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Density of Macroalgae Species on Pasir Panjang Beach Kupang City

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Abstract

Density of Macroalgae Species on Pasir Panjang Beach, Kupang City Macroalgae have an important role for productivity and protection for other marine biota, namely as primary producers, carbon sinks, cosmetic ingredients and have economic value in the trade sector. Pasir Panjang Beach has a high aesthetic value, so it is used as a recreational space for the city community and as a destination for the development of tourist attractions. This study aims to determine the types and density of macroalgae in Pasir Panjang Beach, Kupang City. This study uses the line transect method with quadrant sampling technique with a size of 1m x 1m. The sample consisted of 100 plots of 10 transects at 2 stations. The samples were analyzed quantitatively descriptively to determine the morphological characteristics of the species and the density analysis of each species. The results found 15 types of macroalgae were divided into 3 divisions, namely the Chlorophyta division (7 species), Rhodophyta division (6 species, and Phaeophyta division (2 species). The highest species density at station 1 was Hypnea sp (33.38 ind/m^2) and the lowest namely the species Acantopora spicifera (0.02 ind/m^2), while at station 2, the highest density was Gracilaria salicornia (6.06 ind/m^2) and the lowest density was Neomeris dumentosa (0.14 ind/m^2). The conclusions are 1) There are 15 types of macroalgae from 3 divisions namely Chlorophyta, Rhodophyta and Phaeophyta, 2) The species density differs between stations.

Introduction

Indonesia has the potential of natural resources with the greatest biodiversity in the sea. One of the biological sources found in the waters is macroalgae or also known as seaweed. The very high diversity of macroalgae species makes Indonesia a granary for macroalgae. Macroalgae are included in the plant-like Kingdom Protista, with a body structure in the form of a thallus which generally grows attached to certain substrates such as coral, mud, sand, rocks and other hard objects, has pigments so that they can photosynthesize. Algae mostly live in water areas, both freshwater and marine waters. According to Nurafni *et al*, (2020) macroalgae is also known as seaweed, but botanically it is not included in the grass (Graminae) group (Kordi, 2011). From an ecological point of view, macroalgae function as a provider of carbonate and strengthen the basic substrate that is beneficial for the stability and continuation of the existence of coral reefs. so that it has an impact on the balance of the marine ecosystem and has an economic impact on humans, especially in the field of fisheries (Handayani, 2019).The economic value of macroalgae can be used as food, industrial raw materials, and materials for laboratories such as wet-preserved materials, media materials for the proliferation of bacteria and fungi to produce antibiotics, and there are also types of macroalgae used as medicines (Marianingsih, 2013).

Pasir Panjang Beach is one of the interesting tourist destinations in Kupang City which offers extraordinary views and along its intertidal zone various types of macroalgae are found. However, along with the increase in population followed by the construction of tourism and hotel sites as well as the high routine of the people on the coast, the population and diversity of macroalgae species are reduced, which

will even become extinct if there are no countermeasures. This research on the density of macroalgae species is the first step to record the diversity of macroalgae species that exist in this location.

Several similar research results have been carried out in different locations, including by Wajong and Kasiamdari (2016) conducted in the Alor Islands and it was reported that there were 42 types of macroalgae identified, which belonged to 3 classes, and 19 families. It consists of 26 species from the Florideophyceae class, 9 species from the Ulvophyceae class, and 7 species from the Phaeophyceae class. Ludji *et al* (2018), reported that there were 14 types of macroalgae found in the waters of Tablolong Beach, Tablolong Village, West Kupang District, Kupang Regency with a macroalgae diversity value of H'= 1.0892 (medium category). Similarly, Kadim and Sulastri (2016) did the same. Nggemuk (2021), and Putri *et al* (2017). The results of this research indicate that the diversity of species and density of macroalgae differ in each region depending on the conditions of the area.

Methods

This study used the transect method. Sampling with a quadrant technique with a size of 1m x 1m. The sample consisted of 100 plots of 10 transects at 2 stations. The plot sample was determined using the line transect method with quadrant sampling technique (Kusmana, 2020). Sampling was carried out at two stations with each station consisting of five transect lines. Transect lines are laid systematically perpendicular to the shoreline, with a distance between transects of 100m. The transects were drawn perpendicular from the shoreline to the farthest low tide zone with a distance between transects of 100m. Each transect is made of 10 quadrants, the distance between the quadrants is 10 m. The samples contained in the quadrant are identified. The sketch of the laying of transects and quadrants can be seen in Figure 1.

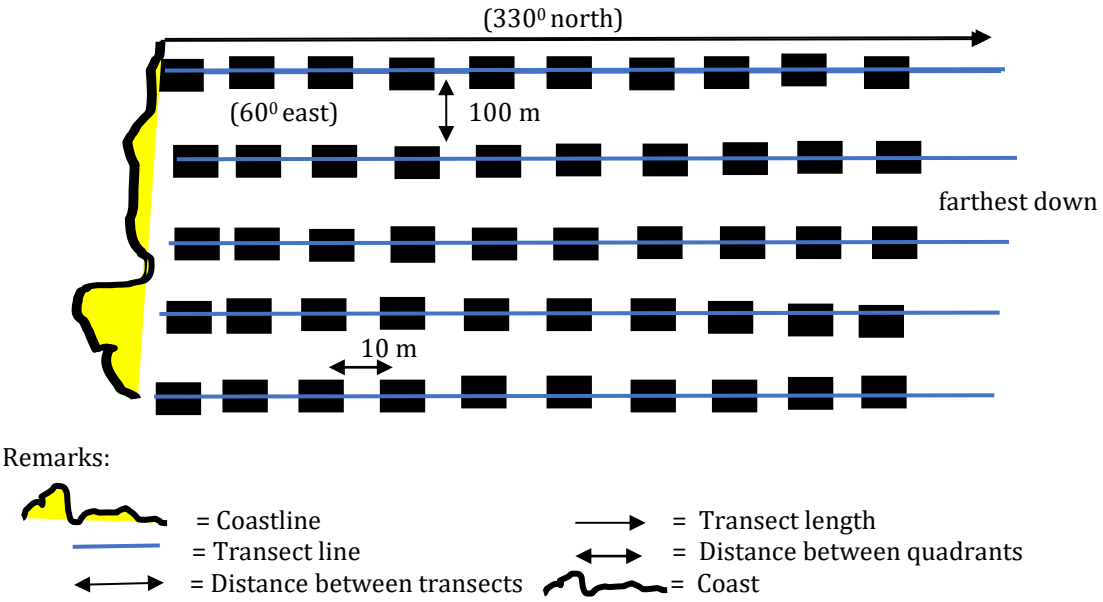

Figure 1. Macroalgae data collection sketch

Each sample of macroalgae was identified by observing the characteristics and suitability of the display characteristics in each sample using various sources, namely Tega (2020), Diansyah *et al* (2018) and Aslan (1991). Physical data collection includes seawater temperature, seawater pH, seawater salinity, TDS (Total Dissolved Solids) seawater and seawater turbidity as well as supporting information. The data were analyzed descriptively quantitatively based on the results of the density calculation of the types of macroalgae found. Macroalgae density was calculated using the equation according to Odum (1996) in Isham *et al*, (2018) as follows:

$$Di = \frac{ni}{A}$$

Remarks:

Di = Density (ind/m^2)
Ni = The number of individuals of the i-th species (individuals)
A = Transect area (m2)

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Results and Discussion

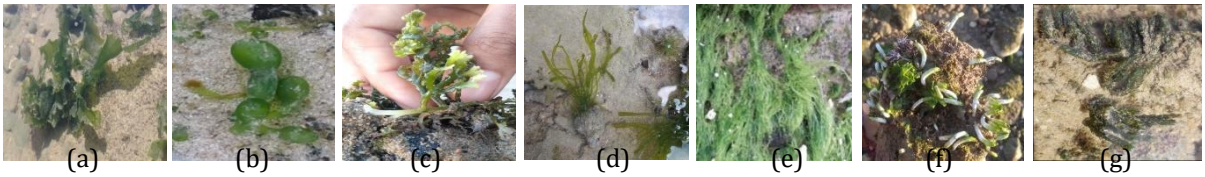
The results of research conducted at Pasir Panjang Beach Kupang City obtained 15 types of macroalgae. The results of the identification analysis based on morphological characteristics of the 15 species were grouped into three divisions, namely 7 types of ***Chlorophyta*** divisions, 6 ***Rhodophyta*** divisions and 2 types of ***Phaeophyta*** divisions. While the results of data analysis of the density values of macroalgae species at station 1 and station 2 obtained various values. The complete results can be seen in Table 1.

Table 1. Density of Macroalgae Species Found on Pasir Panjang Beach, Kupang City

No.	Divisio	Species	Density (ind/m²)	
			Station 1	Station 2
1.	Chlorophyta	*Ulva lactuca*	0,42	0,22
		Ulva reticulate	19,9	5,5
		Ulva flexuosa	8,92	2,34
		Neomeris dumentosa	0	0,14
		Boergesenia forbesi	1,2	3,68
		Caulerpa taxifolia	0	1,22
		Caulerpa serrulata	0,1	0
2.	Rhodophyta	*Anchantophora spicifera*	0,02	1,1
		Galaxaura rugossa	0,22	0
		Halymenia maculate	0,62	0
		Gracilaria salicornia	24,76	6,06
		Gracilaria coronopifolia	1,28	2,74
		Hypnea sp.	33,38	1,92
3.	Phaeophyta	*Padina australis*	10,1	3,46
		Sargassum polycystum	0,04	0,28

Table 1 shows that the density of macroalgae species differs based on the sampling location. The highest macroalgae density value at station 1 was found in Hypnea sp, with a value of 33.38 ind/m², while the lowest species density value was found in Acantopora spicifera with a value of 0.02 ind/m². Meanwhile for station 2, the highest species density value was found in Gracilaria Salicornia of 6.06, and the lowest species density value was found in Neomeris dumentosa of 0.14.

The results of identifying the types of macroalgae found in each morphological division can be seen in Figures 2, Figures 3, and Figures 4. The results of measuring environmental parameters are presented in Table 2.



(a) (b) (c) (d) (e) (f) (g)

Figure 2. Species of Macroalgae of the Chlorophyta Division: (a) *Ulva lactuca*, (b) *Boergesenia forbesi*, (c) *Caulerpa serrulata*, (d) *Ulva reticulate*, (e) *Ulva flexuosa*, (f) *Neomeris dumentosa*, (g) *Caulerpa taxifolia*.

(a) (b) (c) (d) (e) (f)

Figure 3. Species of Macroalgae Rhodophyta Division: (a) *Galaxaura rugossa*, (b) *Halymenia macula,* (c) *Acanthophora spicifera,* (d) *Gracilaria salicornia,* (e) *Gracilaria coronopifolia*, (f) *Hypnoea sp.*

(a) (b)

Figure 4. Species of Macroalgae Phaeophyta Division: (a) *Padina australis*, (b) *Sargassum polycystum.*

Table 2. Average measurement results of environmental parameters at stations 1 and 2 at Pasir Panjang Beach

Environmental parameters	Station I	Station II
Temperature (°C)	29.8	29.7
pH (H^+)	7.60	7.60
Salinity (‰)	29.20	29.20
TDS (ppm)	2985	2984
Turbidity (NTU)	7.71	7.71
Substrate	Coral reefs, dead coral beds, sandy corals, muddy sand and mollusk shells	Mixed sand, broken coral, muddy sand, few rocks

Table 2 shows that the waters of Pasir Panjang Beach have an average temperature of 29.7oC, salinity of 29.2o/oo, pH of 7.6 H+, total marine solids (TDS) of 2,985 ppm, and turbidity of 7.71 NTU. Meanwhile, the type of substrate found in the intertidal zone of Pasir Panjang Beach at station 1 includes coral reefs, dead coral beds, sandy corals, muddy sand and mollusk shells, while at station 2 includes mixed sand, coral fractures, muddy sand, and a little rock. Other environmental parameters measured were not too significantly different because they were located close together, so they also did not affect the density of macroalgae found.

The results of the analysis in Table 1 show the difference in the density values between station 1 and station 2 where at Station 1 the density is high in the type of Hypnea sp. followed by Gracilaria Salicornia, Ulva reticulate and Padina australis indicated that this type of macroalgae grows and is firmly attached to the dead coral substrate so that it is not easily separated from the substrate during strong waves. These three species are also commonly found at station 2. This species is thought to have a good influence from its environmental substrate. The density of different types of macroalgae has the greatest influence on the type of substrate. As supported by the **Directorate of Fisheries (1997)** in Palallo (2013) states that the distribution of macroalgae species in the waters is caused by the suitability of their habitat. Seaweed habitat is generally on the average coral reef. This macroalgae attaches to a hard object substrate in the form of sand, coral, dead coral fragments or shells. Furthermore, it is supported by Ferawati *et al* (2014), that the number of types of seaweed that grows on coral substrates is more than on mixed substrates and sand substrates.

On the other hand, low densities of station 1 were found in the species *Achantopora spicifera, Sargassum polycystum* and *Caulerpa serrulata*. While at station 2 the types were *Neomeris dumentosa, Ulva lactuca* and *Sargassum polycystum*. These types of macroalgae are thought to have low densities because they are influenced by physical environmental factors, especially on the substrate and the season where data collection is carried out during the rainy season so that the presence of these macroalgae grows and must adapt to high waves at Pasir Panjang Beach. In addition, it is also suspected to be affected by excessive community activities at low tide which damage the macroalgae attachment substrate. As supported in Ferawati *et al* (2014), which states that the low level of diversity is largely due to the complexity of the habitat due to substrate damage or high waves. Another factor that causes low diversity is excessive human activity. These results are in line with the opinion of Atmadja (1999) and Kurniawan (2017) that macroalgae are vulnerable to changes and ecological pressures that occur in their environment. Human activities can affect the presence of macroalgae.

The measurement results of environmental parameters (Table 2) greatly affect the density of macroalgae species and environmental parameters on Pasir Panjang beach, Kupang City are still categorized in a fairly good condition to support the growth and development of macroalgae. Because the study was conducted during the rainy season, one of the causes of density is salinity. According to Nakajima *et al* (2015), rainwater can disrupt the salinity of seawater which causes macroalgae to not grow properly. According to Morrisay and Sumich (2012) and Cokrowati *et al* (2014), temperature, salinity, and current factors also play a role in the distribution and density of aquatic organisms. In addition, pH also affects the presence of macroalgae. According to **Bold and Wynne (1985)** in Kurniawan (2017), the degree of acidity of the waters is one of the factors that affect the growth of macroalgae. The pH value greatly determines

the carbon molecule that can be used by macroalgae for photosynthesis. A good pH for the growth of green and brown algae ranges from 6 to 9. Thus, the pH parameter of Pasir Panjang coastal waters is not a problem for habitat and macroalgae growth.

Conclusions and Recommendations

Based on the results of research conducted in the intertidal zone of Pasir Panjang Beach, Kupang City, it can be concluded: 1) there are 15 types of macroalgae from 3 divisions, namely: 7 types of division Chlorophyta (*Ulva lactuca, Ulva reticulata, Ulva flexuosa, Neomeris dumentosa, Boergesenia forbesi, caulerpa taxifolia* and *Caulerpa serrulata*), 6 species from the division Rhodophyta (*Achantopora spicifera, Galaxaura rugosa, Halymenia maculate, Gracilaria Salicornia, Gracilaria coronopifolia* and *Hypnea* sp.), and 2 species from the division Phaeocysta (*Padina australis* and *Sargassum polycystum)* density polynomial the highest species was found at station 1 with a value of 33.38 ind/m2 by Hypnea sp. and the lowest with a value of 0.02 ind/m2, by the species *Acantopora spicifera*. While at station 2, the highest density with a value of 6.06 ind/m^2, by the species Gracilaria salicornia and the lowest density with a value of 0.14 ind/m^2, by the species *Neomeris dumentosa*.

The results of this study contain messages that: 1) the community and the government in charge, to be more aware of protecting the environment around the coast by not littering and cleaning up garbage on the coast regularly to minimize sea water pollution so that the growth and development of macroalgae in coastal waters Pasir Panjang remains stable and well-maintained. 2) For advanced researchers, it is possible to conduct studies on types of macroalgae that can be used specifically by the community in various fields of life.

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