of varying sizes. Cells of the Bacillariophyceae group consist of cell nuclei, golgi bodies, mitochondria, pyrenoids, chromatophores, cell walls, vacuoles, and cytoplasmic strands. One Of the unique cell characteristics of diatoms is the presence of a layer of silica in the cell wall that is bound in the water in the form of $Si(OH)4$. The silica will be used by diatoms to grow and multiply populations in a water body. Photosynthetic pigments contained in diatom cells include chlorophyll a, c, alpha, beta-carotene, and xanthophyll so that they are generally golden in color [27].

At stations 2 and 3, the dominating genus is Radiococcus from the Chlorophyceae class with an abundance of 1969.6 and 1866.7 ind/l. The high abundance of the Radiococcus genus at stations 2 and 3 which have higher levels of contamination indicates that this genus has a high tolerance range compared to other types of plankton. Some species of Chlorophyceae have preferences for certain ecosystem conditions such as water movement, inorganic compound content, pH, calcium concentration, and salinity[4]. It is not uncommon for these conditions to occur in combination, leading to an abundance of one type of plankton in the water [4].

The Chlorophyceae class is one of the classes commonly found in Indonesian waters. The Chlorophyceae class has the main characteristic of having chlorophyll as its dominant pigment so it is also called the green algae group. This group has a varied morphology. The main role of this group is as a producer in the aquatic ecological food chain[1]. In nutrient-rich water conditions the presence of this class can cause algae blooming which is characterized by discoloration in the waters. But in addition, this class is widely utilized as a food supplement, fish feed, and so on (Marbelia & Saraswati, 2019).

Generally, the Chlorophyceae class has green characteristics caused by the presence of chlorophyll-a and b which are not interrupted by additional pigments such as β-carotene and carotenoids. The presence of this class in mesotrophic and eutrophic waters generally rarely causes blooming. However, at certain times such as in early summer this class can become dominant/codominant with other types of algae in the waters. Some types of Chlorophyceae generally have preferences for ecosystem conditions such as water movement conditions, organic compound content, pH, Ca concentration and salinity [4].

Gloeocapsa is a genus of plankton that has the 2nd highest population at station 2. The presence of gloeocapsa which is a plankton of the Cyanophyceae Class has a disadvantageous role in the aquatic environment. The genus Gloeocapsa is known for its ability to survive in extreme environments, showing high tolerance to drought and high solar radiation. They can survive harsh conditions such as low nutrient availability and high temperatures [22].

The Cyanophyceae class is one of the most common classes found in Indonesian. Waters. This class is also known as blue-green algae because it has chlorophyll-a and pycobilin pigments. In general, this group has prokaryotic cells that do not have a nuclear membrane and can be found in freshwater and marine habitats. Cyanophyceae play an important role in biogeochemical processes such as carbon, nitrogen, and phosphorus cycling. However, in nutrient-rich water conditions, its existence can be dangerous because it can cause algae blooms that can produce toxin substances in the waters [20].

Cyanophyceae are known for their ability to tolerate various environmental conditions so the harshness of environmental conditions does not have a significant effect on this class. For example, in eutrophic lakes, this algae can experience enormous growth. However, in oligotrophic water conditions, the presence of this class is very small [4].

Cyanophyta is known to be a type of plankton that has a high tolerance and adaptability to extreme water conditions. In general, the cell structure of cyanophyta consists of peptidoglycan walls, DNA, and 70S ribosomes. The cell wall of cyanophyta consists of 4 layers, the outermost part is the protoplasm containing photosynthetic thylakoids called chromoplasm, then after that is the outer membrane layer, then peptidoglycan, after the innermost part is the plasma membrane. The membrane that protects cyanophyta is made up of two types of lipids, phospoglicerolipids and galactolipids. Phospoglicerolipids have the function of providing basic structure and stability to the cyanophyta cell membrane and play a role in electron transportation in the photosynthesis process. Meanwhile, galactolipids play a role in carrying photosynthetic pigments, and increase the flexibility of cell membranes, allowing cyanophyta to adapt to changes in temperature and environment [9].

Cyanophyta cells have small granules attached to thylakoids called phycobilisomes and photosynthetic pigments called phycobilin. Phycobilin in cyanophyta consists of 3 types of pigments namely phycocyanin (blue), allophycocyanin (blue), and phycoeritrin (red). The difference in phycobilin formation in cyanophyta cells will produce specific coloration whose purpose is to absorb as much radiation as possible from sunlight so that cyanophyta is not always blue-green but will have various colors such as brown, purple, and so on [9].

The presence of Cyanophyceae in a water body can be used as an indicator of ecological status. The dominance of cyanophyceae colonies in a water body indicates the presence of nutrients in the water. Algae in this class are known as a key component of various tropical indices. In addition, changes in the population of cyanophyta colonies in waters can also be used as an indicator of climate change, such as what happened in San Francisco Bay, which experienced a surge in the population of the genus Microcystis due to increased water temperatures and low currents that occurred due to the high number of drought incidents [4].

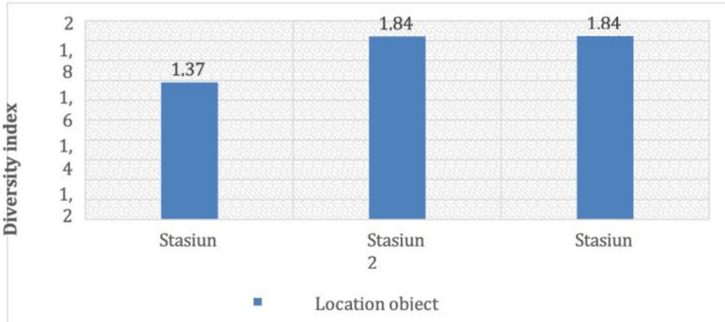

Figure 1. Diversity Index in the Cikapundung River

Based on the analysis of the diversity index value (H'), it is known that the average diversity of stations 1, 2, and 3 are 1.378, 1.831, and 1.847, respectively. Based on the data in Figure 1, station 1 is the station with the lowest average diversity index value with a value of 1.378. The highest diversity value is found at station 3 with a mean value of 1.847. The average value of the three stations is known to have a value of 1 < H'<3 which means it has moderate diversity [25]. The diversity index value at each station indicates the composition of the plankton community which is influenced by abiotic factors at each station. In addition to abiotic factors, the dominance, and evenness of plankton at each location greatly affect the high and low values of the diversity index. The Synedra and Scenedesmus genus which has a very high population number is the main reason for the low value of the diversity index at the station 1. There is a high difference between the Synedra and Scenedesmus genus with other genus at station 1, causing the high value of the dominance index at that location. The higher the dominance value of plankton in a water body, the lower the diversity value.

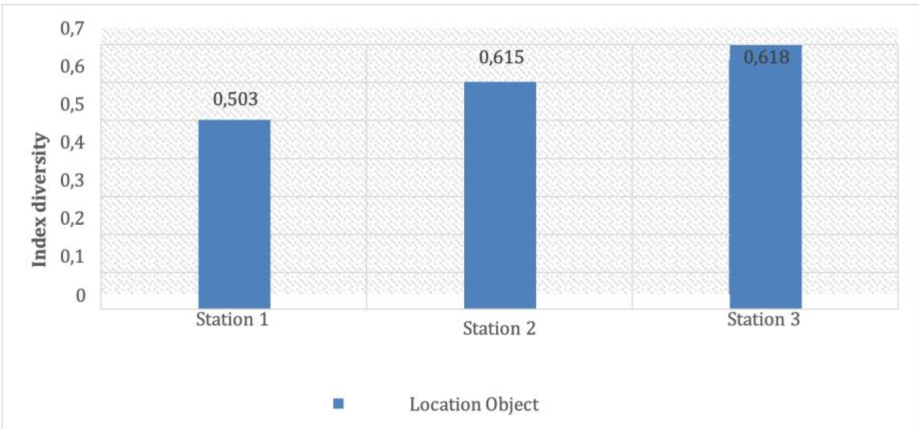

Figure 2. Evenness Index in the Cikapundung River

Based on the data in Figure 2, it is known that the average value of the evenness index at stations 1, 2, and 3 is 0.503, 0.615, and 0.618, respectively. The high value of the evenness index in a water body indicates that there is no dominating species and the distribution of the population is quite evenly distributed (even). The results of the evenness index value have a correlation that is directly proportional to the diversity index. If the composition of the plankton community in a body of water has a high level of evenness, it is likely to have a high diversity index. The dominance of plankton that occurs at station 1 the high population of Synedra makes the evenness value at station 1 lower than other stations. However, besides that, the population of Scenedesmus also has a fairly high number. The existence of more than 1 genus that dominates a water body can increase the evenness value at the station compared to only 1 genus that dominates. In contrast to station 1, stations 2 and 3 have a difference between the population of the plankton genus is not too high with other genus, so the evenness value is relatively high. Based on the mean value of the evenness index, it is known that the diversity of plankton at each station is relatively even.

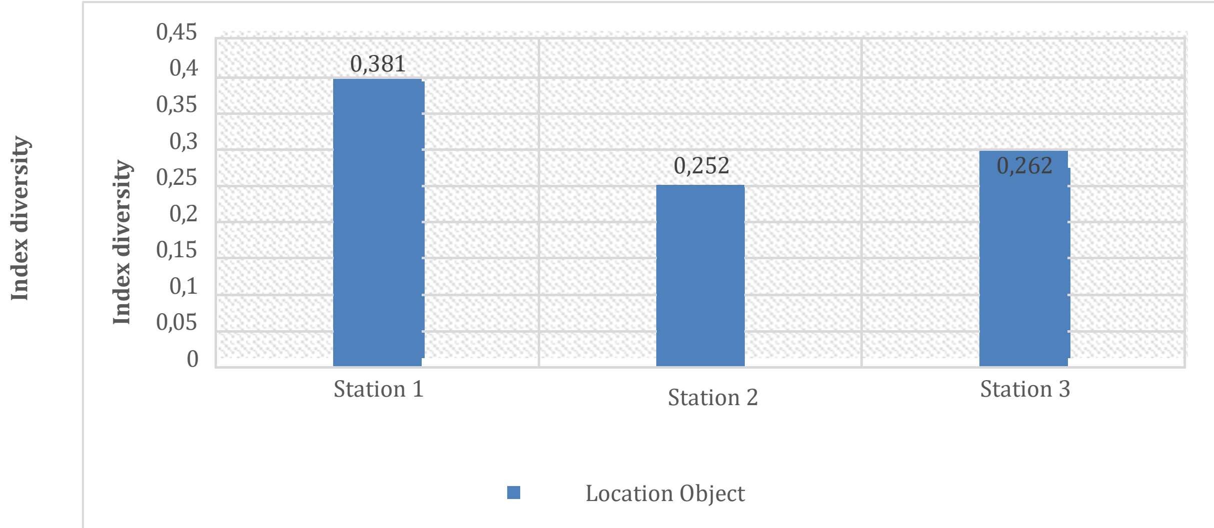

Figure 3. Dominance Index in Cikapundung River

Based on data analysis of the dominance index in the Cikapundung River, it is known that the average value of the dominance index at stations 1, 2, and 3 is 0.381, 0.252, and 0.262, respectively. Based on this value, station 1 is known to be the station with the highest mean value of dominance. The mean value of dominance at each station illustrates that the dominance of plankton at each station is relatively low. The high dominance value at station 1 is the impact of the high population of the Synedra and Scenedesmus genus which has a high population difference with other genus. In contrast to the conditions at stations 2 and 3, the population difference between genera is not too high so the dominance index is relatively low.

The dominance index value is used to indicate the presence of dominance in a water body. The relationship between the dominance index and the diversity and evenness indexes has an inverse relationship [26]. The higher the dominance of a plankton species in the water will reduce the value of diversity and evenness in these waters [26].

The dominance index value in a water body can be influenced by aquatic environmental factors. Changes in environmental conditions indirectly trigger adaptation in the plankton community. Plankton that have a fairly high tolerance range will generally survive in extreme changing conditions, while plankton with a low tolerance range will be prone to having difficulty growing when there are changes in the chemical and physical composition of the waters [16]. Based on this statement, it can be seen that the physical and chemical conditions at station 1 are ideal conditions for The growth of the genus synedra and scenedesmus which are bacillariophyceae and chlorophyceae classes. The physical and chemical conditions at stations 2 and 3 are more suitable for the growth of the radiococcus genus which is a group of Chlorophyceae classes.

3.2. Correlation of Physical and Chemical Parameters to Plankton Community Structure

Testing of physical and chemical factors in the Cikapundung River was done as supporting data that can strengthen the accuracy of the analysis results. The test results of physical and chemical parameters are presented in Table 2.

Tabel 2. The result Physical and chemical parameters in

Parameters									
Location (station)	BOD5 (mg/l)	COD (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)	p H	TDS (ppm)	Suhu (°C)	DO (mg/l)	Kecepatan arus (m/s)
1	15,2	60,23	5,56	<0,0096	8,3	76	23,56	4,73	0,16
2	76,29	172,99	6	<0,0096	8,3	99,33	24	4,06	0,298
3	50,1	125,98	6,29	<0,0096	8	98,66	23,66	3,96	0,303
Baku mutu	2	10	10	-	6-9	1000	±3	1-6	-

Based on testing from all locations, the lowest average BOD5 value is 15.2 mg/l at location 1, while the highest average BOD5 value is found at station 2 with an average BOD5 value of 76.29 mg/l. It is known from these results that the BOD5 value at all sampling locations has exceeded the established quality standard of 2 mg/l [21].

BOD (Biological Oxygen Demand) is one of the chemical parameters commonly used as an indicator of organic matter pollution associated with the degradation of dissolved oxygen content in waters [3]. Changes in BOD values in waters are caused by synergistic or antagonistic interactions between various parameters such as pH, nutrient concentrations in waters, the presence of pollutants, and so on [13]. A high concentration of BOD values illustrates that the condition of the aquatic environment is disturbed [7]. The main source of BOD pollution is generally caused by organic waste discharged into the waters. Therefore, waste treatment needs to be done to reduce the impact on the health of the aquatic environment such as the death of some organisms and a decrease in water quality [10].

Based on testing from all locations tested, the lowest average COD value is 60.23 mg/l located at location 1. The highest average COD value is found at station 2 with an average COD value of 172.99 mg/l. It is known from these results that the COD value at all sampling locations has exceeded the established quality standard of 10 mg/l [21].

COD has an important role in waters. Similar to BOD, COD is generally used as an indicator of pollution of the aquatic environment that causes the degradation of dissolved oxygen content [3]. The higher the COD value in a water body, the higher the amount of oxygen needed to decompose organic matter.

It is known that one of the main sources of increased COD values in waters is the introduction of industrial waste into the waters. In water conditions with high COD values, eutrophication can occur and the death of aquatic organisms such as fish and shrimp [17]. Therefore, a good waste treatment system is needed to preserve the aquatic environment.

Based on testing from all locations tested, the lowest average nitrate value is 5.56 mg/l located at location 1. The highest average nitrate value is found at station 3 with an average BOD5 value of 6.29 mg/l. It is known from these results that the nitrate value at all sampling locations has not exceeded the established quality standard of 10 mg/l [21].

Nitrate (NO32-) is one of the important chemical compounds in water. Based on its chemical structure, nitrate contains nitrogen elements that are needed by autotrophic organisms that do not have the nitrogenase enzyme [16]. The nitrogenase enzyme has an important role in the nitrogen fixation stage in organisms to synthesize proteins [12].

The presence of nitrate in waters is caused by the nitrogen cycle in nature by changing the form of nitrogen. Too high a nitrate value in waters can hurt environmental health. Generally, waters with high nitrate values indicate that they have been exposed to pollutants from agricultural waste [12]. The Habits of local people who still use the river as a place to perform toileting can increase nitrate levels in the waters [29]. High nitrate levels in the water can lead to eutrophication, which can worsen ecological problems in the river. Based on nitrate testing at the three stations, it can be said to be quite low because it has not exceeded the established quality standards.

The mean value of total phosphate at each station is relatively low at <0.0096 mg/l. For the value of dissolved phosphate, there is no quality standard set for river waters. In the aquatic scope, orthophosphate (PO43-) is the only phosphate compound that plays an active role in the aquatic ecosystem. Generally, phosphate in water is used by algae and bacteria to fulfill their nutritional needs. Therefore, when there is a significant decrease in phosphate levels in the water, there will be a surge in the phytoplankton population because phosphate is used for phytoplankton growth so its concentration decreases. This population surge has the potential to cause eutrophication in the waters [16].

Phosphate in waters is naturally produced from sediments and rocks. Anthropogenic activities such as household and agricultural waste disposal can increase the phosphate value in a water body [12]. If waters experience excessive phosphate pollution, it can cause damage to ecosystems and threaten human health.

Based on the results of pH testing, it is known that the average pH value at stations 1 and 2 has the same value and is the highest average pH value of 8.3. While at station 3 the average pH value is the lowest with an average value of 8. Based on these results the average pH at each station has not exceeded or is not less than the established quality standards of 6-9.

Based on the results of TDS testing, it is known that the average TDS value at station 2 is the highest average TDS value of 99.33 ppm. While at station 1 the average TDS value is the lowest with an average value of 76 ppm. Based on these results, the average TDS value at each station has not exceeded the specified quality standard of 1000 ppm [21].

Based on the results of water temperature testing, it is known that the average temperature value at station 2 is the highest average temperature value of 24oC. While at station 1 the mean temperature value is the lowest with a mean value of 23.56oC. Based on these results, the average temperature value at each station has not exceeded the established quality standard of ± 3oC from the air temperature of 26oC (but often fluctuates).

Temperature conditions in water have a correlation with depth and DO in a body of water. At relatively low-temperature conditions generally have higher DO values Compared to high-temperature conditions [6]. Temperature in the water is very important for the survival of aquatic organisms in the water area because it is one of the limiting factors in the aquatic ecosystem in the river [16].

Based on the results of the DO testing, it is known that the average DO value at station 1 is the highest average DO value of 4.73 mg/l. While at station 3 the mean value of temperature is the lowest with a mean value of 3.96 mg/l. Based on these results, the average DO value at each station has not exceeded or less than the established quality standards of 1-6 mg/l [21].

The use of detergent materials utilized by the domestic and industrial sectors can affect DO conditions in a body of water. Generally, waters exposed to detergent waste will experience a decrease in DO [29]. Apart from the use of detergents, the low pH in a water body is related to the high organic matter in the water body.

Based on the test results of water current velocity, it is known that the value of the average current velocity at station 3 is the highest average velocity of 0.303 m/s. While at station 1 the average value of the average current speed is the lowest with an average value of 0.16 m/s. Until now there has been benchmark or quality standard regarding current velocity.

The speed of the current in the river is influenced by the contour or shape of the river and the slope of the river. The presence of currents can be associated with changes in the concentration of suspended sediments in the waters. This is because the current is one of the sediment-stirring factors in the waters [2]. The high speed of the current in a body of water can cause the movement of compounds or pollutants in the water to move faster. Therefore, in conditions of waters with relatively high current speeds generally have fewer pollutants [14].

Based on the data in the table, it is generally known that station 2 has the highest level of pollution compared to other stations seen from the high values of COD and BOD. The station with the highest nutrient richness is station 3 as seen from the high nitrate value
which is higher than the other stations.

Differences in physical and chemical composition conditions at each station have an impact on the structure of the plankton community. Changes in plankton community structure can be seen from the genus that dominates at each station and the number of genera found at each station.

3.3 Spearmann Correlation Test Between Physical and Chemical Parameters to Plankton Communities

Based on the results of the normality test, it is known from the physical and chemical parameters that only TDS, current velocity, DO, diversity, evenness, and dominance parameters have normally distributed data with a significance value> 0.05. Because there are parameters that are not normally distributed, the test is continued using a non-parametric correlation test, namely the Spearman correlation test. Physical and chemical parameters are tested for correlation with the plankton community which includes diversity index, evenness index, and dominance index. The test results table is presented in the table.

Table 3. Spearmann Correlation Test Results of Physical and Chemical Parameters on Plankton Diversity

	Ph	TDS	Suhu	DO	Arus	COD	BOD	Nitrat
Coefficient Correlation	0,207	0,333	0,269	-0,301	0,333	0,233	0,233	-0,1
Sig.2 Tailed	0,593	0,381	0,484	0,431	0,381	0,546	0,546	0,798

The Spearmann Correlation Test on the plankton diversity index does not have a significant correlation with the physical and chemical parameters tested. This is because the value of sig. 2 tailed on the parameters tested does not meet the requirements of less than (<) 0.005 which means there is no relationship between the parameters tested.

Table 4. Spearmann Correlation Test Results of Physical and Chemical Parameters on Plankton Diversity

	Ph	TDS	Suhu	DO	Arus	COD	BOD	Nitrat
Coefficient Correlation	0`	0,483	0,239	-0,494	0,5	0,3	0,317	-0,1
Sig.2 Tailed	1	0,187	0,536	0,177	0,17	0,433	0,406	0,798

The Spearmann Correlation Test on the plankton evenness index does not have a significant correlation with the physical and chemical parameters tested. This is because the value of sig. 2 tailed on the parameters tested does not meet the requirements of less than (<) 0.005 which means there is no relationship between the parameters tested.

Table 5. Spearmann Correlation Test Results of Physical and Chemical Parameters on Plankton Dominance

	Ph	TDS	Suhu	DO	Arus	COD	BOD	Nitrat
Coefficient Correlation	-0,311	-0,183	-0,199	0,268	-0,4	-0,333	-0,3	0,083
Sig.2 Tailed	0,416	0,637	0,607	0,486	0,286	0,381	0,433	0,831

The Spearmann Correlation Test on the plankton dominance index does not have a significant correlation with the physical and chemical parameters tested. This is because the value of sig. 2 tailed on the parameters tested does not meet the requirements of less than (<) 0.005 which means there is no relationship between the parameters tested.

3.4 Pollution Level in Cikapundung River Based on Saprobity Index

The saprobity index can be used as one of the indicators of pollution in a water body. The concept of the probity index is to calculate the number of compositions of certain types of plankton to determine the condition of these waters.

Based on the saprobity index conducted in the Cikapundung River for 3 replicates with a time interval of one week, the results are presented in Table 6.

Table 6. Saprobity value in Cikapundung River

Waktu pengujian	Nilai indeks saprobik (SI)	Nilai tropik saprobik indeks (TSI)
Stasiun 1	0,714	0,715
Stasiun 2	-0,202	-0,203
Stasiun 3	0,745	0,766
Rerata	0,419	0,425

Based on the calculation of saprobity index (SI) and trophic saprobic index (TSI), it is known that station 3 in Cikapundung River has the highest SI and TSI values of 0.745 and 0.766. The second highest SI and TSI values are found at station 1 with an SI value of 0.714 and a TSI value of 0.715. The lowest value is found at station 2 with an SI value of -0.202 and a TSI value of -0.203. According to Rosada & Sunardi (2021), waters with an SI value of 0.5-1 as in stations 1 and 3 have a mild level of pollution.

Waters on this value scale are classified into β mesosaprobic waters. Meanwhile, the analysis of the SI value at station 2 in the Cikapundung River, namely - 0.202, indicates that the station is experiencing moderate pollution. Higher pollution conditions around station 2 based on direct observation are caused by the amount of waste disposed directly into the river and the lack of maintenance in the river body. Based on this value, station 2 is classified into mesosaprobic α/β waters [25]. Based on the results of the saprobity test analysis, the mean values of SI and TSI in the Cikapundung River are 0.419 and 0.425. Based on these values, the Cikapundung River is known to have a mild level of pollution or belongs to the β/α mesosaprobic water group.

4. CONCLUSION

Cikapundung River has moderate diversity, high evenness and low dominance.There is no correlation between physical and chemical parameters to the plankton community in this study.The analysis shows that the Cikapundung River is classified as lightly polluted waters or classified as β-mesosaprobic waters.

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