Original Research Article

Analysis of Gastropod Diversity as a Bioindicator of Waters in Ciburuy Padalarang Situ, West Bandung Regency, West Java.

ABSTRACT

This study was conducted to determine the water quality of Situ Ciburuy based on the structure of the gastropod community as a bioindicator. The study was conducted using a survey method and purposive sampling method.

The observation data were analyzed descriptively. (rephrase)

The results showed that the level of water quality in Situ Ciburuy based on gastropods bioindicators was lightly polluted. That is indicated by the low to moderate diversity of gastropods, which ranges from 1.291-1.960. Gastropod evenness in Situ Ciburuy, which is found at each station, is categorized as the moderate population in unstable conditions because the evenness index ranges from 0.67-0.78, indicating low evenness of gastropod in Situ Ciburuy.

Keywords: water quality, Situ Ciburuy, gastropods

1.INTRODUCTION

Situ Ciburuy is a body of water on land. Situ Ciburuy is used to irrigate rice fields, natural water storage during the dry season, and education and research.

In the lake ecosystem, many aquatic organisms live, one of which is Molluscs. Mollusks are a phylum of invertebrates that have a soft and unsegmented body. Most of the species are protected by a shell. Mollusc species are widely distributed inland, marine, and brackish waters. Phylum Molluscs that exist in the waters are Gastropods, Bivalves, and Cephalopods. Gastropods and bivalves are commonly distributed in fresh and marine waters.

In comparison, cephalopods are only found in the sea and brackish waters. Gastropods are often found at the bottom of the waters; some immerse themselves in sediments, some can be found attached to rocks. Gastropod habitat varies, from very close to the water's surface to far from the surface of the water. The distribution of animals is based on two factors. First, the food factor is that animals that tend to live in an area of gastropods can quickly get food. The second factor is the barrier factor. Barriers significantly affect the distribution of a population because these barriers will hinder the survival of individuals or even the population (Wahdaniar, 2016).

Gastropods are widely studied as water bioindicators. This bioindicator can determine the quality of water in a body of water. Information about the quality of water is vital to know the pollution that occurs in water bodies. Therefore it will be essential to research gastropods in Situ Ciburuy to determine the level of corruption in the area to make plans to overcome pollution.

2. METHODOLOGY

2.1 Research Sites

This research was conducted from January 28 to March 2, 2021 at Situ Ciburuy Kab, West Bandung, West Java. Gastropod identification and water quality parameters were carried out at the Laboratory of Aquatic Resources Management, Faculty of Fisheries and Marine Sciences, Padjadjaran University.

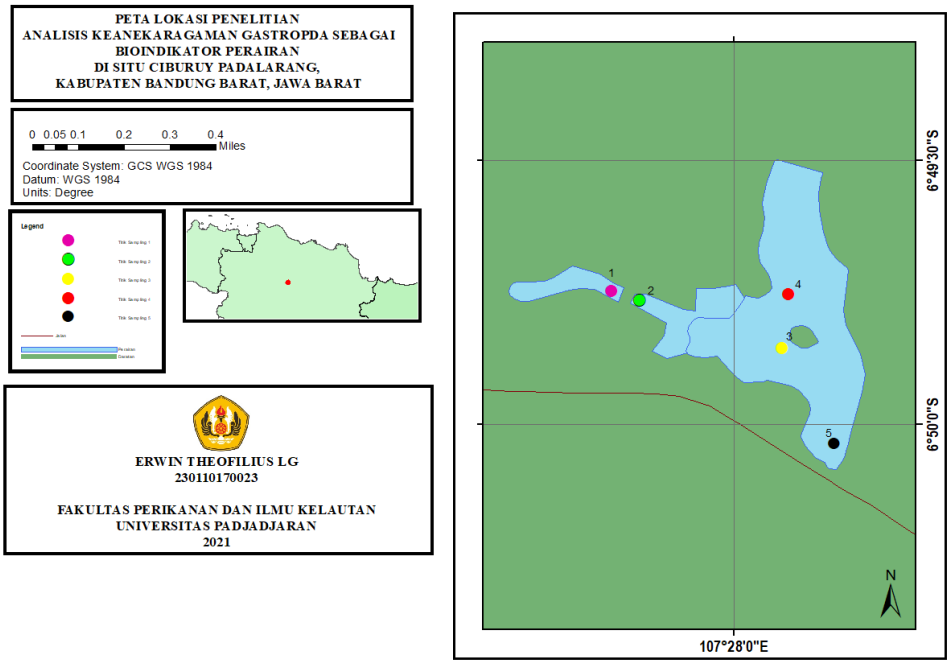

Figure 1. Map of research location

2.2 Materials and Methods

The research method conducted in this study is to use the survey method by sampling in situ Ciburuy in the form of purposive sampling. Selection is made at 5 points of the station as many as four times the replay. The data needed is primary data in gastropods community structure and water quality, including physical parameters, namely temperature, turbidity while chemical parameters include pH, DO, and BOD. Materials (gastropods samples, water samples, formaldehyde 4%, substrate samples, $MnSO_4$, H2SO4, Sodium thiosulfate, and O2 reagent) and tools (Ekman grab, net surber, sieve, cool box, magnifying glass, plastic container, 500 ml sample bottle, pH meter, DO meter, rowing boat.

2.3 Methods and Data Analysis

The parameters measured include the main parameters, namely gastropods and supporting parameters, namely physical parameters in the form of temperature, turbidity, and chemical parameters pH, DO, and BOD.

2.3.1 Density

To calculate the density of species, take samples in the field and count the number of stands.
Calculation of density using the formula Odum :

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

Information:

K = Density of species (number of individuals/m2);
a = Number of individual stands of the ith species
b = Area of sampling area (m2)
n = total number of sampling

2.3.2 Divesity

$$H' = - Pi \log 2 Pi$$

Information:
H' = species diversity index
Pi = ni/N
Ni = number of individuals for each type i
N = total number of individuals

The diversity of an aquatic biota can be determined using the Shannon – Wiener (H') information theory. The primary purpose of this theory is to measure the level of order and disorder in a system.

Table 1. Categories of Diversity

Diversity Indeks	Criteria
H' ≤ 1,0	Low
1,0 < H' ≤ 3,0	Medium
H' ≥ 3,0	High

2.3.1 Evenness

$$E = H' / Hmax$$

Information :
E = evennes index
H' = diversity index
Hmax = log 2 x (S)
S = number of types

H'max will occur when found in an atmosphere where all species are abundant. Meanwhile, the value of E ranges between 0 and 1. The value of 1 describes a situation where all species are relatively plentiful.

Table 2. Categories of evenness index values

Evenness Index	Criteria
0,0 < E ≤ 0,50	Stressed
0,50 < E ≤ 0,75	Less Stable
0,75 < E ≤ 1,00	Stable

3. RESULT AND DISCUSSION

Analysis of chemical and physical data to determine the level of water pollution in Situ Ciburuy is quantitative descriptive data analysis. Quantitative data is data related to numbers, either obtained from the results of measurements or calculations. In contrast, quantitative descriptive data is data obtained from a sample of the research population analyzed using the Diversity and Evenness Index formulas and then interpreted.

3.1 Water Physical and Chemical Parameters

3.1.1 Temperature

At the sampling location, the temperature ranged from 25.7-26.2 °C. At stations 2-5, it had a temperature value of 26.2 °C, while at station one, it was around 25.7 °C. The difference in water temperature at each station is not too significant, at station one, the temperature is slightly lower because it has the deepest depth. It is related to the difference in sunlight penetration from the surface layer to the deeper layers.

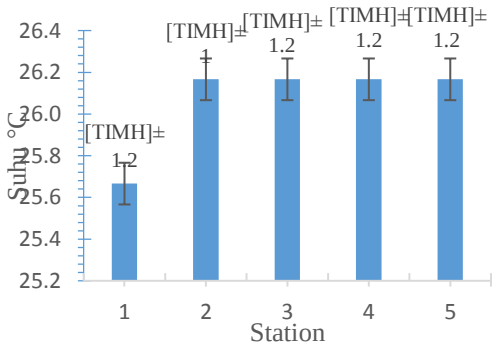

Fig 2.Average temperatures in Situ Ciburuy

3.1.2 Turbidity

Turbidity will measure the number of particles in the water with the help of light.

The relationship between turbidity and gastropods is that gastropods are filter feeders. If the turbidity in the water is high, the gastropods can be used as a food source in these waters. At the sampling location, the most elevated turbidity is seen in table 5. it is at station 4 and station 5, then the lowest turbidity value is at station 1.

Low turbidity at station 1 is influenced by depth. The deepest depth at station 1 causes sedimentation and waste carried into the waters at the bottom of the water so that there is less sedimentation on the surface. According to Nurqolbi & Hindersah (2009), turbidity is influenced by suspended particles that enter the waters and sedimentation is influenced by the type of substrate carried by currents or rainwater.

Turbidity is influenced by suspended particles that enter the water. These particles can be caused by sedimentation and waste carried into the waters, and this sedimentation is influenced by the type of has dissolved substrate carried by currents or rainwater.

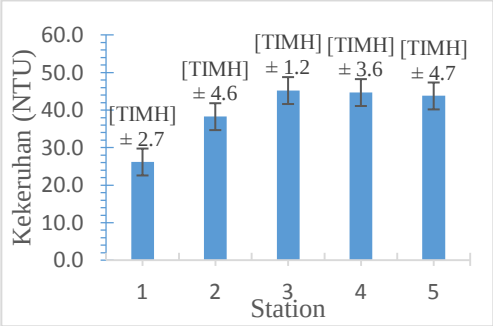

Fig 3. Turbidity inCiburuy Situ

3.1.3 Dissolved Oxygen (DO)

Dissolved Oxygen DO oxygen contained in the waters, gastropods need oxygen to carry out respiration in the body, so oxygen in the waters needs to be measured. Table 6 shows that DO ranges from 6.3-70, the highest DO value is at station 4, and the lowest is at station 4. The DO value at each station does not have a very significant difference. According to Sastrawijaya (1991), gastropod life can survive with minimum dissolved oxygen of 5 mg/l. Low oxygen will make it difficult for gastropods to breathe.

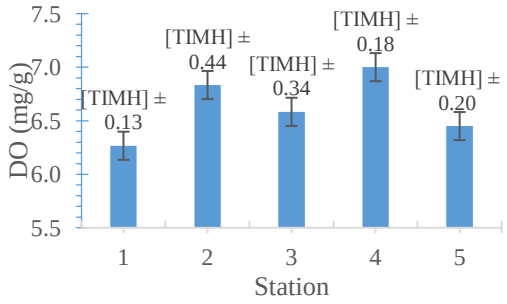

Fig 4. DO in Situ Ciburuy

3.1.3 Biochemical Oxygen Demand (*BOD*)

Biochemical Oxygen Demand is defined as the amount of oxygen required by the organism during the decomposition of organic matter under aerobic conditions. The BOD parameter is a limiting factor for gastropods because overhauling organic matter by microorganisms will consume oxygen in the waters. The very high organic matter turnover will make it difficult for gastropods to carry out the respiration process. It is due to competition with decomposing bacteria that consume oxygen to remodel organic matter in the waters.

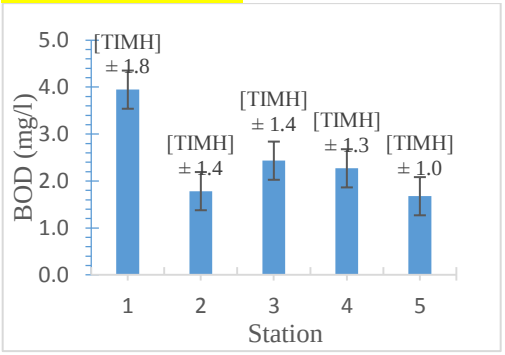

Fig 5. BOD in Situ Ciburuy

In the measurement results, the highest BOD value is at station 1, and the lowest is at station 5. According to the statement (Salmin, 2005), the DO value will be negatively correlated with the BOD value. As shown in the graph, when the DO value is low, the BOD value will be high.

3.1.4 Acidity

The pH value can be influenced by temperature, BOD, and chemical elements that enter the waters. The degree of acidity or pH can be a limiting factor for gastropod life (Ulfa et al., 2017). pH can affect the type and availability of nutrients and the toxicity of trace elements that can affect the life of gastropods.

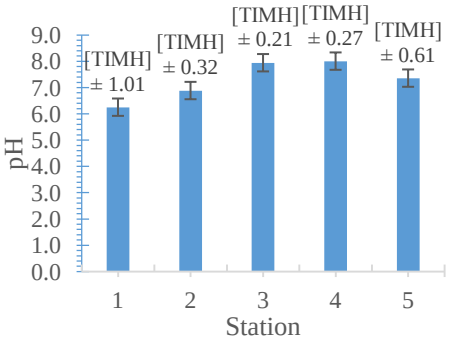

Figure 6. **pH in Situ Ciburuy**

The lowest pH value is at station 1 and the highest is at station 3. The pH value at Situ Ciburuy shows the normal range at stations 2-5 and follows the statement of Odum (1971) that the pH value is between 6.5 - 8.0 as a safe limit for the pH of the waters for the life of the biota in it. The cause of the low pH at station 1 is influenced by several factors, including the photosynthetic activity of aquatic organisms. Oxygen consumption in the waters, densely populated locations, and fishery activities in the area, and station 1, an inlet, gets more waste input than other stations.

Purnomo et al. (2016) mention that every aquatic organism has a different tolerance to pH values. In general, gastropods can live in the pH range of 5-8, so gastropods can still live in the waters of Situ Ciburuy.

3.2 Substrate Physical and Chemical Parameters

The primary substrate is one of the leading environmental factors that affect the structure of the gastropod community (Suhendra et al., 2019). The primary substrate is a critical component for the life of organisms of gastropods. According to Yunita et al. (2013), The characteristics of the substrate can affect the structure of the gastropod community.

Gastropods are animals from the mollusk species that live in the type of substrate from coarse to fine. If the substrate changes, the structure of the gastropod community will change. Observation of sediment's physical condition (type of substrate) and chemical (C-organic content, N-total) concerning the gastropod community's structure is fundamental because sediment is a habitat for these gastropod.

Table 3. Measurement of Substrate Physical and Chemical Parameters in Ciburuy Situ

No.	Parameter	Unit	station				
			1	2	3	4	5
1.	Texture	-	Dusty clay	Clay clay	clay	clay	Clay clay dusty
2.	substrate pH	-	7.44	7.24	7.45	7.36	7.06
3.	C-Organic	%	2.97	0.75	4.55	1.57	3.28
4.	N-total	%	0.17	0.11	0.60	0.11	0.22
5.	C/N ratio	-	17	7	8	14	15

There are 3 different types of substrate texture at each station. Stations I and 5 have a dusty clay texture. At station 2, it is clay, and at stations 3 and 4, it is clay. The number of individual gastropods in Situ Ciburuy mostly live on clay substrate

types. According to Riniatsih & Kushartono (2010), gastropods are more commonly found in waters with a clay bottom substrate. This type of clay substrate has few barriers that can facilitate the movement of gastropods.

The pH value of the substrate tends to be neutral, ranging from 7.06 to 7.45. The pH value is not significantly different. In general, gastropods can live in the pH range of 5-8. The highest organic C-value was at station 2 of 4.55% and the lowest was at station 3 of 0.75%. The value of C-organic is the determining factor of growth in the substrate. The value of C-Organic is low because <5%(Anjani et al., 2012).

The highest N-Total value is at station 2 of 0.6% and the lowest is at stations 3 and 4 of 0.11%. The N-Total score of station 2 according to Anjani et al. (2012) N-Total 0.5-0.75%, including the high category. The high and low content of these values is also influenced by the texture of the sediments, such as at station 2 where the sandy clay sediment type has a smaller size than the clay sediment type found at stations 3 and 4. According to statement Barus et al. (2019), the particle size of the sediment affects the organic matter content in the sediment. It can that the smaller the particle size of the sediment, the greater the N-Total material content.

The most significant C/N ratio at station 1 was 17, and the lowest at station 2 was 7. The C/N ratio at station 1 had a higher value than other stations, indicating bacteria's low decomposition of organic matter. According to Purnomo et al. (2016), the decomposition process of organic compounds indicates the fertility of the waters. It is related to natural food, which is a source of food for gastropods.

Changes in the total N content will affect the C/N ratio. The C-organic will decrease (due to the release of carbon dioxide and the decomposition of organic matter). At the same time, the total N-level will increase so that the C/N ratio will decrease. The higher the total N content formed, the lower the C/N ratio(Barus et al., 2019).

3.3Gastropod Composition and Density

Gastropod organisms were collected at each station using an Eckman grab. Table 7 shows that the most gastropod species were found at station 2, and the lowest was at station 3. In the gastropod collection, there were 7 species, and the highest species divesity was *Pomacea*canaliculata. High quantity can show that it can tolerate the environment to survive.

Table 7. shows the highest divesity at station 2 and the lowest at station 1. The small distribution at station 1 can be influenced by physical and chemical factors that are less tolerant of gastropods. Intense water conditions at station 1 have an effect because gastropods tend to live in shallow waters, then high C/N values so that the decomposition process of organic matter is low so that little natural feed is produced. The temperature value of 25.2°C at station 1 shows that gastropods are still within tolerance to survive.

Table 4. The Composition and Divesity of Gastropods in Ciburuy Situ

Type	**Divesity of Each Station (ind/m2)**				
	1	**2**	**3**	**4**	**5**
Pomaceacanaliculata	7	17	25	29	20
Pila ampullacea	1	8	11	5	4
Terebiagranifera	1	6	0	0	1
Thiarascabra	0	18	0	2	4
Thiaragranifera	0	13	1	0	0
Filopaludinajavanicus	4	8	33	16	43

Melanoidestuberculata	0	21	10	8	12
Melanoidesplicaria	0	7	0	7	0
Lymnearubiginosa	0	0	1	3	0
Total	13	98	81	70	84

At station 2, 7 species of gastropods were found and had the highest divesity. The location has a shallow depth, tolerant temperature, and appropriate DO, BOD, and pH, indicating that station 2 is more supportive for life against various species, besides that, the characteristics of the clay-type substrate are a suitable habitat for gastropods life. The lowest value of the C/N ratio indicates that the decomposition process of organic compounds indicates the fertility of the waters and is related to natural food, which is a source of food for gastropods.

Figure 7 is the percentage of gastropod composition in Situ Ciburuy:

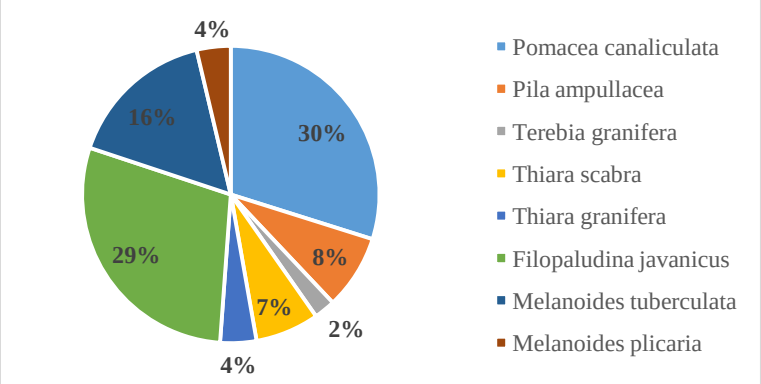

Fig 7. Gastropod Composition in Ciburuy Situ (REFERENCE)

The highest population found in Situ Ciburuy were *Pomaceacanaliculata* and *Filopaludinajavanicus* species. This species is well adapted to this location. It is supported by RisyantiMarwoto's opinion in researchSari (2017) Analysis of Water Pollution Status with Gastropods as Bioindicators in the Sungai PutriSumurPutriTelukBetung Bandar Lampung. Pomaceacanaliculata and *Filopaludinajavanicus* species can survive in conditions without water, even for a relatively long time.

The habitat of Pomaceacanaliculata and *Filopaludinajavanicus* in the muddy substrate and Ciburuy Lake's substrate characteristics tend to be messy. Pomaceacanaliculata and Filopaludinajavanicus can adapt in the Ciburuy Lake area. Isnaningsih & Marwoto (2011)stated that the golden snail, P. canaliculata had the highest tolerance to habitat variations. Generally, this type of snail likes to live in shallow water and has a mud substrate. Station 2 is a rice field area that is a source of food for Pomaceacanaliculata and Filopaludinajavanicus less than at stations 3, 4, and 5 can be caused by the activities of rice farmers who collect these gastropods because they become pests for rice plants.*Pomacea*canaliculata and Filopaludinajavanicus are known to the public, namely the golden snail and the tutut snail. Gold snails and tutut snails are often considered pests for rice plants. It is indicated because the snails damage the rice tissue so that many plants are damaged(Isnaningsih& Marwoto, 2011). Young golden snails attack the young rice plants (aged ± 1-2 months) and make broken plant segments scattered around the rice clumps.

The species with the lowest divesity was Lymnearubiginosa. This species was only found at three stations, namely 3,4 and 5. According to Marwoto & Isnaningsih

(2014), Lymnearubiginosa is more susceptible to environmental changes. Lymnearubiginosa is rarely found in mud habitats because of its respiratory system that uses the lungs. These mollusks usually depend on aquatic plants to facilitate breathing, like shelter, foraging for food, and attaching their egg capsules.

Fig 8is a picture of the types of gastropods found in Situ Ciburuy:

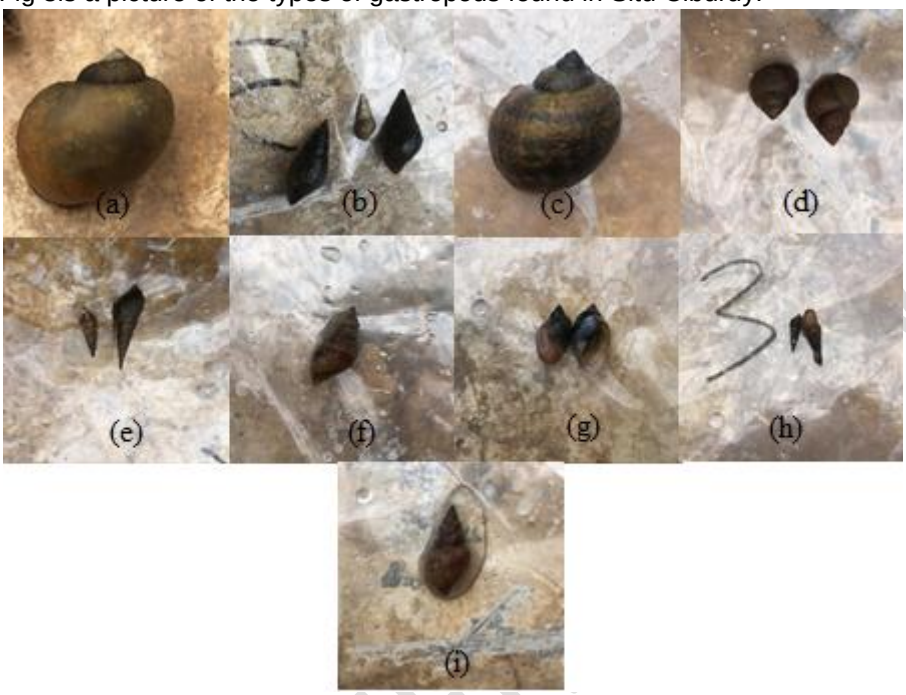

Fig 8.Gastropods found in Ciburuy Lake

Description: (a) *Pila ampullaceal* **(b)***Tarebiagranifera* **(c)***Pomaceacanaliculata* (**d)**Filopaludinajavanica, (e) Melanoidesplicaria, (f) Thiaragranifera, (g) Lymnearubiginosa (h) Melanoidestuberculata (i) Thiarascabra

3.4Gastropod Diversity and Evenness

Calculating the value of gastropod diversity in Situ Ciburuy using the Shanon-Weiner diversity index in table 8

Diversity Index shows that the waters are moderately polluted. The condition is moderately polluted with a value of 1.0 < H' < 2.0. States that are not contaminated are at the number H'> 3.0.

Table 5. Diversity and Evenness Index Value

Index	station				
	1	2	3	4	5
Diversity (H')	0.79	1.39	1.17	1.00	1.06
Evenness (E)	0.67	0.78	0.74	0.65	0.69

The highest diversity was at station 2 with an H' value of 1.79 and the lowest at station 1 with 0.79. All station locations in Situ Ciburuy have a value of H' < 2.0, which indicates a polluted ecosystem. An unclean environment will make it difficult for gastropods to adapt. Station 1, which has the lowest value when viewed from its composition, 1 species dominates in that location, namely the Filopaludina species. Station 2 has the highest H' value and has a more diverse piece than other stations.

Figure 9 is a graph of the value of gastropod diversity in Situ Ciburuy:

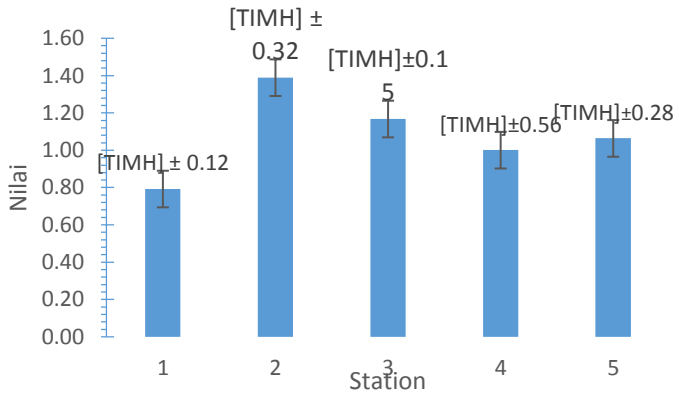

Fig 9. **Diversity Chart in Ciburuy Situ**

According to Wahdaniar (2016), low diversity is due to the unequal distribution of individuals of species and tendency of a species to dominate the population. It follows the theory, which states that a community has high species diversity if it is composed of many species with the same or almost the same species divesity. On the other hand, species diversity is low if the assembly comprises very few species and only a few are dominant.

Gastropod evenness results in Situ Ciburuy, Padalarang, West Bandung Regency, West Java are in table 8. The evenness value shows that almost all stations are unstable with tilapia E < 0.75. This value indicates that there are gastropod species that dominate. Stable evenness conditions are at a value of 0.75 < E < 1.00.

The most stable ecosystem is found at station 2 with an E value > 0.75, indicating no dominance of species evenness from one species. In contrast, stations 1,3,4 and 5 have an E value of < 0.75 that evenness is not stable, which indicates that there are species that dominate at this location. The greater the value of E, the population supports evenness, meaning that the number of individuals of each genus or species is the same or almost the same. Conversely, the smaller the value of E, the smaller the population evenness, meaning that the distribution of the number of individuals of each species is not the same, and there is a tendency for a species to dominate the population (Odum, 1971).

Figure 10 is a graph of the evenness of gastropods in Situ Ciburuy:

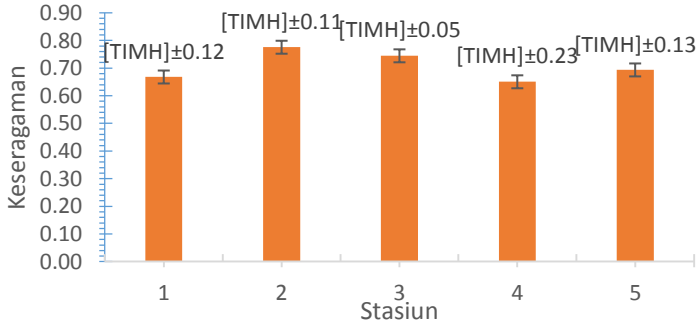

Fig 10. **Evennes Graphics in Ciburuy Situ**

Unpolluted water will show a balanced number of individuals and almost all species present. Conversely, in polluted water, the number of individuals is not evenly distributed, and there tends to be a species that dominates. The location of station 2 describes the best conditions related to the analysis of physical and chemical parameter data which shows that environmental conditions are more tolerant for gastropod life in Situ Ciburuy. Apart from the physical and chemical parameters, a high and more diverse population shows a good balance compared to other stations.

According to Sari (2017), in Habitats with good conditions, the organisms that can tolerate and adapt are extraordinary. On the contrary, habitats with unfavorable environmental conditions are a limiting factor for life in these aquatic habitats.

4. CONCLUSION

The level of water pollution Situ Ciburuy based on bioindicator gastropods is moderately polluted with the following indications:

1. The diversity analysis results showed that the value of the Shannon-Wiener evenness index in Situ Ciburuy falls into the moderate category of 1,291-1,960.

2. Evenness analyst results show evenness values ranging from 0.67-0.78 indicate a stable distribution.

3. Species used as bioindicators are *Pomaceacanaliculata*, *Filopaludinajavanicus*, and *Lymnearubiginosa*. *Pomaceacanaliculata* and *Filopaludinajavanicus* are found at each station, while *Lymnearubiginosa* only lives in a few stations.

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