Research Article

Analysis of Macroalgae Diversity in the West Coastal of Pananjung Beach, Pangandaran

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Abstract.

The needed information about the diversity data in the area that can be used in ecological areas in the future is requested to be investigated. This study aims to analyze the diversity of macroalgae on the west coast of Pananjung beach, Pangandaran nature reserve. The study was conducted from March to April 2020. This research used a survey method using three stations representing the research region. Sampling was taken out in the intertidal zone of the Coastal Coast of West Pananjung, Pangandaran nature reserve, West Java using the purposive sampling method. Data taken consisted of macroalgae types found at each observation station and measurements of environmental data consisting of pH, temperature, salinity, and flow velocity. The results showed that there were 21 species of macroalgae grouped into 9 orders, 13 families, and 3 divisions. The research can conclude that macroalgae in Pananjung Barat Beach Pangandaran have an index value that indicates a moderate category, an evenness index classified as a low category, and a dominance index classified as a low category that shows the dominant species was there and it was Padina australis.

Keywords: macroalgae diversity, west coastal, Pananjung beach.

1. INTRODUCTION

Indonesia is the largest maritime country in the world with a vast ocean of 3.25 million km^2, this huge sea makes Indonesia has a rich biological wealth in the ocean and is known as a country of mega marine diversity, one of the wealth of the ocean is abudance of macroalgae with an amount of more than 903 species that are widespread in Indonesia [1]. The abundances of macroalgae can be found in the region of West Pananjung Beach, Pangandaran Nature Reserve which is a conservation area to maintain flora and fauna with important ecological value, such as macroalgae which have a higher potential in ecology and economy [2].

Macroalgae is a plant that has a body structure named thallus that is consisting of blades, stipes, and holdfast [3, 4]. Macroalgae are divided into three types which is

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Chlorophyta (green algae), Rhodophyta (red algae), and Phaeophyta (brown algae) [5]. Macroalgae are generally found in reef flat areas associated with sand, coral, or muddy sand [6, 7].

Macroalgae have an important role in the marine ecosystem because it acts as a primary producer [8, 9] and being a bio-indicator of the fisheries system. Macroalgae also help in providing carbon and contribute 80% oxygen for life [10]. The importance of the role of macroalgae for ecosystems and the environment makes the decreasing number of macroalgae that can lead to termination of the ecosystem chain and global warming.

The diversity of macroalgae that have an important role must be known, to make macroalgae keep sustainable and the data of the diversity must be collected for the basic data in the next ecological study. So, this research aims to analyze the diversity of macroalgae on the west coastal of Pananjung beach, Pangandaran Nature Reserve.

2. RESEARCH METHOD

This research was conducted from March to April 2020. Data collection for macroalgae was carried out in the Intertidal zone of the west coast of Pananjung Beach, Pangandaran Nature Reserve, West Java, which has a coastline of 1,000 meters. The research location is at the coordinates of 7 ˚ 42'047 "LS and 108 '39 '511" BT. The research location can be seen in Figure 1. which is visualized by the Google Maps application.

This research is descriptive analysis research using survey methods. The determination of the station is arranged by a purposive sampling technique at 3 different stations. At each station, sampling is executed with 3 quadrants each size is 6m x 5m made diagonally. Data was taken completely in sheet counts and specimen images were taken using a camera. The species identification refers to the Gujarat Ecology Commission's approval book [11]; Natural History Museum [12]; Guriy & Guiry [13]. Measurement of environmental data uses a universal indicator to know the pH, salinity measured using a refractometer, the temperature measured using a thermometer, and the flow velocity is measured by related to the plastic bottle motion tracking in units of time.

The research data obtained were analyzed using an ecological index consisting of a various index like diversity index (H '), evenness index (E), and dominance index (D) [14]:

1. Diversity Index (H '),

The calculation of macroalgae diversity done by using the Shannon-Wienner (H ') Index formula:
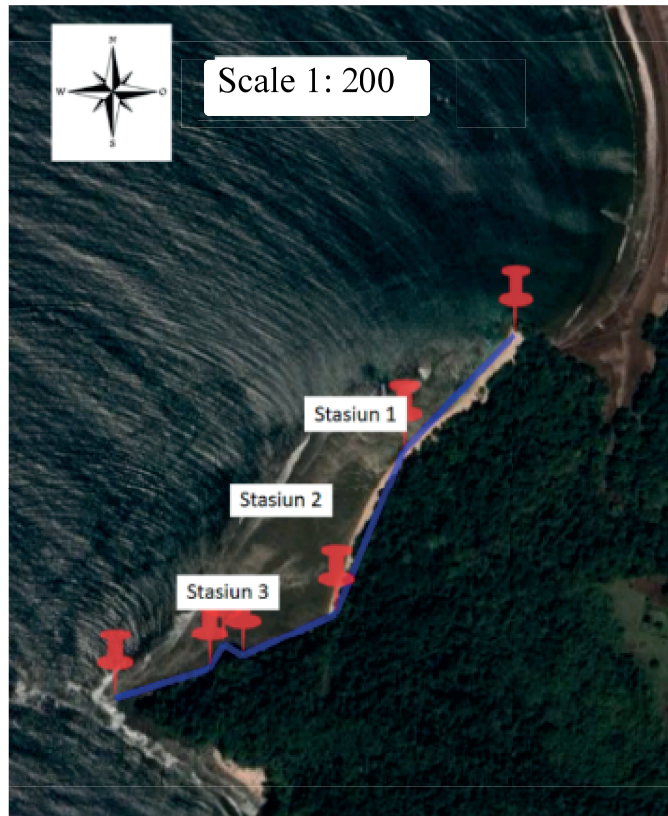
Figure 1: Research sites.

$$H' = -\Sigma \, pi \, \ln \, (1)$$

Information:

H '= Diversity Index

pi = Relative abundance of species

ni = Number of individuals of a type

N = Total number of individuals

Interpretation of the H ' value is based on the following criteria:

1. H '1, low diversity, low productivity, low distribution, low macroalgae of each species, and low community stability.

2. 1 <H '<3, moderate diversity, moderate productivity, medium distribution, macroalgae of each species, and medium stability of the community.

3. H '> 3, high diversity, high productivity, high distribution, high macroalgae of each species, and high community stability.

4. Evenness Index (E)

Evenness index is analyzed using the Evenness formula - Index (E):

E= $H'S$ ln (2)

Information:

E = Evenness index

H ' = Diversity index

lnS = Number of species with E values ranging from 0-1

The interpretation of the E value is based on the following criteria:

1. E <0.4 = Evenness of the population is low

2. 0.4 <E <0.6 = Evenness of the moderate population

3. E > 0.6 = High population evenness

4. Dominance Index (D)

The calculation of macroalgae dominance can be calculated by the Simpson dominance index formula:

C= $\Sigma_i^n\ (Pi)^2$ (3)

Information:

C = Index of dominance

Pi = Proportion of individuals in the i-n species

I = 1, 2, 3 ... n

Simpson's dominance index expressed as 1-D or 1/D, where 1-D is used as an index, ranges from 0 to 1, with values close to 1 indicating the community has an abundance of uniform species while numbers close to 0 representless uniform species in a community or it can be said that one species is more dominant [15].

3. RESULT AND DISCUSSION

The results of research from three stations conducted in West Pananjung Beach, Pangandaran founded 21 species of macroalgae. Macroalgae are found in 3 divisions, 9 orders, 13 families, and 16 genera as shown in Table 1.

The number of species found in Panajung Barat Beach, Pangandaran was analyzed using a diversity index (H'), evenness index (E), and dominance index (D). Data analysis was conducted to knowing the diversity index that shows the diversity value of community structures in ecosystems [16]. Evenness index was calculated to know the level of uniformity of a community and also determines diversity in an environment [17], and also

TABLE 1: The number of macroalgase species in west pananjung beach, pangandaran.

Division	Species	The Number of Species			
		St. 1	St. 2	St. 3	
Chlorophyta	Codium fragile	18	73	43	134
	Halimeda opuntia	37	38	39	114
	Chaetomorpha crassa	90	254	135	479
	Boergesenia forbesii	79	55	20	154
	Cladophoropsis sundanensis	147	157	7	311
	Valoniopsis pachynema	3	-	-	3
	Ulva fasciata	130	292	139	561
Phaeophyta	Sargassum polycystum	11	-	51	62
	Turbinaria deccurens	134	131	147	412
	Padina australis	779	724	780	2283
	Dictyota ciliolate	4	-	4	8
	Colpomenia peregrine	-	-	5	5
Rhodophyta	Euchema spinosum	81	71	16	168
	Euchema denticulatum	2	-	-	2
	Euchema cottoni	-	-	2	2
	Hypnea aspari	60	-	-	60
	Hypnea cornuta	-	-	1	1
	Achantophora muscoides	58	13	-	71
	Achanthophora spicifera	11	172	114	297
	Gracilaria salicornia	29	125	27	181
	Gracilaria hayi	-	-	1	1

the index of dominance calculated to indicates the presence or absence of species that are superior in certain environments [18]. The results of the analysis of the ecological index data presented in Figure 1.

Data analysis on the diversity index of each station based on Figure 2 in between value 1.76 - 2.05 which shows the diversity of macroalgae in the West Pananjung Beach, Pangandaran belongs to the medium category, according to over (14) 1< H <3, formerly the contribution to the region is classified into the medium category. Diversity data at station 1 with station 3, and station 2 with station 3 show significantly different, while station 1 and station 2 showed no significant difference.
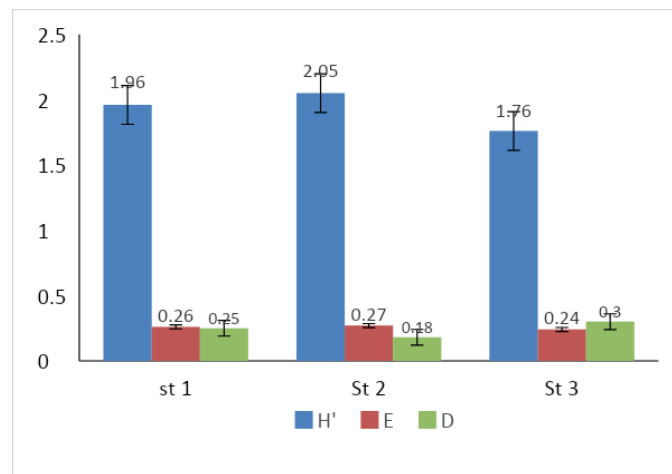
Figure 2: Macroalgae ecological index in West Pananjung Beach, Pangandaran.

Diversity in the medium category shows the stability of the community in the medium category [19] and also shows the existence of environmental pollution in the medium category that affects environmental factors [20]. Environmental factors influence the value of the diversity index [21, 22]. First, the environmental factors affecting macroalgae is the temperature factor based on (15) the diversity of macroalgae are influenced by environmental factors consisting of water temperature variability that cause the limited number of species from an area. Macroalgae can grow optimally between 25°C - 30°C [23], but in each station, temperatures occur between 28.5°C - 31°C that makes some macroalgae can't growth and makes limited species variability.

The factor that also affects macroalgae diversity is salinity, according to [24] salinity is one of the main factors that determine the diversity of macroalgae. The optimal salinity for macroalgae growth is 20‰ - 32‰ [25], but the salinity of each station reaches 29‰ - 35‰ which means that some species are difficult to grow that cause a limited species variability. Macroalgae diversity depends on the flow velocity and pH which has an important role in the diversity of macroalgae [26–28]. Optimal current velocity for the spread and growth of macroalgae is 0.20m/s^2 - 0.30 m/s^2 [29], but the current speed at West Pananjung Beach, Pangandaran switches between 0.04m/s^2 - 0,09m/s^2 which causes limited variability of macroalgae species. The pH also determines macroalgae diversity, the optimal pH for macroalga to growth between 7.5 - 8.4 [26], but the pH of the entire station is 7 (normal) that makes the variability of macroalgae is more limited.

Evenness index at station 2 and station 3 shows significantly different. Meanwhile, station 1 and station 2, and station 1 and station 3 showed no significant difference. Evenness index value based on Figure 2 shows that each station has a range of values of 0.24 to 0.27, which shows that the evenness of macroalgae in the West Pananjung

Beach, Pangandaran is classified into the low category, which the smaller the value of diversity (close to 0), the more close value evenness to 0 shows that the distribution of macroalgae in each species is different and there is a tendency for species to dominate in the region [25, 30, 31]. The statement is also strengthened by [21] that says low evenness is an indicator of dominance in a particular society of the community. This is caused by environmental factors that do not support the growth of several types of macroalgae so that only certain types of macroalgae can grow well [32]. The low level of macroalgae evenness can also be used as an indicator that ecosystem stability has been disrupted [33]. The low level of macroalgae evenness in the West Pananjung Beach, Pangandaran is also evidenced by the analysis of the dominance index data showing there were a dominating species.

Dominance index at station 1 with station 2, and station 2 with station 3 show significantly different. Meanwhile, station 1 and station 3 show no significant difference. The dominance index value based on Figure 2 at each station ranged from 0.18 to 0.3 which indicates there are dominant species [14]. This is corresponding with Simpson's dominance index that expressed as 1-D or 1/D, where 1-D is used as an index, ranging from 0 to 1, which values close to 1 indicating the community has a uniform abundance of species while values close to 0 represent fewer uniform species in a community or it can be said that one species is more dominant [15]. The species that dominating in West Pananjung beach, Pangandaran, is *Padina australis* from the Phaeophyta division. *Padina australis*, has a morphological description fan-like thallus, has a thin yellowish-brown sheet segment, consisting of lobes with a width of 3-4 cm [34].

The dominance of an area indicates that there is an influence on environmental conditions that cause there is a more dominant species. The growth of macroalgae is influenced by physical and chemical environmental parameters [35]. Based on measured environmental parameters it is known that *Padina australis* dominates due to environmental influences like current speed, and substrate. The flow velocity in West Pananjung Beach, Pangandaran is ranging from 0.04m/s - 0.09m/s that supports *Padina australis* to growth optimal and make them dominate the West Pananjung Beach, Pangandaran, as according to (36) optimal current velocity in Padina australis growth is 0.03m/s - 0.09m/s. The type of substrate also affects the dominance, at each station macroalgae is growing on the sandy coral substrate, that is matching [36] statement that brown algae can grow optimally if attached to a stable hard substrate (37). Growth and survival of macroalgae are supported by the stability of the substrate as a place to grow that can determine the diversity of macroalgae [37].

4. CONCLUTION

The results of the macroalgae research can be concluded that the macroalgae on the West Panajung Beach, Pangandaran were found are 21 species, 9 orders, 13 families, from 3 divisions. The macroalgae diversity index in West Pananjung Beach, Pangandaran has a range of 1.75 - 2.07 and entered in the medium category, evenness index has a range of 0.24 - 0.27 which is entered in the low category, and the dominance index ranges from 0.18 - 0.3 is entered in the low category which indicates there is a dominating species, namely *Padina australis* from the Phaeophyta.

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