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COMPARISON OF MACROZOOBENTHOS COMMUNITY STRUCTURE ON SEAGRASS ECOSYSTEMS IN THE WATERS OF NIRWANA COAST AND PULAU PANJANG OF WEST SUMATRA

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ABSTRACT

Macrozoobenthos have various roles in the ecosystem, one of which is as a biological indicator because macrozoobenthos will react to disturbances in an aquatic ecosystem. Seagrasses are breeding and sheltering grounds for marine life, one of which is macrozoobenthos. Nirwana Beach and Pulau Panjang are waters that have seagrass ecosystems in West Sumatra. The purpose of this study was to compare the community structure of macrozoobenthos in the waters of Nirwana Beach and Pulau Panjang, this research was conducted in the waters of Nirwana Beach and Pulau Panjang in June-July 2021. The method used in this study is the survey method; sampling was carried out using three plots on each transect with a size of 1m x 1m and was repeated three times on each plot. The results of this study found that the abundance value in the waters of Nirwana Beach was 20.59 ind/m^2 and in the waters of Pulau Panjang 21.44 ind/m^2, the diversity index (H') in the waters of Nirwana Beach was 2.450 and in the waters of Pulau Panjang was 2.680, The uniformity index (E) in the waters of Nirwana Beach is 0.738 while in the waters of Pulau Panjang, it is 0.807 and the dominance(C) in the waters of Nirwana Beach is 0.162 and in the waters of Pulau Panjang is 0.198. The distribution pattern (Id) of macrozoobenthos at both locations is clustered with a value of 1.07 ind/m^2 in the waters of Nirwana Beach and 1.13 ind/m^2 in the waters of Pulau Panjang. The community similarity index was categorized as moderate with 66% at both study sites.

Keywords: Macroozoobenthos, Seagrass Ecosystem, Nirwana Beach, Pulau Panjang

1. INTRODUCTION

Macrozoobenthos are organisms that are filtered by a 1.0 mm filter that live in silt, sand, rocks, gravel, or organic waste at the bottom of a body of water. Markozoobenthos has various roles in ecosystems, one of which can be used as a biological indicator because macrozoobenthos will react to the condition of the quality of an aquatic ecosystem. Several types of macrozoobenthos have high economic value and several types of macrozoobenthos can also be processed into traditional medicines and their shells are taken as jewelry materials[1].

The existence of macrozoobenthos that inhabit seagrass meadows indicates that there is a dynamic life that occurs in interactions between seagrasses and marine biota, especially utilizing and needing each other in the breeding process. Macrozoobenthos plays a role as one of the links in the energy flow and cycle from algae to high-level consumers. The existence of benthic animals in water is strongly influenced by various factors[2].

Seagrasses are generally scattered in shallow water areas of the intertidal zone which are influenced by tides to subtidal

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areas with certain depths. Seagrass communities have an important ecological function in coastal areas. Tight seagrass beds play an important role in reducing wave energy, precipitating organic particles and nutrients, and providing shelter for various types of marine life[3].

The waters of seagrass ecosystems are spread quite widely in the waters around West Sumatra, including in the waters of Nirwana Beach and Pulau Panjang. Pulau Panjang is one of the small islands located around the sea waters of West Sumatra so the impact of human activity is not too big. In contrast to the waters of Pulau Panjang, the waters of Nirwana Beach are located on the mainland of Sumatra, to be precise near the city of Padang, so the impact caused by human activities on the biota associated with seagrass beds is one of the large macrozoobenthos.

Given the importance of seagrass habitat for the survival of various organisms associated with seagrasses in particular and also macrozoobenthos have a very important role in the survival of other aquatic organisms. Therefore, research on the comparison of macrozoobenthos community structure in seagrass ecosystems in Nirwana Beach and Pulau Panjang waters, West Sumatra needs to be carried out. So that later it can be used as a reference and information in planning the management of coastal areas in the waters of Nirwana Beach and Pulau Panjang, West Sumatra.

This research was conducted to know differences in macrozoobenthic community structure in seagrass ecosystems in Nirwana Beach and Pulau Panjang, West Sumatra, including species, abundance, diversity, dominance, distribution pattern, and community similarity.

2. RESEARCH METHOD

Pulau Panjang, West Sumatra. Macrozoobenthos sampling was carried out at low tide and water quality measurements were carried out at high tide. Furthermore, the identification of samples was carried out at the Marine Biology Laboratory Department of Marine Science, Faculty of Fisheries and Marine, Universitas Riau. In situ measurements of salinity, temperature, and pH were carried out at the research location of Nirwana Beach and Pulau Panjang waters, West Sumatra.

Parameters Measured

The method used in this study was a survey method where Nirwana Beach waters and Pulau Panjang waters were used as research locations and macrozoobenthos were used as research objects. To determine the community structure of macrozoobenthos there were several parameters studied namely species, abundance, diversity index, dominance index, equality community, and pattern of distribution of macrozoobenthos found at the study site.

Research procedure

Determination of Observation Stations

Station selection was based on a preliminary survey to see the condition of the research location. The method of determining stations and placing observational sampling points used in this study is to use a purposive sampling technique. In this study, a station I is located in the waters of Nirwana Beach, Padang City, while station II is located in the waters of Pulau Panjang Pasaman Barat. At each station, there are three transects where on each transect there are three plots.

Macrozoobenthos Sampling

A sampling of macrozoobenthos from each station was carried out on each plot with three repetitions at low tide using a 1 m x 1 m plot and the substrate was taken to a depth of 10 cm in each plot. Then the substrate is sieved using a $1mm^2$ sieve to separate the substrate from the sample found. The sample is then cleaned from the substrate and put into a plastic bag which has been labeled based on the station, plot, and repetition. Identification of aquatic biota is limited to the external

morphological characters of a species examined using a macrozoobenthos identification book, Marine Biology Laboratory, Department of Marine Science, Faculty of Fisheries and Marine.

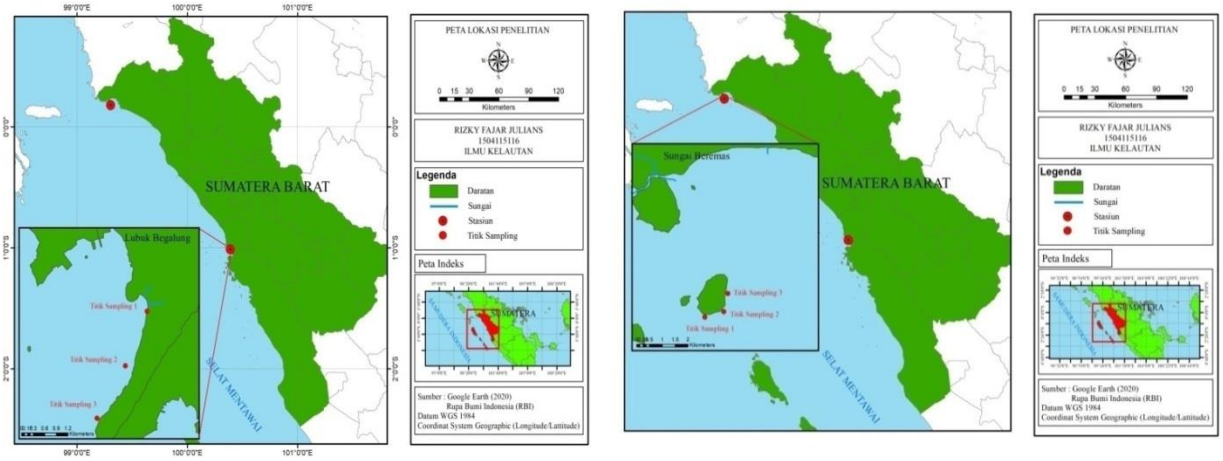

Figure 1. Research location map

3. RESULT AND DISCUSSION

General Conditions of Research Locations

Nirwana Beach is one of the beaches in West Sumatra, to be precise, in Teluk Kabung District, Padang City. Nirwana Beach has the characteristics of clear waters with a sandy substrate and sloping beach topography, in the waters of Nirwana Beach there are several types of aquatic plants such as seagrass species. Apart from being a tourist object, Nirwana Beach is also used by local fishermen as a place to land boats.

The condition of water quality parameters such as pH, temperature, salinity, and brightness are in good condition as a place for biota to live, this is also supported by the addition of seagrass that grows on Nirwana Beach. Geographically, Nirwana Beach is located in Teluk Kabung District, which is located at coordinates 1°00'59"-1°01'85" LS and 100°22'95"-100°23'34" E, has a coastline of ± 6 km. It is bordered by several areas: to the north by Padang Selatan District, to the south by Pesisir Selatan Regency, to the west by the Indian Ocean, and to the east.

Pulau Panjang is one of several small islands located in Sungai Beremas District, Pasaman Barat Regency, West Sumatra. The beach which was used as the research location has the characteristics of clear waters with a sandy substrate and a sloping topography ±50 m from the shoreline. In the waters of the research location, there are mangroves, coral reef, and seagrass ecosystems, but these three ecosystems are in small numbers.

Pulau Panjang is the only inhabited island among the small islands around it. The majority of people in Pulau Panjang work as fishermen, and providers of shipbuilding services and transportation services. The geographical location of Pulau Panjang is at coordinates 00°11'17" South Latitude and 99°18'27" East. Pulau Panjang is in the Indian Ocean, this island is on the west side of Sumatra Island and is close to Pangka Island, Pigago Island, and Tamiang Island.

Water Quality Parameters

The average water quality measurement value for each parameter indicates that the waters are still in good condition. Following the opinion of Marpaung et al[4]. Stating that the range of salinity between 15-30‰ is still suitable for the growth of macrozoobenthos. In general, aquatic biota can live properly in the pH range of 5-9[1]. More details can be seen in Table 1.

Sediment Substrate

Based on the analysis carried out in the laboratory, it can be seen that the type

of sediment found on Nirwana Beach and Pulau Panjang Beach is sand (Table 2).

Table 1. Average quality of Nirwana Beach and Pulau Panjang

Parameter	Nirvana Beach	Pulau Panjang
Salinity (‰)	28.45	28.90
pH	7	7
Brightness (%)	100	100
Temperature (^{o}C)	28,31	29,22
Depth (cm)	30-80	60-100

Table 2. Nirwana Beach and Pulau Panjang sediment fractions

Station	Transect	% Sediment Fraction			Sediment Type
		Gravel	Sand	Mud	
Nirvana	1	8,22	81.7	10.08	Sand
	2	8.86	77,86	13,28	Sand
	3	9,6	78.1	12,3	Sand
Pulau Panjang	1	9,18	77,64	13,18	Sand
	2	10.62	79,32	10.06	Sand
	3	11.76	80.3	7,94	Sand

It can be seen in Table 2. In general, the type of sediment at both research locations is sand. This can be seen based on the percentage value of the sand fraction at a value above 70% on each transect at each research station. As for the silt and gravel fractions, none of them reached a value of 15% on each transect at the two research stations. So it can be concluded that Nirwana Beach and Pulau Panjang waters have sandy sediment types.

Total Organic Ingredients

Based on the results of the analysis conducted at the Marine Biology Laboratory, Department of Marine Science, Universitas Riau, the results can be seen in Table 3.

Table 3. Average organic matter content in Nirwana Beach and Pulau Panjang

Station	transect			Average±std.dev
	1	2	3	
Nirwana	5.57	5.02	5.08	5,23±0.30
Pulau Panjang	4.68	4,12	5,68	4.83±0.79

The organic matter content of the sediments in the waters of Nirwana Beach ranges from 5.02-5.57%. The highest sediment organic matter was found on transect 1, namely 5.57%, and the lowest organic matter was found on transect 2, namely 5.02%, while the results of the analysis of sediment organic matter in Pulau Panjang waters ranged from 4.12-5.68%. The highest sediment organic matter was found on transect 3, namely 5.68%, and the lowest organic matter was found on transect 2, namely 4.12%. Meanwhile, the highest organic matter content at both stations was at Nirwana Beach Transect 1, namely 5.57, and the lowest organic matter content was at Pulau Panjang, transect 2, 4.12.

Macrozoobenthos species

Macrozoobenthos found were from the phylum Mollusca such as from the class Gastropods and Bivalva, from the phylum Echinodermata such as from the class Holothuroidea, and the phylum Arthropoda from the class Malascostraca (Table 4).

The classification of macrozoobenthos found in the coastal waters of Nirwana consists of the phylum Mollusca and Echinodermata. From the phylum Mollusca, there are classes Gastropods and Bivalva, while from the phylum Echinodermata, one class is found, namely Holothuroidea. The number of species found in the gastropod class was 14 species and in the Bivalva class, there were 4 species, while in the Holothuroidea class, there were 1 species.

Table 4. Macrozoobenthos found in waters per station

Phylum	Class	genus	Species	Nirwana Beach	Pulau Panjang
Mollusca	Gastropods	Cerithium	*C. rostratum*	√	√
		Nassarius	*Nassarius* sp	√	√
		Cerithium	*Cerithium* sp	√	√
		Natica	*Natica* sp	√	√
		Strombus	*Strombus* sp	√	√
		Planaxis	*Planaxis snail*	√	√
		Clypeomorus	*C. bifasciata*	√	-
		Littorina	*L. scalba*	√	-
		Naticinae	*P. mammila*	√	√
		Planaxis	*P. sulcatus*	√	√
		Otopleura	*O. auriscati*	√	-
		Moricoidea	*M. rapaninae*	√	-
		Cerithium	*C. littertum*	√	-
		Nassa	*N. fancolina*	-	√
		Morula	*M. granulate*	-	√
		Turbo	*Turbo* sp	√	√
	Bivalve	Anadara	*A. antiquate*	√	-
		Anodania	*A. scalba*	√	-
		Liocyma	*L. fluctuosa*	√	√
		Asaphis	*A. deflora*	√	-
Echinodermata	Holothuroidea	Holothuria	*H. atra*	√	√
Arthropods	Malacostraca	Scylla	*S. serrate*	-	√

The classification of macrozoobenthos found in the coastal waters of Pulau Panjang consists of the phylum Mollusca, Echinoderms, and Arthropods. From the Mollusca phylum, there are classes Gastropods and Bivalva, while from the Echinodermata phylum, one class is found, namely Holothuroidea and in the Arthropoda phylum one class is found, namely Malacostraca. The number of species found in the Gastropod class was 11 species and in the Bivalva class, there were 1 species, while in the Holothuroidea class, there were 1 species and in the malacostraca class there were 1 species.

The macrozoobenthos species that are only found on Nirwana Beach are *A.antiquate, C.literatum, A.alba, C.bifasciata, L.scalba, O.auriscati, M.rapaninae,* and *A.deflorata*. The macrozoobenthos which are only found in the waters of Pulau Panjang is *M.granulata, N.fancolina,* and *S.serrata*. While the species found at the two study sites were *P.sulcatus, P.mammilla,* C*erithium* sp, *C.rostratum, Turbo* sp, *H. atra*, *Strombus* sp, *Nassarius* sp, *L.fluctuosa*, *P.snail,* and *Natica* sp.

At both study sites, it was found that species from Phylum Mollusca were more common than species found from Phylum Echinodermata and Arthropoda. This is presumably because more species from Phylum Mollusca live in the intertidal zone

so more species from Phylum Mollusca are found.

Macrozoobenthos abundance

A comparison of the abundance of macrozoobenthos at the two stations can be seen in Table 5.

Table 5. The abundance of macrozoobenthos at research station

Station	Every Transect			Average (ind/m^2) ± St. Dev
	1	2	3	
Nirvana	19.67	19.33	22.67	20.59±1.84
Long Island	21.00	20,67	22.67	21.44±1.07

The abundance values at each station varied and the highest abundance was found at the Pulau Panjang station transect 3 and the Nirwana coastal station, namely 22.67 ind/m^2, while the lowest average number was at the Nirwana coastal waters station transect 2, namely 19.33 ind/m^2. The high abundance at Pulau Panjang station transect 3 is thought to be caused because the location is quite far from residential areas and at that location there are few mangrove ecosystems, causing a relatively high organic matter content of 5.68%.

The lower abundance value at the Nirwana Beach station than at the 3 Pulau Panjang station transect is thought to be caused because the Nirwana Beach station is located not far from Teluk Bayur port, and also Nirwana Beach is one of the tourist destinations in the city of Padang so that community activities can disrupt the macrozoobenthos ecosystem found in that location. This is following the opinion of Witasari[2], who said that organic matter in sediments is a source of organic matter in sediments that has a major influence on organism populations, sediments that are rich in organic matter are often supported by an abundance of macrozoobenthos organisms.

The high abundance of macrozoobenthos is also influenced by good water quality. It can be seen that the results of measurements of temperature, pH, brightness, and salinity at each station with temperatures ranging from 28.31-29.22°C. In general, the temperature obtained at each station can be said to be good for macrozoobenthos balance. According to Rahmawati et al.[5], the optimum temperature for the development of macrozoobenthos ranges from 20-30 °C. High temperatures ranging from 33-50°C can disrupt the development of the life cycle of organisms, while a decrease in temperature can cause an extension of the generation change time.

The average pH value at the Nirwana Beach station and Pulau Panjang station is 7. This explains that the pH of the waters is still within normal limits; in general, aquatic biota can live properly in the pH range of 5-9[1]. Salinity found in the waters of Nirwana Beach and Long Island waters ranges from 28.45-28.90‰. Salinity in both glasses of water is still in the normal range and still supports macrozoobenthos life. This is following the opinion of Angelina[3] which states that the salinity range between 15-30‰ is still suitable for the growth of macrozoobenthos.

Diversity, Uniformity, and Dominance

Based on the results of calculations that have been carried out, it is known that the highest diversity value is found at transect 2 Pulau Panjang station, namely 2,680, and the lowest diversity is found at transect 3, Nirwana Beach station, namely 2,450. As for the Uniformity Index, the highest score was obtained at transect 2 Pulau Panjang station, namely 0.807, and the lowest value was obtained at transect 3, Nirwana Beach station, namely 0.738. For the Dominance Index, the highest value was found at transect 3 Nirwana Beach stations, namely 0.198, and the lowest

value at transect 2 stations Pulau Panjang, namely 0.162.

Overall the value of diversity and uniformity of macrozoobenthos at Pulau Panjang station was higher than at Nirwana Beach station with a diversity value of 2.559 for Pulau Panjang waters compared to 2. 489 for Nirwana Beach waters and a uniformity value of 0.783 for Pulau Panjang station compared to 0.749 for Nirwana Beach waters. Meanwhile, the dominance value of the Nirwana Beach station was higher than the Pulau Panjang station, namely 0.192 for the Nirwana Beach station and 0.174 for the Pulau Panjang station. More details can be seen in Table 6.

Table 6. Diversity, uniformity, and dominance in the coastal waters of Nirwana and Pulau Panjang

Station	Transect	Macrozoobenthos Community Structure		
		H'	E	C
Nirwana Beach	1	2,520	0.759	0.190
	2	2,497	0.752	0.187
	3	2,450	0.738	0.198
		2,489	0.749	0.192
Pulau Panjang	1	2,653	0.793	0.171
	2	2,680	0.807	0.162
	3	2,483	0.748	0.190
		2,559	0.783	0.174

The Diversity Index values of the two stations indicate that the condition of the macrozoobenthos at both stations is still in fairly good condition. This is presumably because the environmental conditions at each station support some macrozoobenthos species to adapt. This is by Rahmawati et al.[5] The macrozoobenthos diversity index is influenced by the surrounding environmental conditions so that macrozoobenthos can adapt have a high diversity index, while macrozoobenthos that are unable to adapt have a low diversity index.

Previous research conducted by Odum[6] stated that the Diversity Index value at the station I was 1.33 is categorized as moderate. The Diversity Index values at stations II and III were 0.97 and 0.89 which were categorized as low. The Uniformity Index (E) at the Nirwana Beach water station ranged from 0.738-0.759 while the Uniformity Index at the Pulau Panjang water station ranged from 0.748-0.807. The Uniformity Index values at the two stations are included in the criteria for balanced or no competition. This is based on the criteria according to Pielou *in* Odum[6] that if the E value is close to 1 (> 0.5) it means that the uniformity of organisms in waters is in a state of balance or there is no competition for both space and food. This is the same as stated by Rani[7], that is, if the uniformity value is close to 1, it means that the uniformity between species is classified as even, and vice versa, if the uniformity is close to zero, it can be said that the uniformity between species in the community is classified as low.

The Uniformity Index value is 0.5 to close to 0.75 in the medium category, which means that the distribution of genera is relatively the same. While the E value is 0.75 to 1 which means the distribution of genera is very similar or very different. The Dominance Index (C) of macrozoobenthos at the Nirwana Beach water station ranges from 0.187-0.198 while the Dominance Index at the Pulau Panjang water station ranges from 0.162-

0.190. Based on the results of the calculation values at both stations, no individual dominates the criteria Simpson dominance[7]. The value of C ranges from 0-1. If the C value is close to 0, it means that almost no individuals dominate and is usually followed by a large E value (close to 1), whereas if the C value is close to 1, it means that a certain species are dominant and is characterized by an E value that is smaller or close to 0[6].

Distribution Pattern of Macrozoobenthos

Based on the results of observations and calculations of macrozoobenthos in Nirwana Beach waters and Pulau Panjang waters, it was found that distribution pattern data were clustered. The pattern of distribution of macrozoobenthos at both stations can be seen in Table 7. The highest Morisita Index value was found at Pulau Panjang station, namely 1.13, and the lowest at Nirwana beach station, namely 1.07.

Table 7. Distribution pattern of macrozoobenthos on Nirwana Beach and Pulau Panjang

Station	Id (Morisita Dispersion Index)	Spread Pattern
Nirwana Beach	1.07	group
Pulau Panjang	1.13	group

The population distribution pattern is divided into three, namely clustered, random, and evenly distributed/uniform[7]. Clustering behavior is caused by several factors, including environmental conditions, type of substrate, eating habits, and ways of reproduction. In addition, this group's way of life shows a strong tendency to compete with other biota, especially in terms of food. Bahri[8] states that the distribution pattern of biota is influenced by the type of habitat which includes aquatic physic-chemical factors as well as food and the adaptability of biota to the environment.

Clustered, random and uniform distribution patterns are caused by interactions between individuals and environmental conditions. Environmental factors can limit the distribution of species such as temperature, currents, pH, traffic, and food sources. In addition, each species has physiological, anatomical, and behavioral conditions to adapt to the environment, which will affect the distribution pattern of the species[9].

The clustered distribution pattern indicates that the organism or animal can only live in certain habitats with suitable environmental conditions for the organism to survive. This is following Effendi[10] that the distribution in large clusters is likely caused by differences in environmental factors that support the life of organisms, thereby limiting certain species to spread uniformly or randomly in all waters.

4. CONCLUSION

There were 19 species of macrozoobenthos found at Nirwana Beach station and 14 species found at Pulau Panjang station. Macrozoobenthos abundance at Nirwana Beach station with a value of 20.59 ind/m^2 and at Pulau Panjang station the abundance of macrozoobenthos with a value of 21.44 ind/m^2. The diversity of macrozoobenthos at Nirwana Beach station ranged from 2.497-2.520 and at Pulau Panjang station ranged from 2.483-2.680. The macrozoobenthos uniformity values at both stations were in the balanced category. Meanwhile, the dominance index at both stations belongs to the non-dominant category.

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