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Condition of Seagrass Beds Ecosystem on Poncan Gadang Island Based on Macrozoobenthos Diversity

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Abstract: The seagrass ecosystem of Poncan Gadang island is one of the ecosystems that often come under pressure due to ecotourism activities. Pressure on these ecosystems can have an impact on the diversity of the types of animals that live in them. This research is aimed at knowing the condition of seagrass ecosystems based on the diversity of macrozoobenthos that live in them. The observation point is divided into 5 stations. At each point, a square transect of 1x1 meters is made as many as 10 pieces. Collection of macrozoobenthos samples is carried out by the hand sorting method. The samples collected were then identified at the Ecology Laboratory of the Faculty of Teacher Training and Education, University of Labuhanbatu. Data analysis uses the shannon wienner index (H'), Dominance Index (C') and Similarity Index (IS) formulas. Data analysis was done by computer program Plymouth Routines In Multivariate Ecological Research (Primer) 7th version. The results showed that there were 30 species of macrozobenthos living in the seagrass ecosystem of Poncan Gadang island, with a diversity index (H') of 3.031-3.191, a dominance index (C') of 0.0038 - 0.0053, then a similarity index (IS) of 86.792 – 98.305%. This result indicates the condition of the seagrass beds ecosystem of Poncan Gadang Island is in good condition, with a moderate level of uniformity, low dominance and high similarity.

Keywords: Macrozoobenthos; Poncan Gadang Island; Seagrass ecosystem

Introduction

Macrozoobentos are communities of organisms that live based on bottom or sediments in an aquatic habitat. They have a relatively fixed and very limited living habitat, therefore they are more susceptible to environmental disturbances such as changes in water quality and sediments, but are very well used as biological indicators determining conditions in the aquatic ecosystem (Bai'un et al., 2021; Saputri et al., 2021; Siahaan et al., 2021). Macrozoobenthos are a group of organisms that are often found alive associated with seagrass beds ecosystem (Machrizal et al., 2019).

Seagrass is one of the flowering plant communities that live in the intertidal zone (Machrizal et al., 2019; McKenzie et al., 2020; Thangaradjou & Bhatt, 2018). Seagrass is one of the communities in the coastal area that plays an important and effective role as one of the coastal protectors and land safety in coastal areas, so that seagrasses are also capable of stabilizes the substrate (sediment), resists waves and absorbs contaminants (Sholihah et al., 2020). Seagrass beds are an environment that can providing life support for various types of marine organisms including macrozoobenthos. Seagrass beds are home to various types of fish and other biota for shelter, forage, lay eggs and raise cubs (Herawati et al., 2017).

Research on seagrass in Indonesia has been widely carried out by the researchers such as correlation of diversity macrozoobentos with seagrass density at Semawang Beach Sanur Bali (Sholihah et al., 2020), macrozoobentos community structure in ecosystems seagrass in Paciran, Lamongan Regency, East Java (Arfiati et al., 2019), density of macrozoobentos in vegetated areas (Seagrass) and un vegetated in Doreri Gulf Manokwari (Leatemia et al., 2017). Poncan Gadang Island is one of the one island located in the bay of Tapian Nauli, Madya Sibolga City. The island is become one of the tourist destinations for the community because it has a view beautiful underwater. Ecotourism

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activities in the waters of Poncan Gadang Island causing the surrounding ecosystem to gain pressure. Pressure against seagrass ecosystems that are constantly occurring are feared to cause the presence of macrozobentos present in it becomes disturbed. Research this is intended to find out the condition of the seagrass ecosystem based on macrozoobenthos diversity on Poncan Gadang Island, so that it can utilized in the sustainable management of marine ecotourism.

Method

Time and Place

This research was carried out in 2021, sampling was carried out on Poncan Gadang Island. North Poncan Province Figure 1.

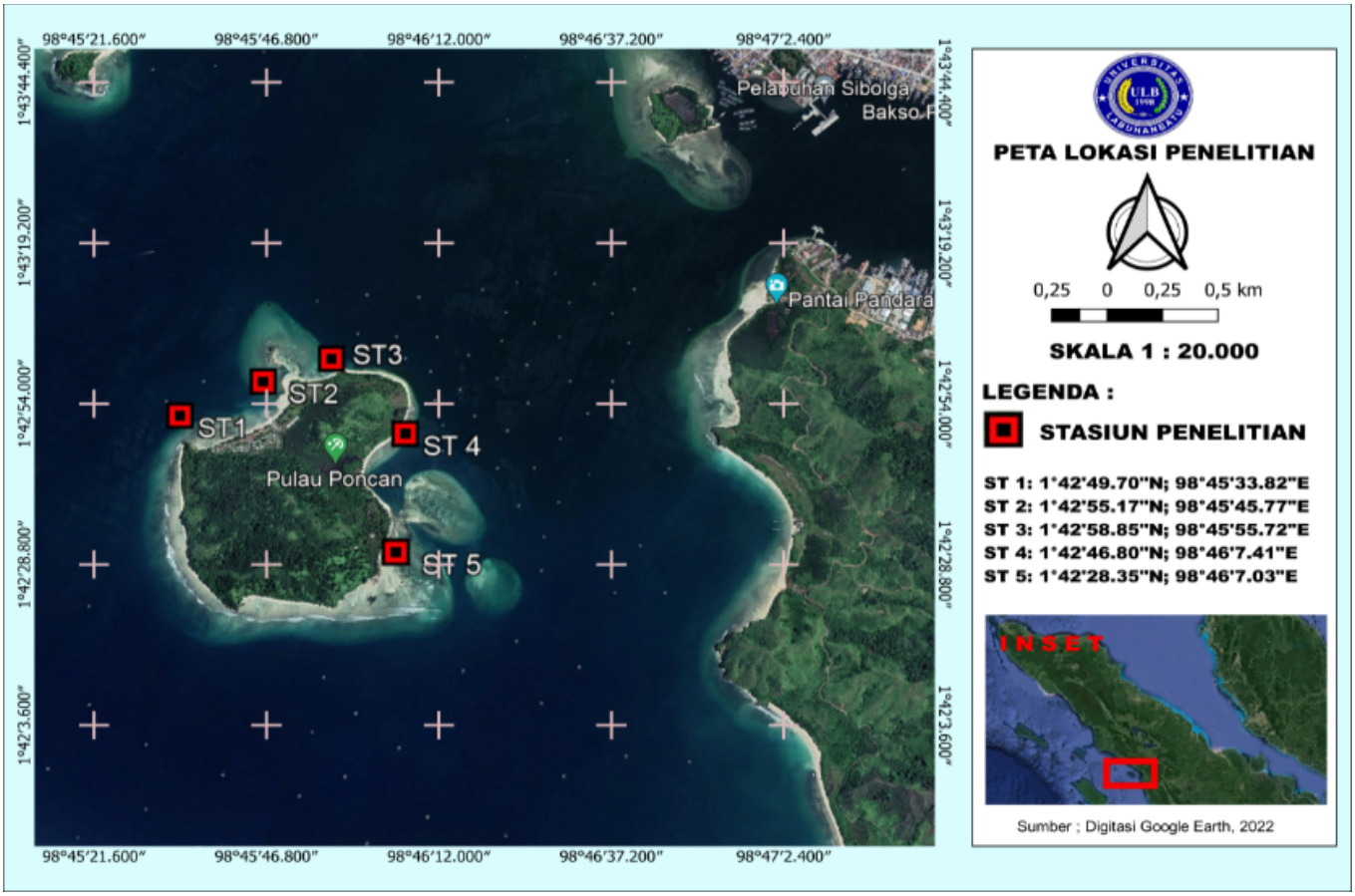

Figure 1. Research Location Map

Sampling Techniques

Sampling is carried out at low tide using the quadratic transect method. The transects used were 15 pieces per transect placement study site starting 10 meters from the shoreline to the sea, each transect was given a distance of 10 meters (Figure 2). Macrozoobenthos are taken using the Hand sorting technique. The samples obtained were collected and preserved with 70% alcohol to be identified in the integrated biological laboratory of Labuhanbatu University.

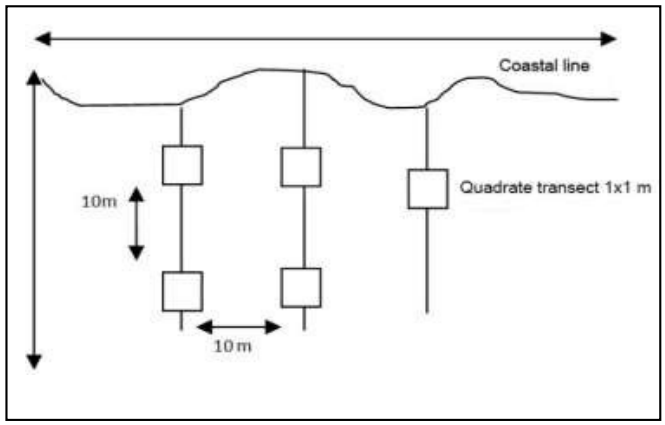

Figure 2. Illustration of transect laying (Sepriani et al., 2021)

Data Analysis

Diversity Index (H')

The diversity index (H') serves to describe the condition of population diversity mathematically in order to facilitate the process of analyzing the number of individuals of each type in a community. The calculation of the Diversity index (H') refers to the Shannon-Wiener equation (Krebs, 1989).

$$H' - \sum_{i=1}^{s} (pi \ln pi) \quad (1)$$

Where:
H' = Shannon-Wiener diversity index
S = Number of species
Pi = Number of individuals of each type (i=1,2,3...)
With H' values :
0<H'<2,3,02 = low diversity
2,302<H'<6,907 = moderate diversity
H'>6,907 = high diversity

Dominance Index (C)

The dominance index is used to obtain information about the species that dominate in a community. The formula is as follows (Odum, 1996) :

$$C = \sum_{i=1}^{s} \left(\frac{ni}{n}\right)^2 \quad (2)$$

information:
C = Index of dominance
Ni = Value of each species (number of i-th individuals)
N = the total value of the entire species (the total number of individuals that have been found)

The dominance index value ranges from 0–1. A C value close to 1 means that there is one species with high abundance at one location (there is only one species at one station). A value of C close to 0 indicates that no species with high abundance are found in a single location.

Similarity Index (IS) or Similarity Index

The similarity index is used to find similarities between species at each research station. The calculation uses the sorensen similarity formula (Barbour et al., 1998).

$$IS = \frac{2c\ a}{+b} x\ 100\% \quad (3)$$

Where:
a = number of species at location a
b = number of species at location b
c = same number of species at locations a and b
with:
IS=75-100% : Very similar
IS=50-75% : Similar
IS=75-100% : Not similar
IS=≤ 25% : Very unlikely

Data analysis in this study was carried out using the computer software Plymouth Routines software in Multivariate Research Version 7th. This software will also be used to create dendograms on the sorensen similarity index.

Result and Discussion

The results of the identification of samples collected from seagrass ecosystems in around poncan gadang island shows there are 30 species of macrozobentos the living ones are associated with seagrass ecosystems (Table 1). This result is not far away in contrast to those obtained (Machrizal et al., 2020) where there are 25 species macrozobenthos live associated in seagrass ecosystems on the beach of Natal, Sumatra North.

Table 1. The composition of macrozoobentos species in the seagrass ecosystem of poncan gadang island.

Spesies	ST 1	ST 2	ST3	ST 4	ST 5
Littoria scabra	+	+	+	+	+
Cymatium Intermedium	+	+	+	+	+
Luria isabella	+	+	+	+	+
Terebridae	+	+	+	+	+
Pugettia gracilis	+	+	+	+	+
diodon holocanthus	+	+	+	+	+
Mauritia arabica	+	+	+	+	+
Asterias amurencis	+	+	+	+	+
Holothuria atra	+	+	+	+	+
Acrosterigma Cygnonim	+	+	+	+	+
Anadara trapezia	+	+	+	+	+
Sesarma sp	+	+	+	+	+
Actrina pectinata	+	+	+	+	+
Leganum Depressum	+	+	-	+	+
Anadara inaequevalvis	+	+	+	+	+
Perna viridis	+	+	+	-	+
Scylla oceanica	+	-	+	-	+
Dardanus calidus	+	+	-	+	+
Holothuria edulis	+	+	+	+	+
Ocypode kuhli	+	+	+	+	+
Holothuria scabra	+	+	+	+	+
Polinices lacteus	+	+	+	+	+
Atrina vexillum	+	+	+	-	+
Astraea caelata	+	+	+	+	+
Conus betulinus	+	+	+	+	+
Cryptochiton sp	+	+	+	+	+
Cypraea pyrum	+	+	+	+	+
Cypreae zonaria	+	-	+	+	+
Trocus niloticus	+	+	-	+	+
Faunus ater	-	+	+	-	+

Note: (+) = Present; (-) = Absent

The results of the diversity index (H') analysis using shannonwienner's equation (table 2), show that the value of the diversity index macrozobenthos on the island of poncan gadang are in the moderate category with H' value (3.031-3.191), this result is not much different from that obtained by (Herawati et al., 2017) in the waters of Natal Beach with an H' value (2.52-2.59), furthermore (Machrizal et al., 2020) get an H' value (2.89-2.98) in the ecosystem seagrass waters of Natal Beach. These results indicate that the condition macrozoobentos diversity on Poncan Gadang Island in the moderate category. Moderate diversity indicates that environmental conditions waters are quite supportive for macrozoobentos life and ecosystems seagrass in such locations has sufficient productivity, ecosystem conditions are sufficient balanced and moderate ecological pressure (Herawati et al., 2017; Machrizal et al., 2020; Siahaan et al., 2021; Wijana et al., 2019).

Table 2. Diversity Index (H') and Dominance (C') values

	Shannon Wienner Index (H')	Dominance Index(C')
Station 1	3.191	0.0053
Station 2	3.188	0.0047
Station 3	3.044	0.0049
Station 4	3.031	0.0049
Station 5	3.181	0.0038

The results of the analysis of the dominance index at the 5 research stations showed the value of close to 0, this indicates that on Poncan Gadang Island there is no one of the predominate types of macrozobentos (found in numbers a lot). A C value close to 1 means that there is one species with high abundance at one location (there is only one type at one station) (Azimah et al., 2021; Machrizal et al., 2020; Wahab et al., 2019). Value C close to 0 indicates that there are no species with high abundance that found in one location. The value of the acquired dominance index ranges from 0.0038 - 0.0053 and is classified as low. This result is not much different from that of the obtained (Herawati et al., 2017; Machrizal et al., 2020) where the index value dominance (C') in the seagrass ecosystem of Natal beach, North Sumatra is in range values from 0.002 to 0.009. This shows that the community is in a state of affairs stable, there has been no ecological pressure resulting in environmental changes. According to Machrizal et al., (2020) say that the presence of dominance indicates a place such have low kind of wealth with an uneven distribution, which says that within the observed community, there are species that dominate other species (Munandar et al., 2016). High and low diversity, and dominance at each observation station is due to temperature, salinity, pH, dissolved oxygen and behavior of an organism that is able to adjust itself to these environmental conditions (Alwi et al., 2020).

The value of the similarity index indicates the similarity of the types of macrobenthos fauna which composes a very high community (Taqwa et al., 2017) at a location that different. The similarity index at all research stations is within the range 86-98%. Station 1 with Station 5 has the most similarity index values high with a value of 98.305% while it is the lowest similarity index value found at station 3 with station 4 with a value of 86.792% (table 3).

Table 3. Similarity Index Value At the research site

IS	ST 1	ST 2	ST 3	ST 4	ST 5
Station 1					
Station 2	94.737				
Station 3	92.857	90.909			
Station 4	94.545	92.593	86.792		
Station 5	98.305	96.552	94.737	92.857	

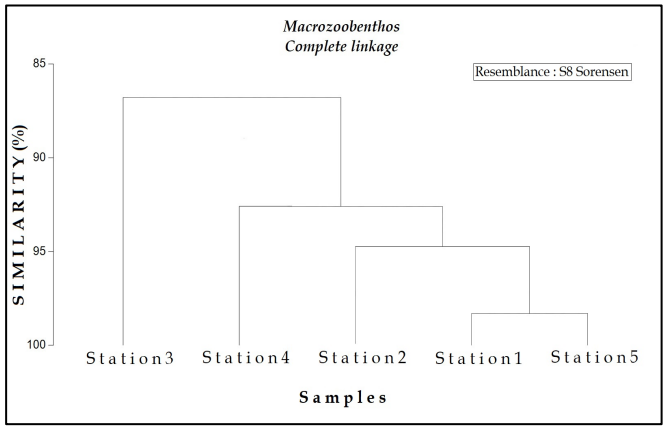

Figure 3. Dendogram of Macrozoobenthos Similarity Index in Poncan Gadang Island Waters

Poncan Gadang Based on data analysis, we can see that the degree of similarity between species from 5 stations are very high because the index shows IS=75-100%. The results of this study are not much different from those obtained (Machrizal et al., 2020) above 90%. This high degree of similarity is due to the whole the research station has almost the same characteristics. Same thing expressed by (Ningrum & Kuntjoro, 2022; Ningsih et al., 2020; Sepriani et al., 2021) the value of the similarity index can be influenced by ecological factors and chemical physical factors at the research site. Almost the same ecological characteristics cause the similarity of species values in a region is very similar.

Conclusion

Judging from the level of macrozoobenthos diversity which is in the moderate category at the five observation points on poncan gadang island, this indicates that the condition of the seagrass ecosystem of Poncan Gadang Island is in good condition.

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