



Macrozoobenthos Community Structure in Mangrove Forest Ecotourism Area Karangsong Indramayu 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 analyze the diversity of macrozoobenthos species and density in mangrove ecotourism waters Karangsong Indramayu Regency West Java. The research was conducted in West Java starting from January 2021 to March 2021. This research method uses primary data in the form of physical and chemical data to measure the density, diversity and uniformity of macrozoobenthos. Data retrieval technique uses *Purposive Sampling* in the determination of 3 stations and 4 repetitions. The results of the research found 15 species of Makrozoobenthos that live in mangrove ecosystems namely *Telescopium telescopium*, *Balanus perforates*, *Clypeomorus zonata*, *Cassidula aurisfelis*, *Cypraea leucogaster*, *Gyrineum natator*, *Polinices powisianus*, *Perna viridis*, *Placuna placenta*, *Tellina sp*, *Gari sp*, *Meretrix meretrix*, *Dossinia sp*, *Saccostrea cucullate* and *Anadara transversa*. The density of macrozoobenthos ranges from 294 – 548 ind/m². The diversity index of macrozoobenthos at stations 2 and 3 is in the medium category with a value of 2.44 and 2.822 and the diversity at station 1 is in the high category with a value of 3.10. Uniformity values range from 0.84 – 0.891 with a high category. The relationship of Water Quality with Makrozoobentos has an R² value of 90% water quality can affect the life of macrozoobenthos and as much as 10% is influenced by other factors.

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1. INTRODUCTION

Indramayu is one of the cities in West Java that has a high fishery and marine potential. Indramayu Regency is located at a geographical position of 108°36'00"E and 06°40'00"S. The area of Indramayu Regency is about 204,011 ha which is divided into administrative areas of 31 sub-districts and 302 villages. Indramayu coastal area has a coastline length of approximately 114 km that stretches along the north coast, there is a mangrove ecotourism area around it.

Karangsong mangrove forest is one of the ecotourism areas located north of Indramayu City, located in Indramayu Subdistrict, Karangsong Village. Karangsong Beach has a mangrove forest conservation area that is quite large approximately 25 ha. In 2008 to 2014 mangrove tree planting was carried out in Karangsong by local governments and companies around the area. Then the area is open to the public for marine tourism.

Karangsong mangrove ecotourism is one of the tourist attractions that has the potential of natural beauty and cultural wealth of high value in the ecotourism industry market. Based on visitor data obtained from the core management of Karangsong mangrove forest, the number of mangrove ecotourism visitors in 2015 as many as 72,975, in 2016 as many as 92,976 people, in 2017 as many as 94,531 people, in 2018 as many as 95,823 people and in 2019 as many as 67,127 people (Markus 2020). Based on the data that the number of visitors increased every year and decreased in 2019. The high number of ecotourism visitors will disrupt the life cycle of organisms, damage habitats and loss of biodiversity [1].

The high number of visitors to Karangsong Mangrove Forest is not accompanied by high self-awareness, it is due to the decrease in environmental quality caused by plastic waste from visitors who take a long time to experience decomposition. According to the Head of the Environmental Maintenance Section at the Indramayu Environmental Service, Plastic waste can block the decomposition process of mangrove vegetation that produces litter from the luruhan leaves and twigs.

According to Mulya (2002), the role of Total Organic Matter (BOT) in marine ecology is as a

source of energy (food), plants and animals, a source of vitamins, as a substance that can accelerate and slow growth so that it has an important role in regulating life. One organism that can be affected is bentos because this animal lives sedentary. Bentos animals are closely related to the availability of total organic matter contained in the substrate, because organic matter is a source of nutrients for marine biota that are generally found in substrates so its dependence on organic matter is very large.

Odum [2] explains that one of the biota that can be used as a biological parameter in determining the condition of a water is macrozoobentos. Changes in water quality and substrates affect the abundance and diversity of macrozoobentos. This abundance and diversity depends on tolerance and sensitivity to environmental changes consisting of biotic and abiotic. Good quality waters usually have a high breed of diversity and conversely in poor or polluted waters usually have a low diversity of species.

2. RESEARCH METHOD

2.1 Time and Place

The research was conducted at Karangsong Mangrove Forest Ecotourism located in Indramayu Regency, West Java in January 2021 to March 2021. The observed samples were macrozoobentos and surface water. Macrozoobentos identification was conducted in the Laboratory of Aquatic Resource Management universitas Padjadjaran and substrate type was conducted in the Laboratory of Soil Chemistry and Plant Nutrition (KTNT) Department of Soil Science and Land Resources Faculty of Agriculture Universitas Padjadjaran.

2.2 Methods

This research uses the purposive sampling method in determining the sampling station. The research station is divided into three based on the density of the mangrove species. At each station, an analysis of environmental parameters will be carried out including chemical parameters (measurement of dissolved oxygen, acidity, salinity and basic substrate content), physical parameters including measurement of water temperature and biological parameters using macrozoobenthos to measure density, diversity index and uniformity index.

Water analysis was carried out directly on the ecotourism waters of mangrove forests and for macrozoobenthos data collection using a 1x1m transect in which there were 25 plots measuring 20x20cm, from 25 plots 5 plots were taken randomly as a place for repeat sampling at each research station.

2.3 Research Parameters

2.3.1 Macrozoobentos density

Density is the number of individuals per unit area or per unit volume. The formulas used are as follows (Fitriana 2006).

$$D_i = \frac{N_i}{A}$$

Information:

- Di = Density of individual type i (ind/m²)
- Ni = Number of individuals of the i-type
- A = Sample transek area (m²)

Density of each m² is obtained by converting the density of macrozoobenthos transek boxes.

2.3.2 Macrozoobentos diversity

The diversity of macrozoobenthos species can be calculated by the Shannon-wiener diversity index (H') formula.

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

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

information:

H' = Shannon Wiener Diversity Index
 Pi = Proportion of species to i (ni) to total number (N)

With criteria:

- H' ≤ 2 = Low diversity
- 2 < H' ≤ 3 = Moderate diversity
- H' > 3 = High diversity

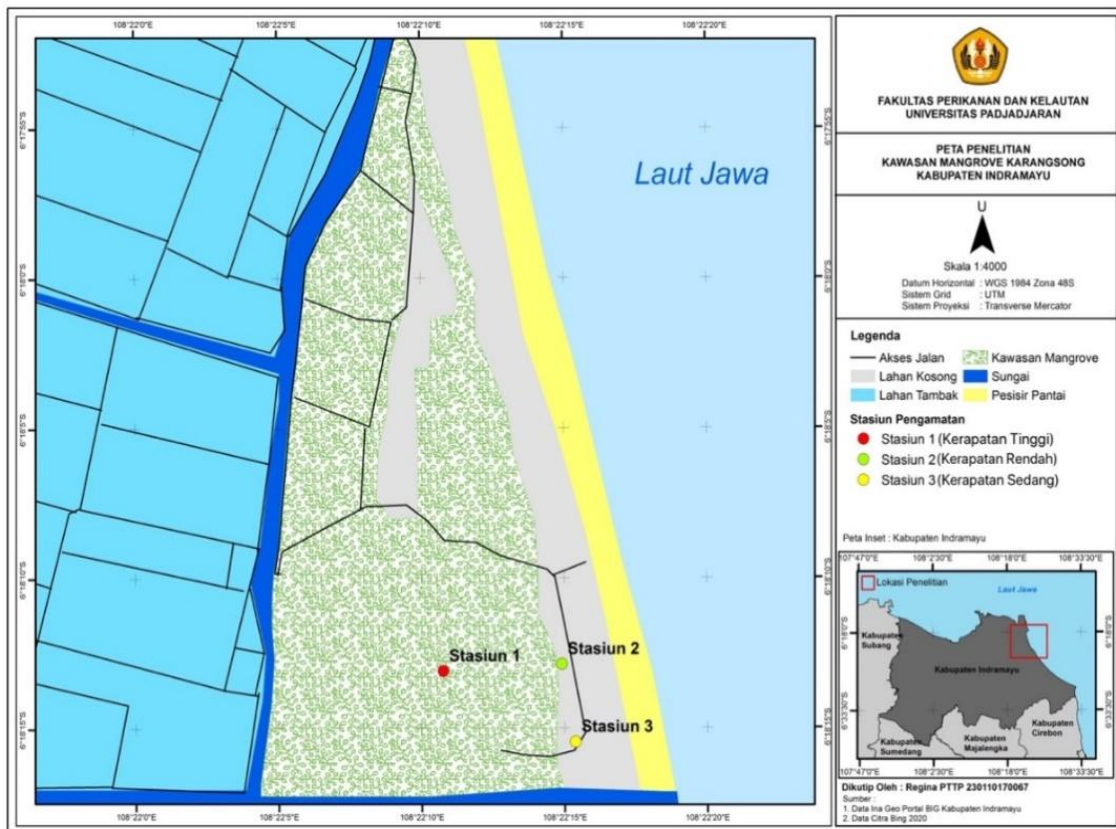


Fig. 1. Map of Makrozoobentos observation station

Note: Station 1 is a mangrove with high carapatan with mud substrate with coordinate point S 6°18'13.17" : E 108°22'10.37", Station 2 is a mangrove with a low carapatan with mud substrate with coordinate point S 6°18'14.43" : E 108°22'16,19", Station 3 is a mangrove with medium density with mudsubstrate with coordinate point S 6°18'15.19" : E 108°22'16,19"

2.3.3 Uniformity/ equitability index (E)

Uniformity index is the spread of individual numbers in each organism can be determined by comparing the value of diversity index with the maximum value (Krebs 1989).

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

Information:

H' = Shannon-Wiener diversity index

Hmax = $\log_2 S$

S = Number of species

With criteria:

0<E<0.4 = Low uniformity

0.4<0<0.6 = Moderate uniformity

E>0.6 = High uniformity

2.4 Data Analysis

Data obtained from the field in the form of density calculation, diversity index, macrozoobentos uniformity index is analyzed descriptively. Each group describes certain characteristics. The average calculation of the index of diversity and density is carried out in each group, so that the diversity and density of macrozoobentos of the existing groups can be compared. The community structure of macrozoobentos compared between stations is tabulated in graph form and described to give an overview of the state of macrozoobentos. The relationship of water quality with macrozoobentos is carried out regression tests. The data used for analysis is the average result of sampling repeat results at each station.

3. RESULTS AND DISCUSSION

3.1 Conditions of the Observation Station

The condition of the waters in mangrove forest ecotourism Karangsong Indramayu Regency West Java at the observation station has different conditions. Station 1 has a clay substrate, canopy cover is lush so that the intensity of sunlight that enters lower, this area is always inundated by water because it is passed by river water flow and the type of mangrove that grows *rhizophora mucronata* (stake) with mangrove density of 4666 Ind/ Ha.

Station 2 has a clay substrate, low canopy cover, so the intensity of incoming sunlight is higher, at low tide some areas are not inundated by water. The type of mangrove that grows is *Avicennia*

marina with an overall mangrove density of 756 Ind/Ha.

Station 3 has a substrate of dusty clay clay, medium canopy cover, high intensity of incoming sunlight, at low tide the area is still inundated by water although very little. The type of mangrove that grows is *Avicennia marina* with an overall mangrove density of 1,235 Ind/Ha.

3.2 Physical and Chemical Parameters of Water

Environmental conditions greatly affect the development of macrozoobentos and mangrove plants diversity. Water parameters can determine the characteristics of these environmental conditions. The results of measurement of physical and chemical parameters of waters that affect the survival of macrozoobentos include temperature, dissolved oxygen (DO), degree of acidity (pH), and salinity. Here is the water parameter data on each observation station (Table 1).

3.2.1 Temperature

Environmental conditions greatly affect the development of macrozoobentos and mangrove plants diversity. Water parameters can determine the characteristics of these environmental conditions. The results of measurement of physical and chemical parameters of waters that affect the survival of macrozoobentos include temperature, dissolved oxygen (DO), degree of acidity (pH), and salinity. Here is the water parameter data on each observation station (Table 2).

The water temperature values obtained at the three observation stations during 4 repetitions ranged from 26.3°C to 31.8°C. The difference in temperature values obtained at all 3 stations is likely due to the difference in the time of water quality data collection. The temperature range found in the research station is a range that is able to support the life of macrozoobentos. Ruswahyuni (2010), states that good temperatures for macrozoobentos organisms range from 25°C - 30°C. From the observation that the water temperature of karangsong mangrove forest observed is still in optimum temperature for macrozoobentos life.

3.2.2 Substrate types

The type of substrate becomes the influence of the spread and presence of Makrozoobenthos because it relates to the availability of nutrients or organic matter for the survival of

macrozoobentos. The results of the analysis of the substrate types of each station can be seen in (Table 3).

C-organic at each station comes from mangrove litter and feces and carcasses of animals living in Mangrove Forest Ecotourism Karangsong Indramayu such as large egrets (*Egretta alba*), it is in line with what sutedjo and Kartasapoetra [3] expressed that the main source of soil organic matter is plant tissue, either in the form of litter or plant remains and dirt and animal carcasses. The highest c-organic value at station 1 with a dust percentage (slit) of 40%, clay (clay) of 41% and sand of 19%. The content of c-organic and particle size have a relationship according to Abdunnur [4] fine sediment the percentage of organic matter is higher than coarse sediment. This is because fine particles in organic matter

settle more easily than coarse particles, and are also excellent for the survival of macrozoobentos (Romdhani 2016). High levels of organic matter in a water will generally increase the number of macrozoobentos animal populations because these animals like substrates rich in organic matter.

3.2.3 Dissolved oxygen (DO)

Dissolved oxygen is used by aquatic organisms for the respiration and decomposition of organic substances (Melay et al. 2015). Dissolved oxygen (DO) at each observation station is in the range of 5.3 – 7.2 mg/L, the highest DO values are at stations 2 and 3 with the lowest density and the lowest DO values are at station 1 with high density.



Fig. 2. Observation station conditions

Note: a = Station location 1, b = Station location 2 and c = Station location 3

Table 1. Physical parameters value of aquatic chemistry

No	Water Quality Parameters	Station		
		1	2	3
1	Temperature (°C)	28,7-31,8	28,5-30,6	26,3-30
2	Degree of Acidity (pH)	6,93-7,34	6,84-7,2	6,62-6,97
3	Dissolved Oxygen (DO) (mg/L)	5,3-6,8	6,2-7	6,8-7,2
4	Salinity (‰)	17-20	20-23	21-25

Table 2. Hasil pengamatan temperature pada station pengamatan

Repetition	Temperature (°C)		
	Station 1	Station 2	Station 3
Sampling 1	28,7	28,5	26,3
Sampling 2	31,3	30,6	28,4
Sampling 3	30,6	29,4	27,5
Sampling 4	31,8	30,6	30

Table 3. Substrate type of each station

Station	C-Organic (%)	Texture			Criteria
		Sand (%)	Dust (%)	Clay (%)	
1	4,95	19	40	41	Clay
2	4,12	8	52	40	Dusty Clay
3	4,52	2	40	58	Clay

As in Setiawan research [5], that in locations with different mangrove densities have no real effect on DO or dissolved oxygen. According to Istipsaroh, et al. [6] this is influenced by water temperature conditions, if the water temperature is high then DO is low and if the water temperature is low then DO is high. Dissolved oxygen in these waters is still good for macrozoobentos life with the concentration range still within the threshold. According to the State Ministry of Environment no. 51 of 2004 do quality standards are > 5 mg / l.

3.2.4 Degree of acidity (pH)

Acidity is one of the important factors to control the activity and distribution of organisms living in a water. The acidity (pH) value obtained from the three stations ranges from 6.62 – 7.34.

The limits of the organism's tolerance to pH vary and are influenced by many factors including temperature and dissolved oxygen [7]. The results of observations that the pH of the waters in karangsong mangrove forest ecotourism observed are still in the optimum pH for macrozoobentos life. Good pH value to meet marine organism life based on Kepmen LH 2004 no 51 with assessment criteria of 6.5 – 8.5. Water conditions that are very acidic and very alkaline will affect the survival of macrozoobentos.

3.2.5 Salinity

Salinity can affect changes in the composition of organisms in an ecosystem [8]. The results of water salinity measurements located in mangrove ecotourism Karangsong range from 17- 25- in Table 6. Station 3 has the highest salinity value of 25‰.

Salinity levels around mangrove forests depend on increasing and decreasing the volume of fresh water flowing from the river. Salinity differences are also influenced by sunlight, seasons, topography, ups and downs [2]. According to Hutabarat and Evans [9] the range of salinity that

is still able to support the life of aquatic organisms, especially macrozoobentos is 15-35‰.

3.3 Gastropod Community Structure

Communities are populations that occur simultaneously in space and time functionally interconnected with each other forming an ecologist [10]. The results of observation data conducted at 3 stations in mangrove forest ecotourism Karangsong found 15 species of Makrozoobenthos that settled in the mangrove ecosystem, namely *Telescopium telescopium*, *Balanus perforates*, *Clypeomorus zonata*, *Cassidula aurisfelis*, *Cypraea leucogaster*, *Gyrineum natator*, *Polinices powisianus*, *Perna viridis*, *Placuna placenta*, *Tellina* sp, *Gari* sp, *Meretrix meretrix*, *Dossinia* sp, *Saccostrea cucullate* and *Anadara transversa*. Macrozoobenthos found are commonly found attached to stems, mangrove roots and inside aquatic substrates. The type and number of Makrozoobenthos from each station can be seen in Table 7.

One species found in large numbers of the three stations is the species *Clypeomorus zonata*. Based on Supratman et al. [11] the high density of this species is due to being able to live in various types of habitats both in mangrove ecosystems, muddy to sandy beaches, in addition this species is able to live in unstable conditions such as in mining areas. This species has a maximum shell height of 4.5 cm found abundantly on the mud substrate in the mangrove area close to puddles. In some places, it is found around a former hole dug by glodok fish that contains a small puddle [12]. The second species found is *Cassidula aurisfelis* with brown outer surface color, the length of the shell ranges from 2.95 – 2.41 cm and the width of the shell is 1.99 – 1.31 cm, the shape of the oval shell is elongated with blunt apex [13]. This species has a very large number on top of muddy substrates, attached to the stems and roots of mangroves.

Table 4. Dissolved oxygen observation results at the observation station

Repetition	Dissolved Oxygen (DO) (mg/L)		
	Station 1	Station 2	Station 3
Sampling 1	6,8	7	7,2
Sampling 2	5,3	6,2	6,8
Sampling 3	6,5	6,8	7
Sampling 4	5,6	6,2	6,8

Table 5. Observation results of Acidity at the Observation Station

Repetition	Degree of Acidity (pH)		
	Station 1	Station 2	Station 3
Sampling 1	6,93	6,84	6,62
Sampling 2	7,34	7,11	6,97
Sampling 3	7,3	7,2	6,7
Sampling 4	7,2	6,93	6,84

Table 6. Salinity Observation Results at Observation Stations

Repetition	Salinity (‰)		
	Station 1	Station 2	Station 3
Sampling 1	20	23	25
Sampling 2	17	20	21
Sampling 3	19	21	23
Sampling 4	20	20	22

Table 7. Types and number of Gastropods from Each Station

No.	Kind	Station		
		1	2	3
Class Gastropoda				
1	<i>Telescopium telescopium</i>	17	0	0
2	<i>Clypeomorus zonata</i>	129	94	107
3	<i>Cassidula aurisfelis</i>	57	42	75
4	<i>Cypraea leucogaster</i>	9	20	8
5	<i>Gyrineum natator</i>	30	23	57
6	<i>Polinices powisianus</i>	0	27	29
Class Bivalvia				
7	<i>Perna viridis</i>	20	0	0
8	<i>Placuna placenta</i>	13	0	0
9	<i>Tellina</i> sp	8	0	22
10	<i>Gari</i> sp	22	21	26
11	<i>Meretrix meretrix</i>	13	0	0
12	<i>Dossinia</i> sp	0	0	22
13	<i>Saccostrea cucullata</i>	35	0	0
14	<i>Anadara transversa</i>	15	8	27
Class Crustacea				
15	<i>Balanus perforates</i>	85	0	0

3.3.1 Macrozoobentos density

Species density indicates the number of species found per plot at each station [11]. The density of an organism in an environment is influenced by several physical and chemical factors. The results of observation data conducted in mangrove forest ecotourism Karangsong macrozoobentos density value can be seen in (Table 8).

The largest density is at station 1 while the lowest density is at station 2. The density value of macrozoobentos at station 1 is 548 ind/m². This is because station 1 has a high mangrove density, so the production of mangrove litter

contained in station 1 is more than other stations. According to Nybakken [8] mangrove leaf luruhan will be an important organic material for organisms that live there, in addition to the type of substrate station 1 that is clay substrates, clay substrates type is a substrate suitable for macrozoobentos life. According to Hutchings and Saengar [14] on clay the exchange between groundwater and water columns is less, therefore such soil is richer in phosphates and causes mangrove growth to become more fertile. The fertile growth of mangroves causes its density to become dense. The denser the density of mangroves, the greater the utilization of nutrients for their growth.

Based on observations from 15 species found at all three stations of the species *Clypeomorus zonata*. Based on supratman et al. [11] the high density of this species is able to live in various types of habitats both in mangrove ecosystems, muddy beaches to sandy,

3.3.2 Macrozoobentos diversity

Diversity is identical to the stability of an ecosystem, i.e. if the diversity of an ecosystem is high then the condition of the ecosystem tends to be stable. Ecosystem environments that have diversity disturbances tend to be moderate, in the case of ecosystem environments that are polluted with low diversity tend to be low [2].

The macrozoobentos diversity index on mangrove ecotourism of Karangsong Indramayu can be seen in Fig. 3.

The macrozoobentos diversity index from observations at station 2 and station 3 is in the medium category $2 < H' < 3$. This condition indicates that the distribution of the number of individuals of each species is moderate, the productivity is quite high, the ecosystem conditions are balanced, and the ecological pressure is moderate. The diversity index with the high category $H' > 3$ is found at station 1, with a diversity index value of 3.10. The high value of diversity at station 1 is caused by the stability of the community and the relatively even distribution of the number in station 1. The high

diversity of macrozoobentos at this station is also caused by water conditions that support the life of macrozoobentos. The abundance of macrozoobentos is strongly influenced by biotic and abiotic factors in an aquatic ecosystem. Suin [15] argues that the height of macrozoobentos is due to conditions that support macrozoobentos life. Environmental conditions at station 1 support macrozoobentos life because of physical factors and good aquatic environment for macrozoobentos growth such as clay substrate type with organic matter of 4.52% which is fairly high. High levels of organic matter in a water will generally increase the population of macrozoobentos because these animals like substrates that are rich in organic matter.

The lowest macrozoobentos diversity was found at station 2 with a value of 2,439. The low value of the diversity index was due to the small number of macrozoobentos species found compared to other observations. The high level of diversity is influenced by the quality of the waters in the mangrove environment. This is in accordance with the statement of Suwondo and Sumanti [16] that the species diversity index will decrease along with the decreasing condition or quality of the waters. Species diversity is stated if the community is composed of many species and the same or almost the same density, on the contrary if the community is composed of a few species and if only a few species are dominant then the species diversity is low [17].

Table 8. Macrozoobentos density index

No.	Kind	Density (ind/m ²)		
		1	2	3
Class Gastropoda				
1	<i>Telescopium telescopium</i>	21	0	0
2	<i>Clypeomorus zonata</i>	161	118	134
3	<i>Cassidula aurisfelis</i>	71	53	94
4	<i>Cypraea leucogaster</i>	9	25	10
5	<i>Gyrineum natator</i>	30	29	71
6	<i>Polinices powisianus</i>	0	34	36
Class Bivalvia				
7	<i>Perna viridis</i>	20	0	0
8	<i>Placuna placenta</i>	13	0	0
9	<i>Tellina</i> sp	10	0	28
10	<i>Gari</i> sp	28	26	33
11	<i>Meretrix meretrix</i>	16	0	0
12	<i>Dossinia</i> sp	0	0	28
13	<i>Saccostrea cucullata</i>	44	0	0
14	<i>Anadara transversa</i>	19	10	34
Class Crustacea				
15	<i>Balanus perforates</i>	106	0	0
	Total	548	294	466

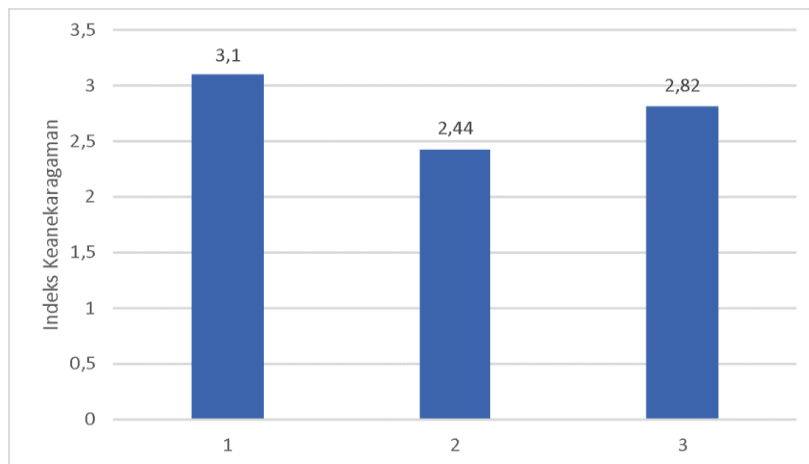


Fig. 3. Macrozoobentos diversity index

3.3.3 Uniformity of makrozoobenthos

The uniformity index is used to determine the evenness of each species in a community, the evenness index can also be used as an indicator of the presence of symptoms of species dominance in a community (Romdhani 2016). Gastropod uniformity index obtained in Karangsong Mangrove Forest Ecotourism was different for each observation station. The results obtained for the macrozoobenthos uniformity index in the ecotourism of the Karangsong Indramayu mangrove forest are shown in Fig. 4.

The uniformity value of the three stations ranges from 0.84 to 0.891 with a high category. Based on the uniformity index value criteria, it can be said that all species found at each station are almost evenly distributed or no species dominates. At each research station, the species found were almost the same, presumably because the availability of food sources for Macrozoobenthos in the study area enabled the macrozoobenthos to defend themselves and

reproduce well. The basic substrate is also an influencing factor because the substrate type is clay-textured and the organic matter content is evenly distributed in the mangrove ecosystem [18].

3.4 Relationship of Water Quality with Gastropods

The results of the regression test between density and water quality in Mangrove Forest Ecotourism Karangsong Indramayu, West Java, obtained $y = -8.3 + 6.3 \text{ Temperature} - 54.0 \text{ pH} + 2.3 \text{ Sal} - 9.4 \text{ DO} + 65.8 \text{ c-organic}$ with an R2 value of 0.90, which means that 90% of water quality can affect the life of Macrozoobenthos and as much as 10% is influenced by other factors.

Regression calculations between the abundance of Macrozoobenthos and Water Parameters can be seen in Table 9.

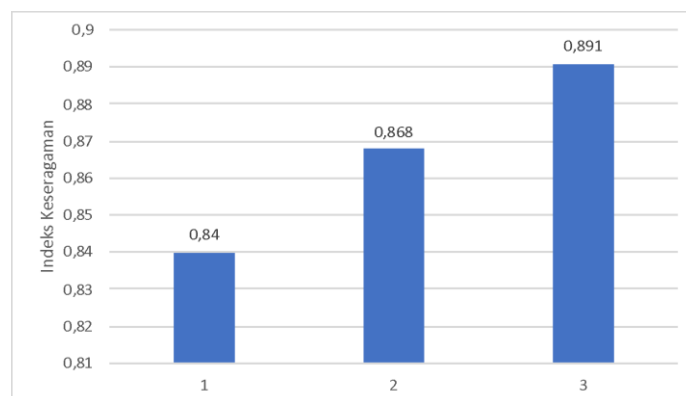


Fig. 4. Macrozoobentos Uniformity Index

Table 9. Regression between macrozoobenthos and water parameters

Regression Statistics	
Multiple R	0,953576868
R Square	0,900308844
Adjusted R Square	0,83373288
Standard Error	9,975639856
Observations	12

ANOVA					
	df	SS	MS	F	Significance F
Regression	5	5986,586323	1197,317265	12,03172014	0,004404867
Residual	6	597,0803432	99,51339054		
Total	11	6583,666667			

	Coefficients	Standard Error
Intercept	-8,302832116	294,2528686
Temperature	6,385990981	4,436299224
pH	-54,0670954	28,83322486
Salinity	2,358384662	3,608301943
Do	-9,496700805	11,24338963
Organic Carbon	65,82323584	9,907036454

According to Sugiyono [19] the correlation coefficient is divided into several groups such as 0.00 – 0.199 very low relationship, 0.20 – 0.399 low relationship, 0.40 – 0.599 moderate, 0.60 – 0.799 strong relationship, and 0.80 – 1,000 very strong relationship. The level of the relationship between macrozoobenthos with water quality that influence such as temperature, pH, salinity, DO and organic carbon were also obtained in the regression test with multiple R value (R compound) 0.95, which means the water quality has a relationship which very strongly affects the life of macrozoobenthos.

From this test, it was found that the density of macrozoobenthos was influenced by the condition of the surrounding waters. Based on the correlation value, it was found that density had the greatest correlation with organic carbon. The higher the c-organic content, the macrozoobenthos density will tend to increase, this is in accordance with the statement of Janestia et al. [17] the high density of macrozoobenthos is influenced by the high value of c-organic at each station. Asriani et al. [20] said that the high c-organic in the waters will generally lead to an increase in the population. In general, the results of environmental parameters in the Karangsong mangrove waters are still feasible in supporting the survival of the macrozoobenthos in it. The activities of ecotourism visitors to the Karangsong mangrove forest that are maintained in the area will have an

impact on the survival of the macrozoobenthos in these waters.

Based on observations from all stations, the highest level of gastropod diversity and has good water quality is station 1. This is in accordance with Asriani et al. [20] the environmental conditions of a waters are said to be still good (stable) if a high diversity index value and a low dominance index are obtained.

4. CONCLUSION

The community structure of 3 stations in the mangrove forest ecotourism Karangsong Indramayu, West Java found 15 species of macrozoobenthos living in the mangrove ecosystem, namely *Telescopium Telescopium*, *Balanus perforates*, *Clypeomorus zonata*, *Cassidula aurisfelis*, *Cypraea leucogaster*, *Gyrineum natator*, *Polinices Plawisianus*, *Perna viridis placenta*, *Tellina sp*, *Gari sp*, *Meretrix meretrix*, *Dossinia sp*, *Saccostrea cucullata*. *Transverse Anadara*.

The density index of macrozoobenthos at the three stations ranged from 294 – 548 ind/m². The largest density is at station 1 while the lowest density is at station 2.

The macrozoobenthos diversity index from observations at station 2 and station 3 was included in the medium category 2 <H' 3 and the

diversity index with the high category $H' > 3$ was at station 1, with a diversity index value of 3.10. This condition shows that the distribution of the number of individuals of each species is moderate, the productivity is quite high, the ecosystem condition is balanced, and the ecological pressure is moderate.

The uniformity value of the three stations ranges from 0.84 to 0.891 with a high category. Based on the criteria for the uniformity index value, it can be said that there is no dominant species.

The relationship between water quality and gastropods has an R^2 value of 90%, water quality can affect the life of macrozoobenthos and as much as 10% is influenced by other factors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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