



Macrozoobenthos Community Structure in Situ Cileunca, Pangalengan District, Bandung Regency, West Java

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This research aims to determine the structure of the macrozoobenthos community which includes variety, diversity, uniformity, coefficient of similarity and the Family Biotic Index (FBI) macrozoobenthos as well as the physical and chemical parameters of the waters and to determine the pollution status of Situ Cileunca waters. The research was conducted in Situ Cileunca, Bandung Regency, West Java from January to February 2021. The research method used a survey method. The method used in data collection is purposive sampling by determining 5 stations and 4 times. Data analysis in this research uses descriptive analysis. The results showed that the lowest average Biochemical Oxygen Demand (BOD₅) value was found at station 4 of 8.90 ± 4.92 mg/L and the highest average BOD₅ value was found at station 5 of 12.99 ± 6.60 mg/L. There are three species of macrozoobenthos that live in the waters of Situ Cileunca, namely *Pomacea canaliculata*, *Filopaludina javanica* and *Anodonta woodiana*. Macrozoobenthos abundance ranges from 400 - 704 ind/m². The diversity index of macrozoobenthos is included in the low category, ranging from 0.17 to 0.28. The uniformity value ranged from 0.36 - 0.59 which was classified as moderate in all including except at station 4 which was classified as low. The lowest average similarity coefficient was found between stations 3 and 5 was 0.13 and the highest average similarity coefficient between stations 4 and 5 was 0.30. The index value of the FBI

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macrozoobenthos ranged from 6.05 to 6.18 with a rather poor category. The pollution status of Situ Cileunca is moderately polluted because the BOD₅ value is categorized as moderately polluted, the diversity (H') is classified as heavily polluted and the FBI value is in the rather poor category.

Keywords: *Macrozoobenthos; biochemical oxygen demand; abundance, diversity; uniformity, similarity coefficient; FBI Index; pollution status.*

1. INTRODUCTION

Situ Cileunca is an artificial lake located in Pangalengan District, Bandung Regency, West Java Province, Indonesia which is used for hydropower, a tourist attraction, used by local residents for bathing, washing and agricultural irrigation. Other activities carried out by residents around Situ Cileunca are vegetable and strawberry plantations. Fishing activities using fishing rods and nets are also still being carried out around the waters of Situ Cileunca. Activities carried out around the waters of Situ Cileunca cause the amount of liquid and solid waste that enters the water body to increase.

Determination of water quality can be done in several ways including using biological components such as macrozoobenthos which play an important role. Macrozoobenthos has a relatively permanent nature so that it will be directly affected if there is a change in water quality [1].

Disturbances due to anthropogenic and natural activities can cause negative impacts in the form of pollution to the physical and chemical quality of the waters that have an impact on the life of aquatic biota such as changes in the structure of the macrozoobentos community such as changes in abundance and diversity [2]. The decrease in abundance and diversity of macrozoobenthos is generally an indicator of ecological disturbances in the waters, therefore it is necessary to conduct research to determine the quality of the waters in Situ Cileunca due to various human activities (domestic, agriculture, tourism) and natural activities that result in the entry of waste into water bodies and determine Pollution status of Situ Cileunca waters.

Therefore, it is necessary to analyze the quality of water physically, chemically, and biologically in Situ Cileunca. This research aimed to determine the structure of the macrozoobenthos community which includes abundance, diversity, uniformity, similarity coefficient and macrozoobenthos FBI index and its relationship with water quality based on the physical and chemical

environmental aspects of the waters and to determine the pollution status of Situ Cileunca waters.

2. MATERIALS AND METHODS

2.1 Research Time and Place

This research was conducted from January to February 2021 at Situ Cileunca, Bandung Regency, West Java. The method used in this research is a survey method and the sampling technique is purposive sampling. Sampling was carried out once every 14 days at five observation stations (Fig.1) and four replications which were determined based on the source of waste generated by activities around Situ Cileunca

- Station 1: Puncak Mara, located at coordinates 7°12'32" SL and 107°33'11" EL is the lake inlet, there are fishing activities using nets and vegetable plantations around the waters.
- Station 2: Cipangisikan, located at the coordinates of 7°12'03" SL and 107°32'31" EL is an area with school and agricultural activities.
- Station 3: Cibuluh, located at coordinates 7°11'44" SL and 107°32'59" EL is a water area located in the middle of Situ Cileunca where there are fishing activities using fishing rods and nets, fruit plantations around the waters. The depth of the waters is generally 1 - 7 meters.
- Station 4: Cibeunying, located at the coordinates 7°11'34" SL and 107°32'46" EL is a water area that is used as a tourist area of Situ Cileunca, stalls and borders Cipangisikan. There is fishing activity with nets and fishing rods.
- Station 5: Pulo Dam, located at coordinates 7°11'25" SL and 107°32'53" EL is a lake outlet, used by local residents for bathing, washing, fetching water for household needs, catching fish using fishing rods and nets and there are many organic and inorganic waste.

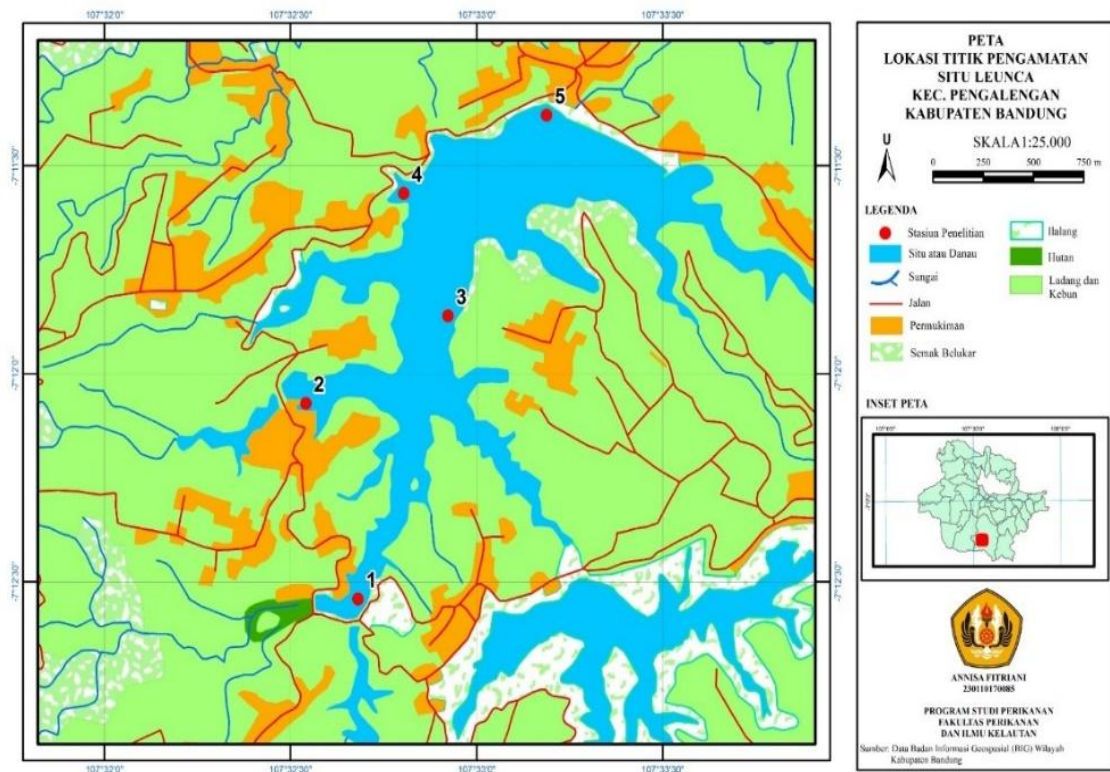


Fig. 1. Map of the Macrozoobenthos observation station

2.2 Sampling and Measurement

Sampling was carried out at 5 stations with 4 repetitions. The sampling period was carried out once every 14 days, and the substrate sampling was only carried out once during the first sampling. The water samples analyzed were temperature, brightness, turbidity, depth, pH, dissolved oxygen (DO) which were carried out in situ. Analysis of Biochemical Oxygen Demand (BOD₅) at the Water Resources Management Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University. Turbidity was analyzed in the Laboratory of Chemistry Study Program, Faculty of Mathematics and Natural Sciences. Identification of macrozoobenthos in PPSDAL Padjadjaran University. Sediment texture was analyzed at the Laboratory of Soil Chemistry and Plant Nutrition (KTNT) Department of Soil Science and Land Resources, Faculty of Agriculture, Padjadjaran University.

2.3 Macrozoobenthos Sampling and Identification

Macrozoobenthos at each station were taken using an ekman grab. Macrozoobenthos and the

substrate were separated using a filter, the substrate sample was put into a labeled plastic bag and the macrozoobenthos sample was put into a labeled bottle. 4% formalin was used to preserve macrozoobenthos samples. Macrozoobenthos samples were identified to the species level visually by comparing the samples obtained with the sample images in the benthic invertebrate identification book and then the sample was counted for the number of individuals for each species.

2.4 Data Analysis

Macrozoobenthos community structure data and water quality were analyzed using comparative descriptive analysis. The data will be compared with Government Regulation of the Republic of Indonesia Number 22 of 2021. The data used for analysis is the result of the average number of samples at each station. The analysis carried out includes, diversity, uniformity, coefficient of similarity and the FBI index.

2.4.1 Abundance of macrozoobenthos

Macrozoobenthos abundance is the number of macrozoobenthos individuals per unit area of

ekman grab opening (m²). Abundance is calculated using the following formula [3]:

$$K = \frac{a}{b}$$

Description:

K=Abundance of macrozoobenthos (individuals/m²)

a= Total macrozoobenthos obtained (individuals)

b = Area of ekman grab opening (m²)

2.4.2 Macrozoobenthos diversity

Species diversity is one of the characteristics of the community structure. The diversity of macrozoobenthos species was calculated using the Shannon-Wiener diversity index (H') formula as follows [4]:

$$H' = -\sum P_i \log_2 P_i$$

$$P_i = \frac{n_i}{N}$$

Description:

H'= Shannon Wiener Diversity Index

Pi= Proportion of the genus in the total genus or the ratio between the number of individuals of type i species (ni) with the number of individuals of all the ith species (ni) of all samples

ni= Number of individuals of type i species

N= Number of individuals of all species from all samples

2.4.3 Macrozoobenthos uniformity

The uniformity index is used to determine the existence of uniformity by certain types, namely using the uniformity index formula as follows [4]:

$$E = \frac{H'}{H_{max}}$$

Description:

E= Uniformity Index

H'= Diversity Index

Hmax = Log₂(S)

S= Number of species found

By Criteria:

0 < E < 0,4 = Low uniformity

0,4 < E < 0,6 = Moderate uniformity

0,6 < E < 1 = High Uniformity

2.4.4 Similarity coefficient

The similarity coefficient can be calculated using the following equation [5]:

$$B = \frac{\sum(X_{ij} - X_{ik})}{\sum(X_{ij} + X_{ik})}$$

Description:

B= Measure of Bray-Curtis Inequality

Xij, Xik = Number of individuals of the ith species in each sample

The similarity coefficient is determined by 1-B

By Criteria:

1-B~0= There are differences in community structure

1-B~1= There are similarities in community structure

2.5 FBI Index

Family Biotic Index (FBI) is a water quality index calculation based on the tolerance value (resistance to environmental changes) of each family. The formula for calculating the FBI index as follows [6]:

$$FBI = \sum \frac{x_i \cdot t_i}{N}$$

Description:

FBI= Family Biotic Index

xi= Number of individuals in the i-th family group

ti= The tolerance value of the i-th family group

N = Total number of individuals

Water quality can be described by FBI value because it is related to the tolerance of the macrozoobenthos family so that only certain families can live in the waters. Water quality criteria based on FBI value can be seen in Table 1.

3. RESULTS AND DISCUSSION

3.1 Physical and Chemical Parameters of Waters

The physical parameters observed during the study were temperature, turbidity and depth parameters. Chemical parameters observed during the study were the degree of acidity (pH), DO and BOD. The measurement data can be seen in Table 2.

Tabel 1. Water quality and pollution levels based on FBI value

FBI Value	Water Quality	Pollution Level
0,00-3,75	Very good	Not polluted with organic matter
3,76 – 4,25	Very well	Slightly contaminated with organic matter
4,26 – 5,00	Well	Contaminated with some organic matter
5,01 – 5,75	Enough	Polluted quite a lot
5,76 – 6,50	Kinda bad	Polluted a lot
6,51 – 7,25	Bad	Polluted so much organic matter
7,26 – 10,00	Very bad	Heavily polluted with organic matter

Table 2. The average value of physical and chemical parameters

Parameter	Station	Lake Water Quality Standards					
		1	2	3	4	5	
Temperature (°C)	Range	19.4-24.5	17.7-26.2	19-27.3	19-26.4	19.2-27.3	Deviation 3
	Average	22.40	22.88	23.50	22.65	22.50	
		±1.93	±3.26	±2.99	±2.62	±3.30	
Turbidity (NTU)	Range	40.82-	21.91-	14.18-	21.99-	14.09-	50
	Average	6.55	91.46	23.05	40.53	18.98	
		59.08	45.36	18.68	32.40	16.17	
Depth (meter)	Range	1.6-4.0	1.0-3.5	2.0-4.0	1.7-3.8	1.5-3.7	
	Average	2.7 ±0.94	2.3 ±0.89	3.2 ±0.79	2.8 ±0.76	2.8 ±0.80	
pH	Range	5.79-7.6	7.74-9.22	6.29-7.49	6.83-8.94	4.85-7.49	6-9
	Average	7.03	8.57-0.47	6.87	7.97	6.39	
		±0.73		±0.54	±0.81	±1.09	
DO (mg/L)	Range	9.3-12.3	11.8-13.8	8.7-13.8	7.7-12.4	6.7-13.7	4
	Average	10.68	12.98	11.63	10.80	11.03	
		±1.34	±0.79	±2.13	±1.84	±2.78	
BOD ₅ (mg/L)	Range	3.25-	3.25-24.3	3.25-	4.85-	3.25-21.1	3-12
	Average	17.85	9.73	17.85	14.55	12.99	
		10.54	±8.64	9.74	8.90	±6.60	
		±5.20		±5.50	±4.92		

Information: *Government Regulation of the Republic of Indonesia No. 22 of 2021

The temperature in the waters of Situ Cileunca as a whole ranges from 17.7 - 27.3°C. The lowest average temperature value is at station 1 of 22.40 ±1.93°C and the highest average value is at station 3, which is 23.50 ±2.99°C. The water temperature that varied at the five research stations was influenced by the time of measurement, namely the order of the five stations was randomized in each sampling so that in the first sampling the physical and chemical parameters of the waters were measured in the morning and the next sampling was measured in the afternoon. The randomization of the stations was carried out so that there was no imbalance in the data. The intensity of sunlight entering the waters in the morning is lower than when measuring the waters during the day which has a high intensity of sunlight. According to [2] the intensity of

sunlight, the temperature exchange between water and air, geographical altitude, and the presence of trees growing on the banks of the river are factors that cause temperature differences.

According to [7] a good temperature for macrozoobenthos life ranges from 25 – 30°C. The overall temperature in Situ Cileunca is still within the tolerance value for the life of aquatic organisms including macrozoobenthos. in general, the temperature in the waters of Situ Cileunca still meets the class 2 category of Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management of lake water quality standards, namely deviation 3.

The depth of the waters of Situ Cileunca based on the results of the study ranged from 1.5 - 4.0

meters. The lowest average depth is located at station 2 of 2.3 ± 0.89 meters where there are agricultural activities whose waste directly enters the waters and there are many weeds such as water hyacinth. According to [8] water hyacinth plants cause silting in the waters. The highest average depth value at station 3 is 3.2 ± 0.79 meters. According to [9] in [10] the depth of a waters will affect the number of species, individuals and biomass of macrozoobenthos organisms and can affect the distribution pattern or distribution of macrozoobenthos. The depth of a waters is related to the abundance of macrozoobenthos, namely an increase in water depth followed by a decrease in the abundance of macrozoobenthos, whereas a high abundance is found in shallow waters [11].

The turbidity value in the waters of Situ Cileunca is in the range of 14.18 – 91.46 NTU. The lowest mean turbidity value is found at station 5 of 16.17 ± 2.04 NTU and the highest average value of turbidity is found at station 1 of 59.08 ± 10.55 NTU. The high turbidity at station 2 is due to the large amount of organic waste from agricultural activities entering the water body. According to [12] the factors that affect the turbidity of the waters are organic matter in the form of suspended particles and colloids. The turbidity value or Total Suspended Solid (TSS) in Situ Cileunca still meets the class 2 category of Government Regulation no. 22 of 2021 concerning the Implementation of Environmental Protection and Management, the lake water quality standard is 50 NTU.

The pH value in the waters of Situ Cileunca during the study ranged from 4.85 - 9.22. The lowest average pH value was found at station 5 of 6.39 ± 1.09 and the highest average pH value was found at station 2 of 8.57 ± 0.47 . The high pH value at station 2 is caused by vegetable plantation waste such as fertilizer that goes directly into water bodies. The concentration of organic matter is quite high, causing the pH value to be high. Rehabilitation of organic matter is quite smooth if the pH is high enough. This is because pH affects the activities and life of microorganisms [8].

According to [13] the pH value that can support macrozoobentos life is between 6 - 7. Overall the pH of the Cileunca Situ waters is still safe for macrozoobenthos life. Based on Government Regulation no. 22 of 2021 concerning the Implementation of Environmental Protection and Management of lake water quality standards, the

pH value of Situ Cileunca waters still meets the class 2 category, which is 6 - 9.

The concentration of dissolved oxygen (DO) in the waters of Situ Cileunca during the study ranged from 6.7 - 13.8 mg/L and oxygen saturation of 87-100%. The lowest DO average value was found at station 1 of 10.68 ± 1.34 mg/L. The highest average DO value was found at station 2 of 12.98 ± 0.79 mg/L because the temperature at station 2 was higher than other stations during the study. This is supported by the statement [11] that the concentration of dissolved oxygen depends on temperature, photosynthesis of aquatic plants, the level of light penetration which depends on the depth and turbidity of the water, the level of hardness of the water flow, the amount of organic matter such as garbage, dead algae and industrial waste. The high temperature causes the dissolved oxygen concentration to increase. In general, the concentration of dissolved oxygen in the waters of Situ Cileunca still meets the class 2 category of Government Regulation no. 22 of 2021 concerning the Implementation of Environmental Protection and Management, the lake water quality standard is for class 2 of 4 mg/L.

The concentration of BOD₅ in the waters of Situ Cileunca during the study ranged from 3.25 - 24.3 mg/L. The lowest average BOD₅ value was found at station 4 of 8.90 ± 4.92 mg/L and the highest average BOD₅ value was found at station 5 of 12.99 ± 6.60 mg/L because at station 5 there was bathing activity. and washing by local residents, and there is a lot of organic waste around the waters. The overall average value of BOD₅ in the waters of Situ Cileunca is 10.38 ± 1.36 mg/L. The concentration of BOD₅ is determined by the activity of decomposing organisms such as bacteria in decomposing organic matter [14]. In addition, domestic and industrial waste entering water bodies can also affect the BOD₅ value [15]. Based on Government Regulation no. 22 of 2021 concerning the Implementation of Environmental Protection and Management of lake water quality standards, the concentration of BOD₅ in the waters of Situ Cileunca belongs to the class 4 category of 12 mg/L so it is in the moderately polluted category.

3.2 Substrate

Substrate parameters measured during the study were substrate pH, C-organic, N-organic (N-total), C/N ratio and substrate texture. The

substrate parameter data table can be seen in Table 3.

Data from the measurement of substrate pH at each station obtained values ranging from 6.12 to 6.80. The overall substrate pH value at Situ Cileunca is neutral, there are only acidic substrates, namely at station 3 which is the middle part of Situ Cileunca and station 5 which is the outlet part. According to [8] the pH value of the substrate has a close relationship with the content of organic matter. A pH value that is too low inhibits the smooth overhaul of organic matter so that there is a decrease in organic matter, on the other hand, the reshuffle of organic matter is quite smooth if the pH is high enough. During the research, the pH value of the substrate was still relatively safe for the life of macrozoobenthos.

The concentration of C-organic on the substrate at Situ Cileunca ranged from 3.43 - 5.43%, namely station 3 and station 4 were classified as high, while at station 1, station 2 and station 5 were classified as very high. The total N-concentration on the substrate at Situ Cileunca ranged from 0.54 - 1.15%, which was high at station 2, station 3 and station 4 and very high at station 1 and station 5. The concentration of C/N ratio was low, namely ranged from 5-10.

The concentration of organic matter in aquatic substrates such as C and N will affect the type and abundance of macrozoobenthos. This is due to the deposition of organic matter to the bottom of the water that can be used as food for macrozoobenthos so that the amount of organic matter at a certain limit will affect the presence of macrozoobenthos. According to [16] organic carbon (C) is a determining factor in the growth of benthic biota in the substrate. The type of bottom substrate of the waters determines the density and composition of macrozoobenthos because these organisms have different adaptability to different types of substrates.

Based on the data in Table 3, the dominant substrate fraction in the waters of Situ Cileunca during the study was dust with an average percentage of 54.6%. The type of substrate in the waters of Situ Cileunca at the five stations is clay substrate. The clay substrate has a fairly high organic matter content that allows for the existence of organisms at the station because organic matter is a component needed by macrozoobenthos for its survival and substrate conditions with a combination of three types of

substrate, namely sand, mud and clay which are suitable for macrozoobenthos habitat [17]. Organic matter tends to increase with increasing silt and clay content [10]. The clay fraction has a smaller grain size than the sand and mud fraction so that the clay fraction can settle [18].

Sandy substrates contain relatively large amounts of oxygen compared to smooth substrates because in sandy substrates there are water pores that allow more intensive mixing with the water above, but in sandy sediments there are not many nutrients [17]. The finer substrate, although it contains very little oxygen, provides sufficient nutrients in large quantities.

According to [12] the particle size of the sediment affects the organic matter content in the sediment or it can be said that the smaller the particle size of the sediment, the greater the organic matter content. The solid material that is carried by the current and settles contains a texture suitable for benthic organisms, in addition to the suitable texture, another factor is that the material that settles has more clay fractions than sand and dust so that it contains high levels of organic matter and can be used as life support. macrozoobenthos animals.

All stations are dominated by gastropod groups. Stations 3, 4 and 5 have high abundance values because the substrate type has a high organic matter content, namely dusty clay, sandy clay and dusty clay loam. The Gastropod group prefers sandy loam substrate because it contains a lot of organic matter. According to [19] the Bivalves group prefers a substrate that has a smooth texture such as mud in accordance with their feeding behavior, namely almost all types of Bivalves are filter feeders or food filters.

3.3 Macrozoobenthos Community Structure

Based on the results of the study, three species of macrozoobenthos were found, namely *Pomacea canaliculata*, *Filopaludina javanica* and *Anodonta woodiana*. Data on the abundance of macrozoobenthos in Situ Cileunca can be seen in Table 4.

The abundance of macrozoobenthos in Situ Cileunca 400 – 704 ind/m² (Table 4). The lowest abundance was found at station 1 at 400 ind/m² due to the frequent washing of local residents due to macrozoobenthos cannot live in waters with excessive detergent concentrations [8]. The

highest abundance value is found at station 3 of 704 ind/m² because there are fruit plantation activities whose waste directly enters water bodies such as pesticides and fertilizers. The gastropod class macrozoobenthos can survive in substrate environmental conditions with high organic matter content and can adapt well to live in various places [20]. This difference in abundance is caused by differences in the influence of organic matter and changes in environmental conditions, especially substrates as a result of anthropogenic activities around the area that cause environmental pressures on certain types of macrozoobenthos [21].

Pomacea canaliculata is an indicator that a water has been contaminated with agricultural waste [21]. *Filopaludina javanica* is a widespread macrozoobenthos because of its high adaptability. *Anodonta woodiana* is an organism that is resistant to pollution, even heavy metal waste.

The lowest Shannon-Wiener (H') macrozoobenthos diversity index is at station 4 of 0.17 while the highest diversity index value is at station 3 and station 1 of 0.28 (Fig. 2). The diversity value of the five research stations is classified as low diversity. The low diversity value indicates that the waters have dominant species, the waters experience high ecological pressure or the ecosystem is unstable because the waters of Situ Cileunca are heavily polluted with organic matter due to plantation activities at stations 1, 2, and 3, tourism at station 4 and bathing and washing activities at station 5 which causes only a few species of macrozoobenthos to survive in the waters of Situ Cileunca because they can tolerate these conditions. According to [20] the value of diversity is related to environmental conditions that affect the tolerance level of macrozoobenthos because each type of macrozoobenthos has a different tolerance.

Table 3. The content and characteristics of the research station substrate parameter

Parameter	Station				
	1	2	3	4	5
pH	6.70	6.80	6.12	6.63	6.38
C-Organic (%)	5.42	5.14	4.60	3.43	5.43
N-Total (%)	0.87	0.54	0.56	0.65	1.15
C/N	6	10	8	5	5
Texture	Clayey Clay	Clay	Dusty Clay	Sandy Loam	Dusty Clay

Table 4. The abundance of macrozoobenthos

Species	Abundance (Ind/m ²)				
	Station 1	Station 2	Station 3	Station 4	Station 5
<i>Pomacea canaliculata</i>	320	464	592	576	544
<i>Filopaludina javanica</i>	48	64	64	32	80
<i>Anodonta woodiana</i>	32	32	48	32	16
Total	400	560	704	640	640

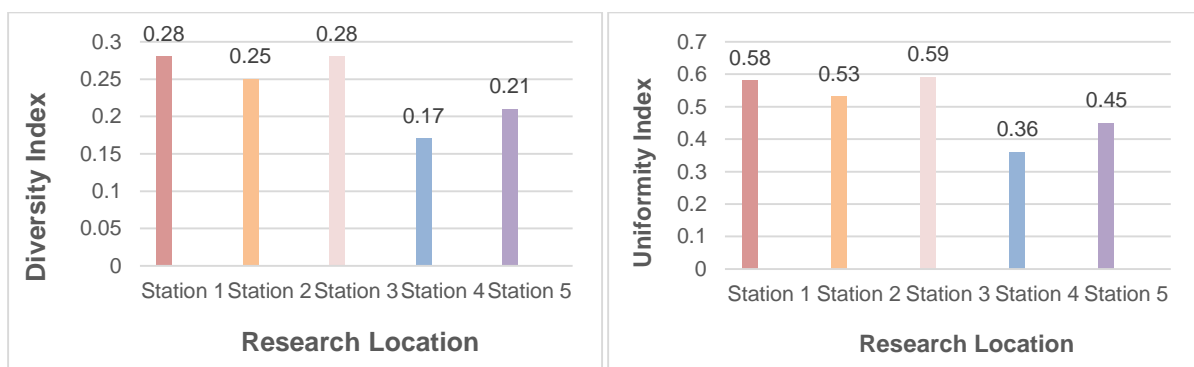


Fig. 2. Diversity and uniformity index of Macrozoobenthos

According to [22] the low diversity value is caused by the uneven distribution or distribution of macrozoobenthos in a community. This low diversity can also be caused by the physical and chemical conditions of the waters such as pH, temperature, and the substrate is only suitable for species found during sampling, namely *Pomacea canaliculata*, *Filopaludina javanica* and *Anodonta woodiana*.

The lowest uniformity index value of macrozoobenthos was found at station 4 of 0.36 and the highest uniformity value was found at station 3 of 0.59 (Fig. 2). The value of macrozoobenthos uniformity at the five research stations was moderate, except for station 4, which was low. Station 3 is a water area with plantation activities around it, tourism boats passing by and fishing activities have a moderate uniformity index indicating that the macrozoobenthos at the station are unevenly distributed and their composition is not balanced. Station 4 is a tourism area and fishing has a low uniformity index indicating that the macrozoobenthos community is depressed, and there is a dominant species. The five stations are dominated by gastropods. Gastropods can accumulate pollutants without being killed, are found in large numbers, and live for a long time.

According to [23] the uniformity index (E) is used to see whether in an observed aquatic organism community there is a pattern of dominance by one or several groups of organism types. The uniformity index value that is close to zero indicates that the distribution of the number of individuals or species is not evenly distributed, there are individuals whose number exceeds or is dominant compared to other types.

The lowest average similarity coefficient value was found between stations 3 and 5, which was 0.13 and the highest average similarity coefficient value was found between stations 4 and 5, which was 0.30 (Table 5). The lowest coefficient of similarity between stations 3 and 5 indicates that there are differences in the structure of the macrozoobenthos community that inhabits these waters, while the highest coefficient of similarity between stations 4 and 5 describes the structure of the macrozoobenthos community living at each station that has similarities in terms of type and number.

The abundance of macrozoobenthos at station 3 during the study ranged from 48 - 592 ind/m² while at station 5 the abundance of

macrozoobenthos ranged from 16 - 544 ind/m², this indicates that there is a difference in water quality, namely station 3 has a lower level of water pollution than station 5. At stations 4 and 5, the highest similarity coefficient values were at station 4 the abundance of macrozoobenthos ranged from 32 to 576 ind/m² and at station 5 the abundance of macrozoobenthos ranged from 16 to 544 ind/m². This indicates that the two waters are relatively the same level of pollution and the basic substrate factors also have similarities and are located close together.

The substrate type at station 3 is dusty clay while at station 5 it is dusty clay. The type of substrate at station 4 is sandy clay loam, while at station 5 it is dusty clay loam. The facultative gastropod group prefers sandy loam substrates [15] such as *Pomacea canaliculata* and *Filopaludina javanica*. According to [19] the Bivalves group prefers a substrate that has a smooth texture such as mud in accordance with its feeding behavior, namely filter feeder.

FBI value on the five stations ranged from 6.05 - 6.18 (Fig. 3). Based on the classification of water quality levels based on the FBI value, the water quality of Situ Cileunca is included in the category of rather poor water quality, namely the level of pollution is heavily polluted with organic matter. The highest FBI value is at station 3 of 6.18, while the lowest FBI value is at station 5 which is 6.05.

Pomacea canaliculata and *Filopaludina javanica* are facultative organisms, namely organisms that can live in lightly to moderately polluted waters [15]. Families in the gastropod group are able to adapt well to environments containing high concentrations of pollutants [24]. Family Unionidae (*Anodonta woodiana*) is a group of macrozoobenthos that has a high tolerance value to changes in environmental conditions [25].

3.4 Discussion Summary

Water quality needs to be analysed to determine the extent of pollution and to develop a water management plan. Pollution status in the waters of Situ Cileunca can be seen in Table 6.

Based on the table, pollution status in Situ Cileunca waters at the five research stations has moderate to heavily polluted status because the BOD₅ value is categorized as moderately polluted, the diversity (H') is classified as heavily polluted and the FBI value is in the rather

poor category. Based on the type of macrozoobenthos found, the indicator species of moderate to severe pollution were *Pomacea canaliculata* and *Filopaludina javanica* and the indicator of heavy pollution was *Anodonta woodiana*.

Table 5. Average similarity coefficient value of macrozoobenthos

Station	Average Similarity Coefficient Value	Station
1	0,23	2
	0,25	
	0,24	
	0,22	
2	0,23	3
	0,25	
	0,24	
	0,22	
3	0,22	4
	0,13	
4	0,3	5

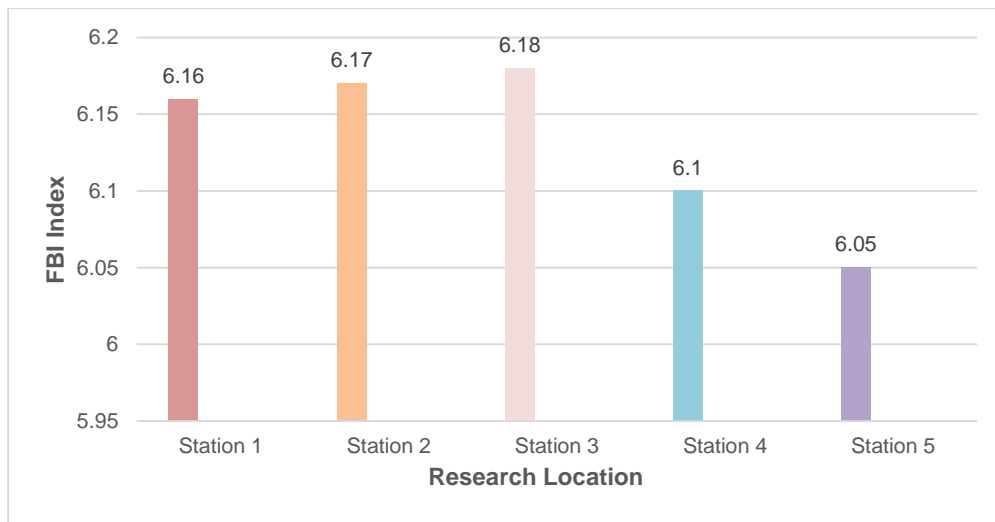


Fig. 3. FBI Index of Macrozoobenthos

Table 6. The pollution status of situ cileunca waters

		BOD	H'	FBI	Status
Station 1	Value	10.54 ±5.20	0.64	6.16	Moderately polluted
	Catogory	Moderately polluted	Heavily polluted	Rather poor	
Station 2	Value	9.73 ±8.64	0.58	6.17	Moderately polluted
	Catogory	Moderately polluted	Heavily polluted	Rather poor	
Station 3	Value	9.74 ±5.50	0.65	6.18	Moderately polluted
	Catogory	Moderately polluted	Heavily polluted	Rather poor	
Station 4	Value	8.90 ±4.92	0.39	6.10	Moderately polluted
	Catogory	Moderately polluted	Heavily polluted	Rather poor	
Station 5	Value	12.99 ±0.60	0.49	6.05	Heavily polluted
	Catogory	Heavily polluted	Heavily polluted	Rather poor	

4. CONCLUSION

Based on the results of the study, the average value of BOD5 in the waters of Situ Cileunca was 10.38 ± 1.36 mg/L which included the criteria for moderate pollution, the value of Shannon-Wiener diversity (H') ranged from 0.17 – 0.28 which included the criteria for heavy pollution and FBI scores ranged from 6.05 to 6.18 with a rather poor category, thus the status of the waters of Situ Cileunca, which is polluted, is moderately polluted. Species found during the study were *Pomacea canaliculata* and *Filopaludina javanica* as indicators of moderate pollution and *Anodonta woodiana* as indicators of heavy pollution.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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