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To cite this article: Choirunnisa and N D Takarina 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **284** 012027

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Community Structure of Macrozoobenthos at Blanakan Fish Pond, Subang, West Java

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Abstract. Macrozoobenthos has an important role as detritivore in water ecosystem. Macrozoobenthos community also act as a biomonitoring instrument. The purpose of this study is to know the composition, density, diversity, evenness, and dominance of macrozoobenthos at Blanakan Fish Pond. This study was done from February to June 2018. Macrozoobenthos samples were collected from 3 stations and each station consist of 3 fish ponds. Sampling on each ponds was done by purposive random sampling on 3 sampling points with twice repetition on each point. Water abiotic factors sampling was done on each points. Macrozoobenthos samples were identified and analyzed using Shannon-Wiener diversity index, Pielou evenness index, Simpson's dominance index, Sorensen similarity index, and t-test. The results showed that there are six species of macrozoobenthos from 3 classes found, which are *Melanoides tuberculata*, *Brotia costula*, *Cerithidea cingulata*, *Nephtys inornata*, *Cossura sp.*, and *Erpobdella sp.* Highest species density at Blanakan Fish Ponds is *Brotia costula*, amounting to 10907 ind./m³. The diversity and evenness of macrozoobenthos at Blanakan Fish Ponds classified as low and there is a dominant species at Blanakan Fish Ponds. There is no difference between macrozoobenthos diversity on 3 stations.

1. Introduction

Macrozoobenthos is defined as invertebrate that live at the bottom of a water column. Their sizes are over 1 mm and they can be found in mangrove ecosystem. Most macrozoobenthic species in mangrove ecosystem are molluscs, crustaceans, and Polychaeta. Macrozoobenthos plays an important role in the food web. They are connecting the primary producers to the higher trophic levels [1]. They are also capable of breaking down organic matter. The macrozoobenthos community also acts as a biomonitoring instrument. Biomonitoring is used in decision making to protect ecosystem sustainability [2]. Macrobenthic animals is strongly influenced by abiotic factors, such as water temperature, dissolved oxygen (DO), acidity (pH), and salinity.

Blanakan District in Subang Regency, West Java is known as commercial fish ponds implementing the silvofishery system. Silvofishery is a form of aquaculture that integrates into the mangrove ecosystem. Most fish ponds in Blanakan use a traditional system without additional feeding. Silvofishery model used in Blanakan are mostly the *empang parit* model [3]. There are usually two species cultivated in one pond, such as milkfish (*Chanos chanos*) and tiger shrimp (*Penaeus monodon*). The water used in Blanakan fish ponds is brackish water coming from mix of the river and sea water. The pond's distance



from the sea can affect the amount of sea water input so the water salinity in Blanakan is uneven [4]. The different salinity range can in turn affect the macrozoobenthic community structure in Blanakan fish ponds.

The aim of this paper was to determine the macrozoobenthic community structure which includes the species composition, density, diversity, evenness and dominance in Blanakan fish pond, Subang, West Java. The hypothesis is the macrozoobenthic community structure is different in 3 stations of Blanakan fish pond, Subang, West Java.

2. Materials and Methods

This study was carried out on April 2018 at Blanakan fish pond, Subang, West Java. The sampling stations were based on their distance from the sea, such as station I, II, and III (figure 1). The samples were collected from 3 sampling fish ponds in each station. Each fish ponds consists of 3 sampling points with twice repetition.



Figure 1. Map of sampling stations in Blanakan fish pond, Subang, West Java

Sampling of macrozoobenthos was done using Van Veen Grab (14.5 x 15 x 10 cm width x length x height). The benthic samples were retained using 1 mm meshsize sieve to separate the benthic animals from the substrate. The samples were collected, preserved in 75% alcohol and identified based on identification keys [5, 6 & 7]. Water temperature, dissolved oxygen, pH, and salinity were measured at each sampling point. The ecological indexes used are density index, Shannon-Wiener diversity index (H'), Pielou evenness index (E), Simpson dominance index (D), Sorensen similarity index (IS), and t-test [8, 9 & 10].

Density index

$$K_i = \frac{1000000 \times N_i}{V}$$

where:

K_i = Species density (ind./m³)

N_i = Total number of species (ind.)

V = Volume of sampling area (m³)

= 14.5 x 15 x 10 cm = 2.175 m³

*1000000 is conversion of cm³ to m³

Shannon-Wiener diversity index

$$H' = - \sum p_i \ln p_i, \text{ with } p_i = \frac{n_i}{N}$$

where:

H' = Diversity index

n_i = individual numbers of i^{th} species

N = total number of individuals

Pielou evenness index

$$E = \frac{H'}{\ln S}$$

where:

E = Evenness index

H' = Diversity index

S = total number of species

Simpson dominance index

$$D = \sum (p_i)^2, \text{ with } p_i = \frac{n_i}{N}$$

where:

D = Dominance index

n_i = individual numbers of i^{th} species

N = total number of individuals

Sorensen similarity index

$$IS = \frac{2j}{a+b} \times 100\%$$

where:

IS = Sorensen similarity index

a = number of species found on station a

b = number of species found on station b

j = number of species found on both station

diversity t-test

$$t\text{-test} = \frac{H'_1 - H'_2}{\sqrt{S_1^2 + S_2^2}}$$

where:

H' = diversity index

S = deviation standard

3. Results and Discussions

The water temperature in Blanakan fish pond ranges from 28.47°C to 34.8°C. The temperature for the growth of macrozoobenthos is around 25-31°C [11]. The pH of the water in the Blanakan pond area ranges from 7.15 to 7.98. The pH value favored by aquatic biota is around 7-8.5 [12]. Water salinity in

the Blanakan pond area ranges from 0 to 25.67 psu. The range of salinity suitable for macrozoobenthic life is around 15-35 psu [13]. DO water in the Blanakan pond area ranges from 6.83 to 7.63 mg/L. The minimum DO value for macrozoobenthic life is 5 mg/L [14].

Table 1. Abiotic factors at each sampling station in Blanakan, Subang, West Java.

Station	Ponds	Temperature (°C)	pH	Salinity (psu)	DO (mg/L)
I	1	30.93	7.15	0.00	7.27
	2	29.63	7.70	3.67	7.57
	3	28.47	7.57	4.67	7.63
	Mean	29.68	7.47	2.78	7.49
II	1	32.03	7.42	12.00	7.37
	2	31.97	7.83	11.67	7.40
	3	32.27	7.98	10.67	7.33
	Mean	32.09	7.74	11.45	7.37
III	1	33.77	7.75	22.67	7.20
	2	34.80	7.63	24.00	6.83
	3	33.67	7.38	25.67	7.03
	Mean	34.08	7.59	24.11	7.02

Six species of macrozoobenthos were identified at Blanakan fish pond, Subang, West Java. The species found are *Melanoides tuberculata*, *Brotia costula*, *Cerithidea cingulata*, *Nephtys inornata*, *Cossura sp.*, and *Erpobdella sp.* *Melanoides tuberculata*, *Brotia costula*, and *Cerithidea cingulata* are species of the Gastropod class. *Nephtys inornata* and *Cossura sp.* are species from the Polychaeta class. *Erpobdella sp.* is a species from the Clitellata class and subclass Hirudinea. Table 2 shows that the highest density at station I is *Brotia costula* with 7791 ind./m³, second highest density is *Melanoides tuberculata* with 945 ind./m³, and lowest density is *Nephtys inornata* with 102 ind./m³. This result indicates that *Brotia costula* is dominant at station I. The same result was found at station II which is dominated by *Brotia costula*. The density of *Brotia costula* at station II is 10907 ind./m³. Density of *Nephtys inornata*, *Cerithidea cingulata*, *Erpobdella sp.*, and *Cossura sp.* at station II respectively 128 ind./m³, 26 ind./m³, 77 ind./m³, 26 ind./m³ (Table 3). Meanwhile, station III is dominated by *Cerithidea cingulata* with 7433 ind./m³ (table 4).

Table 2. Species density at station I in Blanakan, Subang, West Java.

No.	Species	Density (ind./m ³)			
		Station I			
		P1	P2	P3	Mean
	Gastropods				
1	<i>Melanoides tuberculata</i>	1916	77	843	945
2	<i>Brotia costula</i>	2375	11418	9579	7791
	Polychaeta				
4	<i>Nephtys inornata</i>	0	307	0	102

Table 3. Species density at station II in Blanakan, Subang, West Java.

No.	Species	Density (ind./m ³)			
		Station II			
		P1	P2	P3	Mean
Gastropods					
1	<i>Brotia costula</i>	11188	9962	11571	10907
2	<i>Cerithidea cingulata</i>	77	0	0	26
Polychaeta					
3	<i>Nephtys inornata</i>	0	230	153	128
4	<i>Cossura sp.</i>	0	0	77	26
Clitellata					
5	<i>Erpobdella sp.</i>	0	153	77	77

Table 4. Species density at station III in Blanakan, Subang, West Java.

Table 4. Species density at Station III in Damdama, Shadwa, West-Gov.					
No.	Species	Density (ind./m ³)			
		Station III			
		P1	P2	P3	Mean
Gastropods					
1	<i>Cerithidea cingulata</i>	11111	4751	6437	7433

The macrozoobenthos class dominating the Blanakan pond area is Gastropods. Gastropods can live and thrive on various types of substrates. Gastropod density is high in all three stations due to substrate texture, high organic matter content, and good adaptability to live in various places compared to other classes [15]. Gastropod species dominating stations I and II is *Brotia costula*. *Brotia costula* tends to live on sand, mud and rocks. This species is also often found in areas with aquatic plants. In addition, *Brotia costula* is also found in shallow waters [16]. *Cerithidea cingulata* is the only species found on station III. This happened because *Cerithidea cingulata* is a marine gastropod, so it can be found in station III which has high salinity. The very high density of *Cerithidea cingulata* at Station III is caused by a very high breeding pattern [17].

Index of diversity at station I is 0.42, at station II 0.14, and at station III 0. The diversity index of all three stations are categorized as low. The low value of this diversity index shows that individual density in each species is uneven. When linked to environmental conditions, this shows that the environment in the study area is considered lacking or unable to support the ongoing processes of living organisms [17]. Evenness index at station I is 0.38, at station II 0.09, and at station III 0. The evenness index of all three stations are categorized as low. The low level of evenness index indicates that the spread of macrozoobenthos is uneven. Evenness index is low if there are one or more species in the community compared to other species. The higher the evenness index, the higher the uniformity of the community. Dominance index at station I is 0.78, at station II 0.95, and at station III 1. The dominance index of all three stations are categorized as high. The value of this dominance index shows that there are certain species that dominate the community [8]. This shows that the macrozoobenthic community structure is unstable and there is ecological pressure on the life of the macrozoobenthos.

Table 5. Species diversity, evenness, and dominance index in Blanakan, Subang, West Java

Station	H'	E	D	Number of species
I	0.42	0.38	0.78	3
II	0.14	0.09	0.95	5
III	0	0	1	1

Table 6. Diversity t-test

No	Samples	t-table	t-count	Difference
1	H' I dan H' II	2.015	0.008	No real difference
2	H' I dan H' III	2.015	0.015	No real difference
3	H' II dan H' III	2.015	0.004	No real difference

Based on table 6, the t-count between H' stations I and II is 0.008, t-count between H' stations I and III is 0.015, and t-count between H' stations II and III is 0.004. The results show that there is no difference in the diversity of macrozoobentos communities in all three stations. This is shown in the t-count value of diversity which is smaller than the t-table value at 5% confidence. The diversity of macrozoobenthic communities in stations I, II, and III is not different because there is dominance by certain species in all three stations. Stations I and II are dominated by *Brotia costula*, while station III is dominated by *Cerithidea cingulata*. The composition of the species that make up stations I, II, and III is different. In addition, the number of individuals of each species in all three stations is also different, but the evenness of the species in the three stations is no different. This causes the diversity index values in all three stations tend to be the same because diversity is influenced by the number of individuals and evenness. Based on the station, the highest number of species is found in station II, while the number of species is at least at station III. The small number of species on station III is probably due to its location adjacent to the sea, so that the salinity at station III is relatively high.

Table 7. Sorensen Similarity index

	St. I	St. II	St. III
St. I	1	0.5	0
St. II	0.5	1	0.3
St. III	0	0.3	1

The Sorensen Similarity Index value on species composition at stations I and II is 0.5. This value indicates that the macrozoobenthos community at stations I and II are almost the same. The value of the Sorensen Similarity Index on species composition at stations I and III is 0. The value of the Sorensen Similarity Index on species composition at stations II and III is 0.3. This value indicates that the macrozoobenthos community are not the same. Macrozoobenthos composition is most influenced by salinity. The same species in stations I and II are *Brotia costula* and *Nephtys inornata*. The same species in stations II and III are *Cerithidea cingulata*. Station I and III do not have the same species. *Brotia costula* can be found at stations I and II because *Brotia costula* is a freshwater gastropod. This is consistent with the salinity values at stations I and II. Meanwhile, *Cerithidea cingulata* can be found in stations II and III because *Cerithidea cingulata* is a marine gastropod.

4. Conclusion

Macrozoobenthic species found in the Blanakan pond area consist of six species from the Gastropoda, Polychaeta, and Clitellata classes. Species include *Melanoides tuberculata*, *Brotia costula*, *Cerithidea cingulata*, *Nephtys inornata*, *Erpobdella sp.*, and *Cossura sp.* The macrozoobenthos community is dominated by the Gastropoda class with the highest density held by *Brotia costula* which is equal to 10907 ind./m³. The diversity index value and macrozoobenthos evenness index are low, and there are macrozoobenthos species dominating. There is no difference in macrozoobenthos diversity in all three stations.

Acknowledgement

This research was funded through University of Indonesia PITTA Grant.

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