Original Research Article

Assesing The Community Structure of Macrozoobenthosin Cibeureum Lake,Tasikmalaya, West Java, Indonesia

ABSTRACT

The purpose of this research is to determine the water quality of Cibeureum Lake, Kab. Tasikmalaya by analyzing the macrozoobenthos community structure. The study was conducted from September to November 2021 using a survey method with purposive sampling. Descriptive analysis was employed to analyze the observation data. The studi revealed the presence three classes and eight species of macrozoobenthos with *Pomaceacanaliculata*(58 Ind/m^2 (28%) being the most abundant species. The results demonstrated that the water quality in Cieureum Lake, as determined by macrozoobenthos bioindicator, fell into the moderately polluted category. This is diversity indicated values ranged from 1.3 to 1.8, classifying the macrozoobenthos community as moderately diverse. The uniformity index value ranged from 0.57 to 0.66, indicating an unstable population conditions, suggesting moderate uniformity of macrozoobenthos in the lake. According to FBI (Functional Biological Index) score, Cibeureum Lake exhibit a range of water quality criteria from very good to fair. Station 2 and station 4 obtained excellent waters quality rating with an FBI rating 3.97 and 4.16 respectively. Station 1 obtained a good water quality rating with an FBI score 4.72, while station 3 received a sufficient water quality rating with an FBI rating 5.50. Cinsequently, the pollution status of Cibeureum Lake was ranged from slightly polluted to quite polluted.

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Keywords: FBI Index, Water Quality, Macrozoobenthos,Cibeureum Lake, Community Structure

1. INTRODUCTION

In Tasikmalaya there are seven natural lakes or what the local community usually calls *Situ* that are utilized in daily life, one of which isCibeureum Lake.Cibeureum Lake has an area of about 21 hectares and this lake is located inTamansari District, Tasikmalaya City, West Java Province. This lake has various functions, including ecological functions as ecosystem protection, water reserves and irrigation sources for local residents, as well as tourism and fisheries objects [1]. Various water and land use activities aroundCibeureum Lake can generate waste such as settlements, stalls, traders, tourists, and fishing activities. Of course, this waste can affect the chemical, physical and biological properties of waters [2].

Cibeureum Lake does not have an inlet from the river but the main water supply comes from rainwater, but there are several drainage channels for local community waste that enter the waters.

This has the potential for enrichment in theCibeureum Lake water body which can result in a decrease in water quality due to eutrophication. Eutrophication is a condition in which waters experience an increase in the concentration of organic matter or the presence of nutrients entering the waters [3].

Detailed information regarding the level of pollution and water quality in the waters of Cibereum Lake is incomplete. Therefore, it is necessary to monitor the quality of the waters of CibereumLake to find out changes that have occurred in the quality of the aquatic environment as a form of management efforts there. One of the important water quality parameters for water management is biological parameters (biomonitoring). Biomonitoring in aquatic ecosystems can be carried out by studying the community of aquatic organisms, namely aquatic invertebrates, including macrozoobenthos [4]. Macrozoobenthos are sedentary in aquatic substrates, have relatively slow movements, and can live longer in an ecosystem [5]. If there is a change in the structure of the macrozoobenthos community, it will also describe the changes that occur in the aquatic environment [6]. The purpose of this study was to determine the water quality ofCibeureum Lake based on the macrozoobenthos community structure as a bioindicator.

2. MATERIALS AND METHODS

2.1 Time and Location

This research was conducted atCibeureum Lake, Tamansari District, Tasikmalaya City, West Java, Indonesia. Water quality analysis and plankton identification were carried out at the Laboratory of Aquatic Resources Management, Faculty of Fisheries and Marine Sciences, Padjadjaran University. The research was conducted in September – November 2021 during the rainy season.

2.2 Research Methods

The research method used in this study was to use a survey method with purposive sampling. In a timeseries with an interval of seven days with six times sampling for each station on the surface waters. There are 4 observation stations that have been determined based on water conditions at theCibeureum Lake location. Parameters observed and analyzed were macrozoobenthos samples as the main parameter and water quality parameters as supporting parameters which included physical parameters, namely temperature, turbidity while chemical parameters included pH, DO and BOD.

2.3 Data analysis

The main parameters analyzed were the macrozoobenthos community structure consisting of composition, abundance, diversity, macrozoobenthos uniformity and Family Biotic Index (FBI).
The abundance of macrozoobenthos at each station is calculated using the following formula:

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

Calculation of macrozoobenthic diversity using the Shannon-Wiener diversity index equation [7]:

$$H' = - \sum Pi \, Ln \, Pi$$

Macrozoobenthos uniformity was calculated using the Uniformity Index formula [8]:

$$E = \frac{H'}{Hmaks}$$

*Family Biotic Index*is an index used to analyze water quality. The FBI value can be calculated by the following formula [7]:

$$FBI = \frac{xi.\,ti}{N}$$

Observational data were analyzed using a quantitative descriptive method, namely by explaining water quality data which included physical and chemical variables, as well as calculating macrozoobenthic community structure data which included composition, abundance, diversity, and uniformity. In addition, macrozoobenthos data is associated with physical and chemical variables and is used to measure the Family Biotic Index to assess the level of contamination ofCibeureum Lake.

3. RESULTS AND DISCUSSION

3.1 Water Quality Parameters

3.1.1 Temperature

Temperature plays a very important role in controlling the condition of aquatic ecosystems [9]. TemperatureCibeureum Lake mean water can be seen in Figdifferent and each station has its own conditions and characteristics.

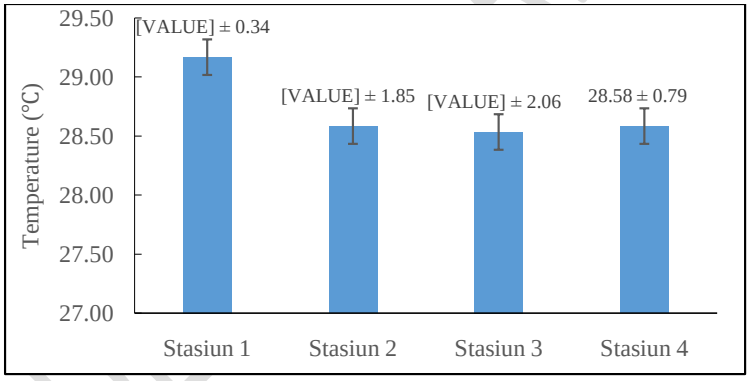

Fig 1. Temperature Value

The water temperature that varies at the four research stations is influenced by the location of the different station points. Highest average temperature at station1, ie29.17℃ ± 0.34, while the lowest average temperature is at station 3 ie28.53℃±2.06. Changes in temperature that occur in waters are influenced by several factors such as the intensity of sunlight entering the waters, the occurrence of heat exchange between the water and the air around the waters and whether or not there is cover by vegetation from trees on the edge of the waters[10]. These results show that the average temperature in the waters of CibereumLakeis still suitable for the life of aquatic biota, one of which is macrozoobenthos, because according to Rahman (2009) [11] inChoirudin*et al*. (2014) [12] the optimum temperature for the development of macrozoobenthos is around 20-30℃ and a dangerous temperature for macrozoobenthos ranges from 35℃ - 40℃.

3.1.2 Turbidity

Turbidity in waters can be caused by suspended and dissolved organic and inorganic materials (egmud and fine sand), as well as inorganic and organic materials in the form of plankton and other microorganisms [13]. Turbidity data forCibeureum Lake waters is shown in Fig 2.

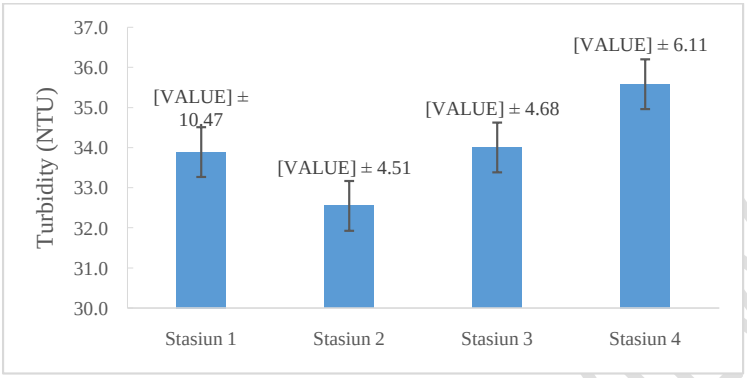

Fig 2. Turbidity Value

Based on these results, it shows that the lowest average turbidity value is at station 2 of 32.55 ± 4.51 NTU and the highest average turbidity value is at station 4 of 35.58 ± 6.11 NTU. The high turbidity value at station 4 is caused by the weather factor because the sampling was carried out during the rainy season. High water turbidity can be caused by high rainfall [14]. Other factors come from human activities such as people washing, children swimming, and fishing activities on rafts using throwing nets on bamboo rafts. High turbidity is not liked by macrozoobenthos because it interferes with vision and the respiratory system, thereby inhibiting the growth of benthic organisms in it [15]

3.1.3 Degree of acidity (pH)

pH has a very important role in life processes in aquatic systems because pH is very important to determine the corrosiveness of water. A low pH value indicates a high corrosive level of water [16].The pH data ofCibeureum Lake waters is shown in Fig 3.

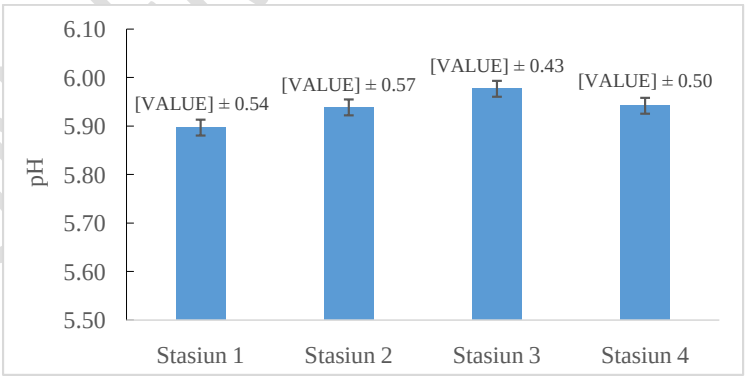

Fig 3. pH value

The lowest average pH value was at station 1 of 5.90 ± 0.54 and the highest average pH value was at station 3 of 5.98 ± 0.43. The pH value at each station tends to be acidic with a value below 6. The pH value which tends to be acidic in the waters ofCibeureum Lake is strongly influenced

by rain. Rainwater is naturally acidic because of carbon dioxide in the atmosphere, when it rains and hits the waters it will cause a decrease in the pH of the water [17].

Every aquatic organism has varying pH tolerance limits and in general aquatic organisms are sensitive to changes in pH [18]. The pH value that is suitable and most preferred for macrozoobenthos is with a value range of 7-8.5 [13]. Based on the research results, it was found that several species were suspected of having a high level of tolerance to environmental changes.Cibeureum Lake has a pH that is not optimal for macrozoobenthos life.

3.1.4 Dissolved Oxygen (DO)

Dissolved oxygen is very important to support the life of aquatic organisms, especially macrozoobenthos in the process of respiration and decomposition of organic matter. Without dissolved oxygen at a certain concentration level, many types of aquatic organisms cannot survive [6]. The concentration of dissolved oxygen in the waters ofCibeureum Lakeas a whole can be seen in Fig 4.

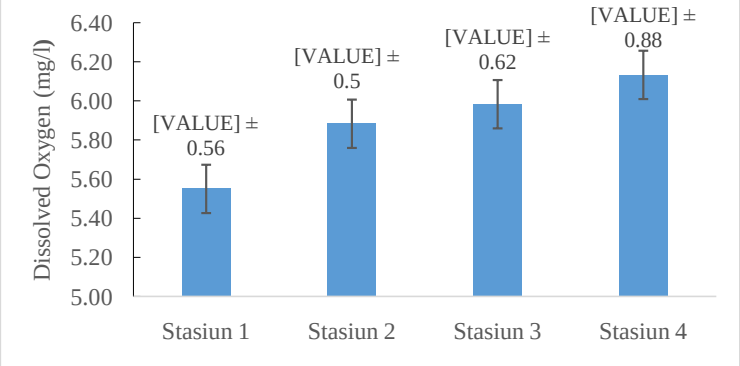

Fig 4. ValueDissolvedOxygen (DO)

The lowest average dissolved oxygen concentration was at station 1 with DO of 5.55 mg/l ±0.65 and the highest value was at station 4 with DO of 6.13 mg/l ±0.88. Dissolved oxygen concentration is affected by water temperature and BOD value [19].Station 1 has the lowest concentration of dissolved oxygen, this is related to the bod value of station 1 which is quite high when compared to the other 3 stations.The high BOD value in a watersisduetohigheractivitiesaroundthewaterssothat a lot oforganicmatterentersthewaterbodies [20].

The low DO value at station 1 is also related to the temperature value at station 1whichisquitehighwhencomparedtotheother 3 stations. An increase in watertemperature in thewaterswouldcause a decrease in DO [21]. An increase in watertemperatureby 10°C canresult in anincrease in oxygenconsumptionbyorganismsofabout 2-3 times, sothatthe BOD numberwillalsoincrease. The lowconcentrationof DOin a waterindicatesthattheoxygenrequirementofmicroorganismstodecomposeorganicmatterisquitehigh [22].

CibeureumLake can be said to be included in the ideal category in supporting the growth of macrozoobenthos. That ideally the dissolved oxygen content in waters to support the growth of aquatic organisms is >5 mg/l [23].

3.1.5 Biochemical Oxygen Demand (BOD)

The observed data ofCibeureum Lake BOD isshown in Fig 5.

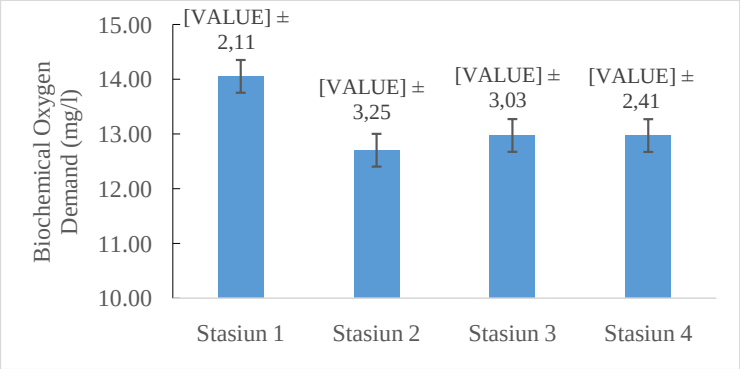

Fig 5.BOD value

The lowest BOD average value was at station 2 of 12.70 ± 3.25 mg/l and the highest average BOD value was at station 1 of 14.05 ± 2.11 mg/l. The low BOD at station 2 is because station 2 is a station far from human activities which can cause waste. The high BOD value at station 1 is due to the presence of livestock pens near the river bed and domestic sewage channels from the houses of the surrounding residents which directly enter the waters. The high value of BOD also means the process of decomposition of organic matter is also high [24].

The greater the concentration of BOD, it indicated that the water was polluted, the concentration of BOD, which had a low level of pollution and could be categorized as good waters, had a BOD value ranging from 0 - 10 mg/l, a moderate pollution level of 10-20 mg/l and a pollution level high >25 mg/l [25]. The overall average value of BOD in the waters ofCibeureum Lake is 13.18 mg/l, soCibeureum Lake is in the moderately polluted category.

3.2 Substrate Physical-Chemical Parameters

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 1.

Table 1.Results ofCibeureum Lake Substrate Measurements

No.	Parameter		units	Station			
				1	2	3	4
1.	Texture	Sand		9	15	3	7
	Land	Dust	%	37	25	22	16
		Look		54	60	75	77
2.	substrate pH		-	5,42	5,41	5.45	5.54
3.	C-Organic		%	2.82 (currently)	2.92 (currently)	3.03 (high)	2.48 (currently)
4.	N-total		%	0.26	0.30	0.30	0.36
5.	C/N ratio		-	11	10	10	7

CibeureumLakehas a substrate of sand, silt and clay. The dominating substrate fraction in the waters ofCibeureum Lake during the study was clay with an average percentage of 67%.Organic matter tends to increase with increasing silt and clay content [26].

Overall, the pH of theCibeureum Lake substrate was acidic. The pH values obtained ranged from 5.41 - 5.54. The pH value of the substrate has a close relationship with the organic matter content. A pH value that is too low inhibits the smooth decomposition of organic matter resulting in a decrease in organic matter, on the other hand the decomposition of organic matter is quite smooth if the pH is high enough [27]. The best pH value that can support macrozoobenthos life ranges from 6-7 [28]. It can be said that the pH value of the substrate inCibeureum Lake is classified as not good for macrozoobenthos life.

The C-organic content at station 3 has high criteria and the remaining stations have low criteria. In research conducted by Mushthofaet al.(2014) [29] it is known that the greater the organic matter content, the greater the abundance of macrozoobenthos. Benthic animals are closely related to the availability of organic matter contained in the substrate, because organic matter is a source of nutrients for biota which are generally found in the basic substrate. However, if the presence of organic matter exceeds a reasonable threshold, then the position of the organic matter is considered as a pollutant [30].

Pusat Penelitian dan Pengembangan Tanah dan Agroklimat [31] classifies the value of N-total on the substrate as follows:

- 0.1-0.3% : Low
- 0.3-0.6% : Currently
- 0.6-1.0% : Higt
- >1% : Very high

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Based on these criteria, the N-total station 1 is included in the low criteria and stations 2 to 4 are included in the medium criteria. The percentage of the total N-value in waters has an effect on the value of the C/N ratio [32]. The higher the N-total value, the lower the C/N ratio will be.

The C/N ratio of station 1 is 11, station 2 and station 3 have a C/N ratio of 10 and the C/N ratio of station 4 is 7. Changes in the total N content will affect the C/N ratio. C-organic will decrease (due to the release of carbon dioxide and decomposition of organic matter) while the total N-concentration will increase, so the C/N ratio will decrease. The higher the total N-content formed causes a decrease in the C/N ratio, a mineralization process occurs. A low C/N ratio indicates the mineralization process is going well [33].

3.3 Composition and Abundance of Macrozoobenthos

The macrozoobenthos composition that was found based on the identification resultsin the waters ofCibeureum Lake there were 8 species from 4 research stations. The average percentage of species found from each station is shown in Fig 6.

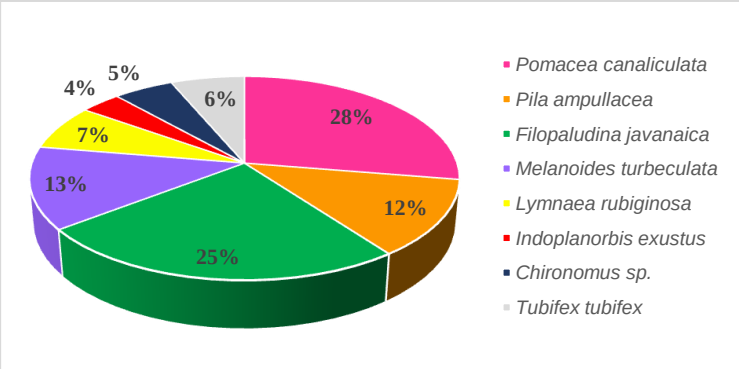

Fig 6.The average percentage of each macrozoobenthic species

The top three macrozoobenthos species with the most composition are*Pomaceacanaliculata* (28%), *Filopaludinajavanaica* (25%), and *Melanoidesturbeculata* (13%). Macrozoobenthos species with a high composition are influenced by their tolerant ability or not [34]. Physicalspecies*Pomaceacanaliculata*,*Filopaludinajavanaica*, And*Melanoidesturbeculata*canbeseen in Fig 7.

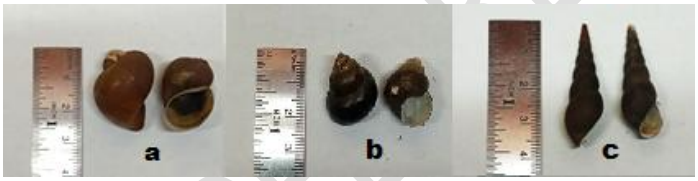

Fig 7. Most common macrozoobenthos
(Remarks: a. Pomaceacanaliculata, b.*Filopaludinajavanaica*,c.*Melanoidesturbeculata*)

Macrozoobenthosthathave a hightolerancewillincrease in abundance in anenvironmentthat has a high level ofdisturbance, whilespeciesthathave a lowtolerancewilldecrease in abundance [35].It is known that the tolerance level of *Pomaceacanaliculata* has a tolerance value of 3 [36], so that this species can survive in environments with extreme conditions.*Filopaludinajavanaica*is the second macrozoobenthos that is often found in the waters ofCibeureum Lake.The number of types of macrozoobenthos*Filopaludinajavanaica*due to this type of snailhas wide distribution capabilities from rivers, rice fields, lakes, ponds, swamps with calm water or fast water [37]. The existence of the *Melanoides tuberculate* species can be caused by the organic matter content and the type of substrate present in these waters. This is supported by opinionIrmawanet al. (2010) [38]that the *Melanoidestuberculata* species is more resistant to water conditions that have a high level of organic matter and sediment textures in the form of clay towards clayey clay and dusty clay are suitable habitats for macrozoobenthos life.

Macrozoobenthos abundance is defined as the number of individual macrozoobenthos per unit area (m^2)[39]. Observational data on the abundance and types of macrozoobenthos found inCibeureum Lake are shown in Table 2.

Table 2.The abundance and types of macrozoobenthos found inCibeureum Lake

Sampling Data	Abundance Each Station (ind/m2)

Class	Species	1	2	3	4
Gastropods	*Pomaceacanaliculata*	23	8	20	7
	Pila ampullacea	5	3	6	3
	Filopaludinajavanaica	12	8	15	8
	Melanoidesturbeculata	5	5	3	7
	Lymnaearubiginosa	3	0	3	5
	Indoplanorbisexustus	2	0	2	3
Insecta	*Chironomus sp.*	6	0	12	0
Oligochaeta	*Tubifex tubifex*	5	0	11	0
Total Macrozoobenthos		59	24	70	32

Based on Table 2,Cibeureum Lake has the lowest abundance of macrozoobenthos, namely 24 ind/m^2at station 2 and the highest abundance of macrozoobenthos is 70 ind/m^2 at station 3. Station 2 is an open water area. Areas of open water without any vegetation blocking the surroundings cause the currents to be so strong that the wind causes them to experience more frequent changes of water masses. As a result, small sediment particles are deposited because the condition of the basic substrate, which is often stirred, also affects the life of benthic organisms [40]. Station 3 has the highest abundance because the substrate of station 3 contains high C-organic, making it a preferred habitat for macrozoobenthos. As statedYunitawati et al. (2012) [41] on substrates with high C-organic content there is a high abundance of macrozoobenthos.

Also based on Table 2, it can be seen that the many macrozoobenthos found inCibeureum Lake come from the gastropod class. Gastropods like habitats that have a high organic matter content and habitats that have sandy substrates [42]. The presence of gastropods that dominate the waters ofCibeureum Lake can also indicate that the waters have been polluted by organic matter. Based on research Saru (2014) [43], PhylumMolluscs will dominate water areas that have high organic content originating from industrial waste, housing and streams from agriculture.

Species*Chironomus sp.*and *Tubifex tubifex* were only found at station 1 and station 3 (Fig 8). This is because the waters are indicated to be polluted.Increasing the content of organic matter in waters will also increase the types that are resistant to polluted waters.Spesies*Chironomus sp*have hemoglobin (Hb) in their blood which allows them to live in waters with a fairly low concentration of dissolved oxygen [44]. According toSastrawijaya (1991) [45] type*Chironomus* sp. classified as an indicator of heavy pollution and can live in limited oxygen conditions such as in areas experiencing high organic pollution. As stated by Anjani et al. (2012) [46] that macrozoobenthos which is an indicator of heavily polluted waters is *Chironomus*sp..

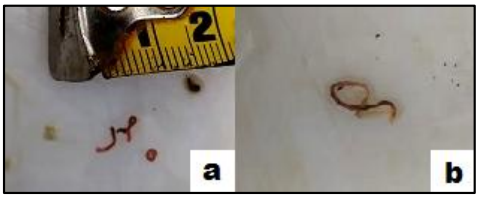

Fig 8. Macrozoobenthos found only at station 1 and station 3
(Remarks: a. *Chironomus* sp. and b. *Tubifex tubifex*)

*Tubifex sp.*is also one of the species that is resistant to polluted waters [47]. Along with the increasing amount of waste released, the growth of these worms is growing [48]. The abundance of aquatic plants at station 3 is also a factor in sedimentation, with a supportive environment *Tubifex tubifex* will be suitable for living and developing in these waters. This is because *Tubifex tubifex* is a resistant and tolerant animal with low oxygen concentrations, so its adaptability is higher than other macrozoobenthos. The existence of the dominating Tubificidae family also indicates watersit is polluted by organic matter [49].

3.4 Diversity of Macrozoobenthos

Diversity of macrozoobenthos can indicate the condition of a waters [50]. Waters that have a high level of diversity indicate that the condition of these waters has not experienced changes in environmental conditions, while waters with an uneven distribution of species abundance indicate that these waters have experienced changes in environmental conditions [51]. Data from observations of the macrozoobenthic diversity index inCibeureum Lake calculated using the Shannon-Wiener diversity index are shown in Fig 9.

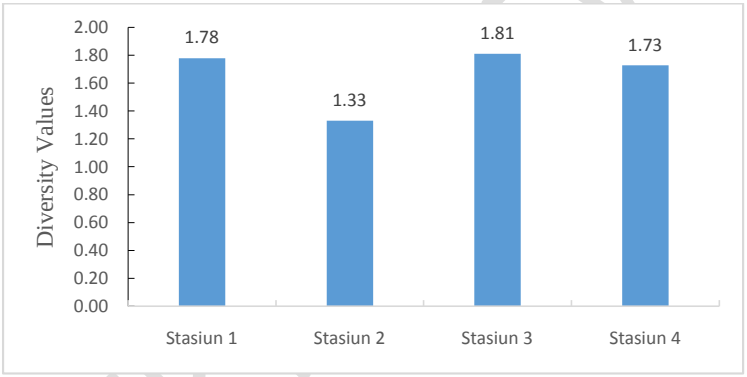

Fig 9. Macrozoobenthic diversity values

Based on the diversity index values of the 4 research stations, according to Krebs' (1972) [52] criteria in Rijaluddin*et al*. (2017) [49]Cibeureum Lake has a moderate diversity value. Diversity values between 1-3 indicate moderate diversity and indicate that the waters are in fairly stable condition. This diversity index value indicates that the condition ofCibeureum Lake is starting to experience ecological pressure and the stability of the ecosystem inCibeureum Lake is starting to decline, so that the macrozoobenthic communities that live there are starting to experience a decrease in their distribution. The ecological pressure that occurs inCibeureum Lake is strongly suspected of originating from the daily activities of the surrounding community. This has been proven when sampling, found domestic waste from people's homes and livestock waste. There is trash because there are fishing grounds, picnic areas, restaurants or stalls at several points around the site, residents' livestock pens and places used by the community for bathing and washing.

Diversity results inCibeureum Lake is comparable to research by Rijaluddin*et al*. (2017) [49], the value of the diversity index (H') in BungurLakeand GintungLake is moderate, namely 2.29 and 1.74, indicating that the area is moderately polluted. It's the same with research Fiona et al. (2021)

[53] the diversity index value at the species level inCibeureum Lake is between 1.3 – 1.8 which indicates that the watersmoderately polluted.

3.6 Uniformity of Macrozoobenthos

The macrozoobenthos uniformity index values at the four research stations can be seen in Fig 10.

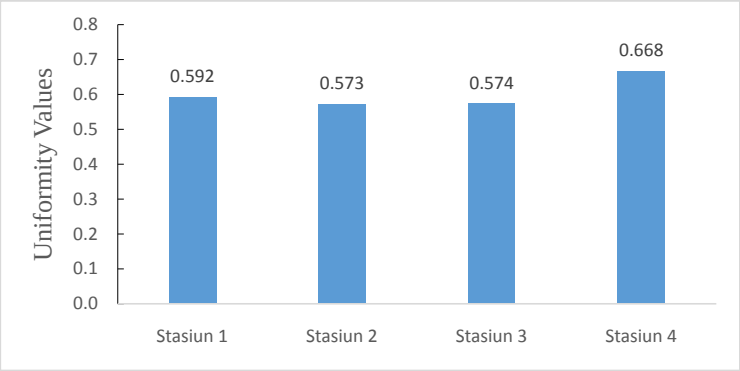

Fig10.Macrozoobenthos uniformity values

The uniformity index value in the waters ofCibeureum Lake shows the number 0.573 – 0.668 meaning that the community is in an unstable condition because the uniformity index is at $0.50 < E \leq 0.75$. The highest uniformity value is at station 4 of 0.668 and the lowest uniformity value is at station 2 with a value of 0.573. Refers toBrower and Zar (1977) [8]macrozoobenthos in the waters ofCibeureum Lake in several placesnot spread evenly and there is a tendency for one species to dominatewith moderate uniformity the value is $0.4 < E < 0.6$, namely at station 1 to station 3 and at station 4species spread evenly withhigh uniformity value $0.6 < E < 1$. A stable community indicates that the ecosystem has high diversity, and there is no dominant species and the distribution of the number of individuals is evenly distributed, that the distribution of the number of individuals of each type is the same, and there is no tendency to be dominated by a certain type [7].

3.7 Family Biotic Index (FBI)

Family Biotic Index(FBI) is an index used to analyze water quality by taking into account the tolerance of an organism based on its family. Organisms with a high level of sensitivity to dissolved oxygen content have a low tolerance value [11]. Meanwhile, organisms with a low level of sensitivity to dissolved oxygen content have a high tolerance value. The FBI data of macrozoobenthos found in place of Cibeureum are shown in Table 3

Table 3.FBI ValueofMakrozoobentos inCibeureum Lake

NO.	FBI	Water quality
Station 1	4.72	Good
Station 2	3.97	Very well
Station 3	5.50	Enough
Station 4	4,16	Very well

The station with the lowest FBI value is station 2 with a value of 3.97 and based on the FBI value criteria it can be seen that station 2 is included in the very good water quality criteria. Station 4 has an FBI value of 4.16 and is also included in the very good water quality criteria. Based on the very good FBI criteria, it can be seen that stations 2 and 4 have a slightly polluted level of organic matter. In accordance with the observations made at stations 2 and 4 that the C-organic substrate at these stations contained moderate C-organic (Table 1).

Station 1 has an FBI value of 4.72 which is included in the criteria for good water quality, which means that the waters have a level of pollution contaminated with several organic materials. In contrast to stations 2 and 4, which have very good water quality criteria, station 1 has good water quality criteria, which means station 1 is more polluted than stations 2 and 4. At station 1, 8 types of macrozoobenthos species were found, the same as at station 4. but the number of species at station 1 was less, especially the species *Tubifex tubifex* and *Chironomus* sp. found at station 1 is less than station 3, this is because station 1 contains moderate C-organic so that these species are found less and the level of contamination at station 1 is better than station 3.

The station with the highest FBI score is station 3 with a value of 5.50 and based on the FBI's score criteria it can be seen that station 3 has sufficient criteria with a relatively high level of pollution of organic matter. This is in accordance with the results of observationsC-organic substrate, which shows that the substrate at station 3 contains organic C with high criteria than other stations (Table 1). The FBI value is of course related to the tolerance level of the macrozoobenthos found at each station. Families in the gastropod group are able to adapt well to environments containing high concentrations of pollutants[54]. The macrozoobenthos tolerance value describes whether the macrozoobenthos is intolerant or tolerant, the tolerance value of macrozoobenthos to environmental changes ranges from 0-10 [36]. All stations were dominated by *Pomaceacanaliculata* from the Ampullariidae family which had a tolerance value of 3 and *Filopaludinajavanica* from the Viviparidae family which had a tolerance value of 4.*Pomaceacanaliculata*and *Filopaludinajavanica* are facultative organisms, namely organisms that can live in lightly to moderately polluted waters [55]. Not only that, at station 3 there are other types that are also commonly found, namely the species *Chironomus* sp. and *Tubifex tubifex* which has a high tolerance value of 8 and 10 which are indicators of heavily polluted waters.

4. CONCLUSION

Based on the research results, the level of water pollution inCibeureum Lake based on the macrozoobenthos bioindicator is moderately polluted with an indication of Diversity Value. The uniformity value of macrozoobenthos inCibeureum Lake at each station is categorized as a population in an unstable condition. 3.The FBI value ranges from 3.97 to 5.50 indicating very good to moderate criteria, thus the pollution status ofCibeureum Lake waters is slightly polluted to quite a lot polluted.

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