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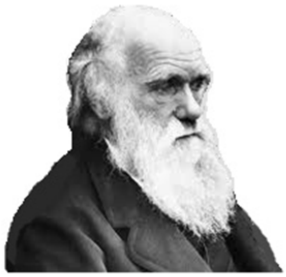

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Community structure of macrozoobentos on artificial reef made from reef rubble and split rock in Tunda Island, province of Banten, Indonesia

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ABSTRACT

Tunda Island has underwater beauty that has the potential to be developed into a marine tourism object. One important part of this is the fringing reef around the island. Unfortunately, this has been severely degraded. This study aims to determine if reef rubble and split rock artificial reefs have the ability to be a living space for macrozoobenthos and to measure the potential community structure. The research was conducted in August 2018 - November 2018 in the eastern part of Tunda Island, and included monitoring the initial conditions, artificial reef creating and positioning, gathering and analyzing macrozoobenthos data. The macrozoobenthos data collection was carried out from September to November 2018 as 4 observations, and was obtained using the Belt Transect method. In the analysis, the community structure data retrieved was divided into 3 categories: diversity, abundance and dominance. The diversity index obtained ranged from 0.43 – 7.65, meaning that it is of low to moderate diversity. The abundance of macrozoobenthos ranged from 1 - 18 individuals /m^2 on the rubble type artificial reef and 2.13 – 4.26 individuals /m^2 on the split type artificial reefs, with the most common class being gastropods. On rubble type artificial reefs, 14 macrozoobenthos genera were found to be common, while 13 genera were observed in the split type. The genus found was Culcita sp., Chicoreus sp., Diadema sp., Chelidonura sp., Thrombus sp., Chromodoris sp., Cymatium sp., Trochus sp., Terebra sp., Dardanus sp., Malea sp., Oliva sp., Opheodosoma sp., Actinopyga sp., Conus sp., Enoplometopus sp., Cypracea sp., Lambis sp., and Phylidia sp. The dominance index value was in the range of 0.18-1.00 or low to high on both rubble and split types

Keywords: Macrozoobenthos, Split rock, Tunda Island, Reefs Rubble, Artificial Coral Reef Community Structure

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1. INTRODUCTION

Tunda Island, which is surrounded by the Java Sea, is the outermost region of the Serang Regency, and is geographically located at 106º50'00 "- 105º51'51" BT and 5º56'15 "- 5º59'00" LS. The main village is Wargasara and it is part of Tirtayasa District. Tunda Island has underwater beauty that has the potential to be developed into a marine tourism object. An important aspect of this is its fringing reef. In 2016, conditions were discovered where dead coral or rubble was piled up and scattered around the island, even making natural breakwaters in the eastern part of the island. Moreover, the condition of the coral reefs in the southern part of the island of Tunda was assessed as poor. In the coral reef ecosystem, there are associated biota such as reef fish and macrozoobenthos. Macrozoobentos have low motility, so these are often used as environmental indicators. One way to rehabilitate the macrozoobenthos ecosystem is to create and place artificial coral reefs. Artificial reefs are man-made habitats placed on the bottom of waters and are usually made from heaps of materials such as used tires, cement or concrete molds and bamboo. Because materials like split rock and used tires are difficult to find on Tunda Island, the coral detritus on the island have been has used for artificial coral reef construction. Artificial coral reefs can mimic some of the characteristics of natural reefs so that they can attract species of marine organisms to live and settle upon them. Hence, functional artificial reefs can provide new habitat for macrozoobenthos and can reduce waves action so as to provide a coastal safeguard. Macrozoobenthos response to changes in environmental conditions come in the form of changes in the structure of abundance, diversity and biomass. Therefore, by establishing macrozoobenthos community structure on these artificial reefs and comparing this with that associated with natural coral reefs in the area, a benchmark can be ascertained so as to reveal the success of artificial reef establishment.

2. METHODS

The research location was in the eastern waters of Tunda Island, Banten (Figure 1). The research was conducted in August 2018 - November 2018, including location determination, measurement of physical and chemical parameters of the water, data collection on macrozoobenthos community structure and data analysis. The created artificial coral reefs were lowered on August 12, 2018, and macrozoobenthos data was collected four times: September 2, September 23, October 14 and November 18, 2018, at depths between 3 to 6 m.

The methods used in this study were the survey method and Purposive Sampling. The data points were carefully selected to exclude the influence of the surrounding natural coral reefs. At each station, 6 pieces of artificial reef were deployed (3 pieces of rubble composition and 3 pieces of Split composition) with a minimum distance of 2 to 5m between the artificial reef components (Figure 2). At each research station, data was collected at 10:00 WIB for 3 months every 3 weeks. Before the artificial reef was installed, observations were made of the initial conditions. Measurement of physical parameters was taken in the form of temperature, current velocity and turbidity. The chemical parameters of water quality taken were DO (dissolve oxygen), salinity and pH. Research on the macrozoobenthos community was carried out using the Belt Transect Method. Herein, macrozoobenthos abundance is based on the number of Macrozoobenthos found with a 2 m radius of an observation station. Macrozoobenthos abundance can be calculated by formula:

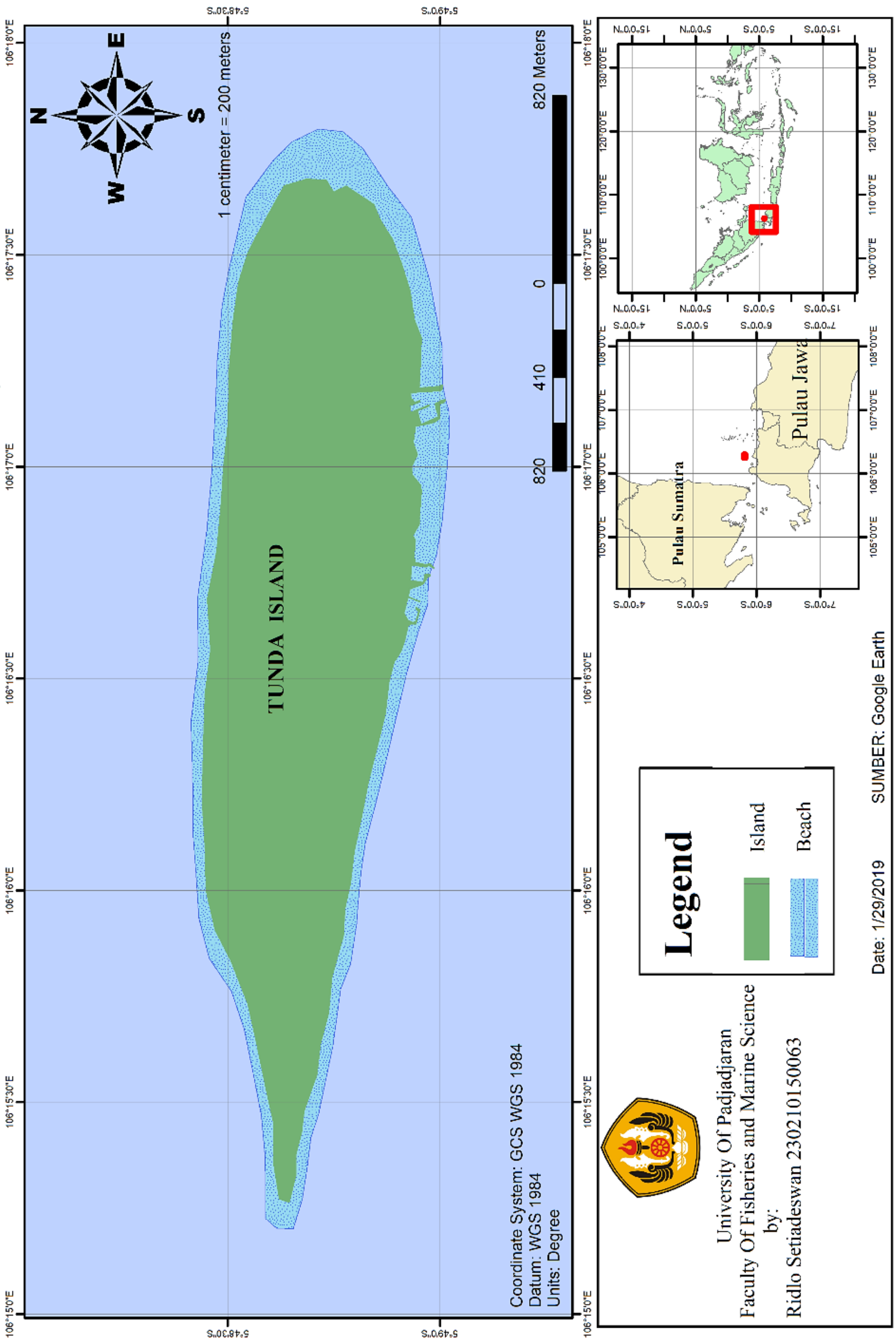

Figure 1. Research location.

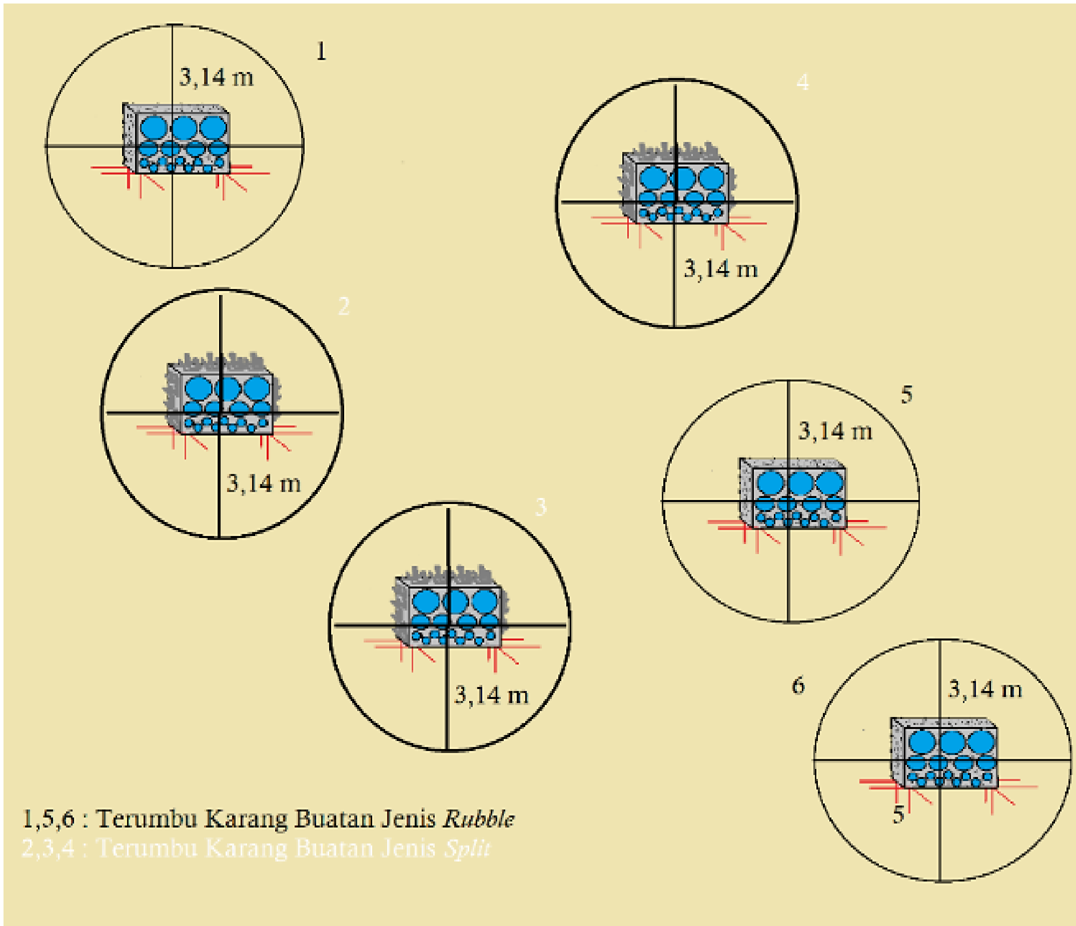

Figure 2. Illustration of Artificial Reef Placement

The Diversity Index is used to obtain a mathematical description of the organism's population. This aims to facilitate the analysis of information on the number of individuals of each species within a community. Macrozoobenthos diversity is calculated by the Shannon-Wiener Index using the following formula:

$$K = \frac{total\ individual}{area\ of\ oservation}$$

where:

K = Individuals richness (ind/m^2)

The Diversity Index is used to get a description of the organism's population mathematically. This aims to facilitate the analysis of information on the number of individuals in each species in a community. Macrozoobenthos diversity is calculated by the Shannon-Wiener Index using the following formula:

$$H' = -\sum_{i=1}^{n} pi \ln Pi$$

Information:

H ′ = Shannon-Wiener Index
pi = Comparison between the number of i (n_i) individual species; (i: 1,2, .. n) with the total number of individuals (N)

The Macrozoobenthos diversity index category is:

H ’<1 = small diversity
1 <H ’<3 = medium diversity
H '> 3 = high diversity

To measure the dominance of a type used the Simpson Dominance Index as follows:

$$D = (ni / N) ^\wedge 2$$

Description:

D : Dominance Index
Ni : Number of i-type individuals
N : Number of individuals of all types

The range of the Dominance Index values are:

0.00 <C <0.30: low dominance
0.30 <C <0.60: moderate dominance
0.60 <C <1.00: high dominance

3. DISCUSSION

3. 1. Water Conditions at the Research Site

The results of measurements of water quality (Table 1) show that the waters as assessed by the seawater quality standards for aquatic biota issued by the Ministry of Environment in Minister of Environment Decree No.51 of 2004 are in good condition.

3. 2. Macrozoobenthos Community Structure

The community structure of macrozoobenthos is observed in the form of abundance data, diversity index and macrozoobenthos dominance index.

3. 2. 1. Macrozoobenthos Diversity

On the artificial coral reefs, 19 genera of macrozoobenthos were found in the four observations. Genus found include *Culcita* sp., *Chicoreus* sp., *Diadema* sp., *Chelidonura* sp., *Thrombus* sp., *Chromodoris* sp., *Cymatium* sp., *Trochus* sp., *Terebra* sp., *Dardanus* sp., *Malea* sp., *Oliva* sp., *Opheodosoma* sp., *Actinopyga* sp., *Conus* sp., *Enoplometopus* sp., *Cyperaceae* sp., *Lambis* sp. and *Phylidia* sp. A community is said to have high species diversity if there are many species, with individual numbers of each species relatively evenly distributed. If a community consists of only a few species with an uneven number of individuals, then the community has a low diversity index.

Table 1. Physical and Chemical Parameter Value of Aquatic Each Observation

Parameter	Observation data					Quality standards*
	1	2	3	4	5	
Temperature (^oC)	27-28	29	29	29-30	29-30	28-30
pH	8	8	8	8	7-8	7-8,5
DO (mg/l)	5,4-5,6	5,1-5,6	3,8-4,2	4	8,3	>5
Brightness (%)	100%	100%	100%	100%	100%	>5m
Salinity (ppt)	33,5-34	32	31-32	32-33	32	33-34
Current Speed (m/detik)	0.31					-

Table 2. Diversity index

Data number	1	2	3	4
H' *Rubble*	0.69	0	1.83	1.61
H' split	0.00	0.95	1.23	1.83

In this study, we found one genera that was common, namely chicoreus spp. This is a mollusk phylum that is very successful in adapting to fluctuating conditions. Molluscs (Bivalvia and Gastropoda) and Polychaeta are common in the estuary benthic community.

3. 2. 2. Abundance of Macrozoobenthos

On the artificial coral reefs, both rubble and Split species were found to have an abundance of ± 0.78 ind / m^2 and ± 0.75 ind / m^2 in artificial coral cover of 2.78 m^2. The index values of each observation can be found in Table 3.

Table 3. Found macrozoobenthos abundance.

Observation	Type	Genus	Amount	Type	Genus	Amount
1	*Rubble*	*Culcita* sp.	1	Split	*Diadema* sp.	5
		Chicoreus sp.	1			
		Total	2		Total	5
2	*Rubble*	*Chelidonura* sp.	1	Split	*Diadema* sp.	3
					Chicoreus sp.	1
					Strombus sp.	1
		Total	1		Total	5
3	*Rubble*	*Chicoreus* sp.	3	Split	*Culcita* sp.	1
		Culcita sp.	2		*Chicoreus* sp.	6
		Phylidia sp.	1		*Terebra* sp.	1
		Chromodoris sp.	1		*Cymatium* sp.	1
		Actinopyga sp.	1		*Dardanus* sp.	1
		Cymatium sp.	1			
		Trochus sp.	1			
		Total	10		Total	10
4	*Rubble*	*Culcita* sp.	1	Split	*Cypracea* sp.	1
		Malea sp.	1		*Chicoreus* sp.	3
		Oliva sp.	1		*Lambis* sp.	1
		Opheodosoma sp.	3		*Malea* sp.	1
		Actinopyga sp.	9		*Phylidia* sp.	1
		Canus sp.	1		*Cymatium* sp.	1
		Chicoreus sp.	1		*Canus* sp.	2
		Enoplometopus sp.	1			
		Total	18		Total	10

In the 3rd round of observations, we found one species of the nudibranch order, chelidonura spp. The presence of nudibranch is due to the emergence of nudibranch food on the artificial coral reefs, namely sponges. Almost all Nudibranchia members are carnivorous and predators of sponges, soft corals, anemones, sea pens, Bryozoa, ascidians, hydroids and other Nudibranch eggs. In addition, some species are parasitic.

3. 2. 3. Dominance Index

Dominance will occur in a community that has low diversity. In our study, the dominance index value approaches 0 (zero). This means that no type dominates. This shows that the macrozoobenthos habitat is viable. Dominance data can be seen in Table 4.

Table 4. Dominance index obtained

.	Observation			
	1	2	3	4
Rubble	0.50	1.00	0.18	0.30
Split	1.00	0.44	0.40	0.18

The dominance that occurs in this study is in the low range because macrozoobenthos generally prefer sandy substrate types, whereas in this study area the dominant substrate type is rocky. Hence, the living conditions are less suitable. States that the type of substrate greatly influences the presence of macrozoobenthos, and puts forward that fine sand to muddy substrates are most suitable to promote the macrozoobenthos community.

4. CONCLUSIONS AND SUGGESTION

4. 1. Conclusions

On artificial coral reefs, 19 genera of macrozoobenthos were found during the study. Genus found include *Culcita* spp., *Chicoreus* sp., *Diadema* sp., *Chelidonura* sp., *Strombus* sp., *Chromodoris* sp., *Cymatium* sp., *Trochus* sp., *Terebra* sp., *Dardanus* sp., *Malea* sp., *Oliva* sp., *Opheodosoma* sp., *Actinopyga* sp., *Conus* sp., *Enoplometopus* sp., *Cypraea* sp., *Lambis* sp. and *Phylidia* sp.

The abundance of macrozoobenthos is not significantly different on either rubble and split types of coral reefs, with the abundance ranging from 0.85 - 7.65 individuals /2.34m^2 on artificial coral types of rubble and 2.41 – 7.48 individuals / 2,34 m^2 on split type artificial reefs, with the most common class being gastropods.

The dominance that occurs in this study is in the low range, this comes about because most types of macrozoobenthos generally live on sandy substrate types, whereas in the study area the substrate is rocky or hard. The dominance index values are in the range of 0.18-1.00 for both rubble and artificial split types

The value of the Macrozoobentos community structure on rubble-made coral reefs does not differ greatly from split types. This is because the water quality values do not differ. Over all, however, macrozoobenthos are more adaptable to rubble types of artificial coral than to reefs of the artificial split type.

4. 2. Suggestion

Further research needs to be done on various aspects of the macrozoobenthos community structure, and must be extended in time. In addition, more observation must occur so as to achieve better comparison between artificial and natural reef types. Periodic monitoring is also needed to preserve the coral reef ecosystem in Tunda Island.

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