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SEDIMENT ORGANIC MATTER CONTENT BASED ON THE DIFFERENT AGES OF MANGROVE VEGETATION IN THE LANTEBUNG MANGROVE ECOTOURISM AREA, MAKASSAR

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ABSTRACT

One of the roles of the mangrove ecosystem for the environment is providing organic matter through its fallen litter. The litter is mostly decomposed by bacteria in the sediment, some is exported to other ecosystems and a small part is used directly by other biotas. The content of organic matter in the sediment is considered to be related to the age of the mangrove vegetation. The research was conducted in the Lantebung mangrove ecotourism area, Makassar City. Four sampling stations were deployed to analyze the organic matter content. The stations are placed based on the distance from the land with the assumption that the farther from the land, the younger the mangrove vegetation. Analysis of organic matter in sediments was carried out using the combustion method at high temperatures. The results showed that there were three species of mangroves, namely Avicennia marina, Rhizophora mucronata and Excoecaria agallocha. The species of A. marina was dominant on the inside and the middle, while R. mucronata was dominant on the outside. The organic matter content of the sediment ranged from 5.77-7.40% with an average of 6.68±0.68%. In the sediment layer 0-30 cm, the younger the age of the mangrove vegetation, the lower the organic matter content. However, in the sediment layer below, the organic matter content is relatively the same between different ages of vegetation. The total organic matter in the Lantebung mangrove area which is used as an ecotourism area (6.5 ha) is 2,769 tons or an average of 426 tons per hectare.

Keywords: organic matter, mangrove sediment, age of mangrove vegetation, Lantebung Makassar

INTRODUCTION

Mangroves are one of the coastal ecosystems that have an important role for the environment. These roles include as a pollution biofilter (Kariada and Isradi, 2014), coastal protection from wave action causing abrasion (Indarsih and Masruri, 2019), as a breeding ground, shelter and foraging for various marine and terrestrial organisms (Purnomo et al. 2020), as primary producers, as well as carbon sinks and stores (one of the mitigations against climate change) (Howard et al., 2014; Marchand, 2017).

As primary producers, mangroves use sunlight to assist the photosynthesis process in forming organic materials from inorganic materials. Thus, one of the roles of the mangrove ecosystem for the environment is as a provider of organic matter through fallen litter. Some of the litter is decomposed by bacteria in the mangrove substrate, eaten by biota (Nordhaus et al., 2012) and some is exported to other adjacent ecosystems. The largest portion of the litter is decomposed by bacteria, and only a small portion is utilized directly by organisms.

The content of organic matter in mangrove sediments is strongly influenced by the sources and processes that occur. Organic matter may originated from various sources (Koch et al., 2011), both from the mangrove ecosystem itself (autocthonous) including from components of algae and mangroves, as well as from outside the mangrove ecosystem (allochtonous) such as from the mainland (Kristensen et al., 2008; Isman et al., 2018). Organic matter originating from within the mangrove ecosystem is thought to be highly dependent on the characteristics of the mangrove vegetation such as density, canopy cover, dominant mangrove species and the average age of mangroves (Yulma et al. 2013; Syukri et al. 2018). On the surface of the substrate, the contribution of mangroves to organic matter may achieve more than 70% (Chen et al. 2018).

In addition to sources of organic matter, biological, physical and chemical processes affect the presence of organic matter in mangrove sediments. Factors that affect the decomposition rate of litter indirectly affect the organic matter content in mangrove sediments, such as the number of bacteria, oxygen concentration in the interstitial space, temperature and so on (Yulma et al. 2013; Sari et al., 2016). The rate of litter decomposition in mangrove areas is quite high (Dharmawan et al. 2016).The distribution of mangroves in Makassar City is very

limited. Only found on the northern coast, starting from the mouth of the Tallo River to the border with the coast of Maros Regency. The thickness of the mangroves is also very thin. The rapid pace of urban development has consequences for the decline in mangrove area. In some locations, mangroves have been converted to warehousing, settlement and pond expansion areas. One of the locations where the mangroves are still well maintained by the community is some of the mangroves in Lantebung which are used as ecotourism locations. In addition to the natural mangroves that are on the inside, the community is making efforts to plant outward so that the mangrove area is increasing. The age of the mangroves on the inside is older than the mangroves on the outside. This condition is expected to affect the organic matter content in the sediment. This is the reason for conducting research in the Lantebung mangrove ecotourism area.

MATERIALS AND METHODS

The research was conducted in July 2020 in the Lantebung mangrove tourism area, Makassar City, South Sulawesi Province. Observation of the structure of the mangrove community was carried out using a plot measuring 10 m x 10 m. There were five stations that were placed based on differences in position relative to the ground. The assumption used in station placement is that the farther from the land, the younger the mangrove vegetation. Station 1 was closest to land (oldest vegetation) and Station 4 is furthest from land (youngest vegetation). Each station made 9 plots for mangrove observation and sediment sampling (Figure 1). The next step was to identify all the mangrove species in the plot and count the number of trees to determine their density (Bengen, 2001). The tree category has a trunk circumference of at least 16 cm at a position of about 1.3 meters from the ground (Sutaryo (2009). Mangroves were identified based on Noor et al. (2012) and Pramudji (2018). Data collection on mangrove canopy cover was carried out using the Hemispherical Photography method. using a camera with the photo taking position adjusted to the condition of the mangrove canopy and followed by photo analysis using imageJ software (Dharmawan & Pramudji, 2017).

In each plot, sediment samples were taken for analysis of organic matter. Sediment is taken using a corer (Marchand, 2017). Cores with a diameter of 7 were inserted into the sediment to a depth of 50 cm. The corer was removed and the sediment was carefully removed so that the shape remains intact. To represent the sediment layers (layers 0-10 cm, 10-20 cm, 20-30 cm, 30-40 cm and 40-50 cm), the sediments removed from the corer were cut each 10 cm long. The sample was put in a sample bag and brought to the laboratory. Furthermore, an analysis of the content of organic matter in each layer of sediment was carried out. Analysis of organic matter content was carried out using the high-temperature, loss on ignition (LOI) combustion method (Heiri et al. 2001).

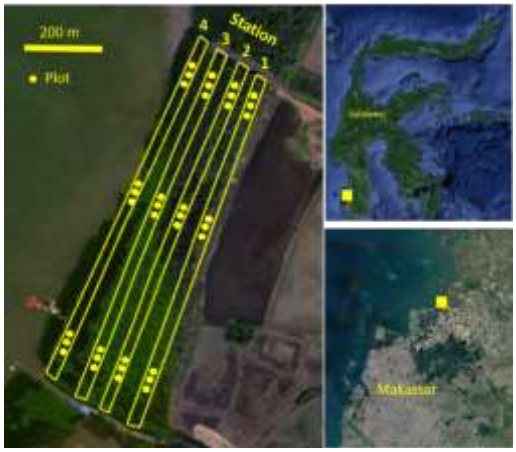

Figure 1. Research station in the Lantebung mangrove ecotourism, Makassar

RESULTS AND DISCUSSION

Mangrove Community Structure

Mangroves in the Lantebung ecotourism area consist of mangroves that grow naturally on the inside, but on the outside towards the sea, mangrove vegetation is the result of planting by the community. The structure of the mangrove community is not too diverse, at least in the block used as a tourist area only consists of three species, i.e., *Avicennia marina*, *Rhizophora mucronata* and *Excoecaria agallocha*. Mangrove density varies based on its position from the land, ranging from 1,022-2,511 trees/ha with an average of 1,725±707 trees/ha. This mangrove density value is classified as a good category (very dense) when referring to the Minister of Environment Decree number 201 of 2004. The farther out to the sea, the higher the mangrove density (Figure 2).

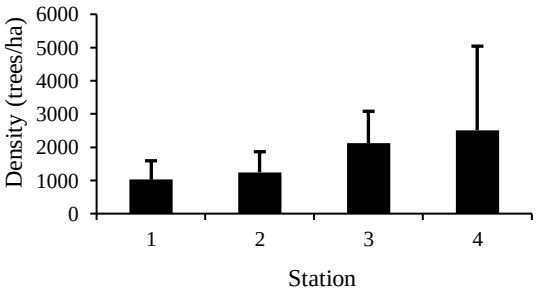

Figure 2. Mangrove density in Lantebung mangrove ecotourism area

In a position close to the land, mangrove density is low because it is a mangrove that grows naturally, while in the outer position, mangrove vegetation is the result of planting by the community, both independently and in collaboration with various institutions. The low spacing makes the mangrove density on the outside higher than the inside, but with a younger mangrove age.

In contrast to density, the pattern of mangrove canopy cover does not show any significant difference between the position of the part that is close to the land and outwards. Although on the inside, the age of the mangroves is older than the outside, the mangrove density shows the opposite. This causes no significant difference in mangrove canopy cover between positions. Canopy cover ranged from 75.2-85.7% with an average of 80.8±4.3%. This mangrove canopy cover value is categorized as good (very dense) when referring to the Minister of Environment Decree number 201 of 2004.

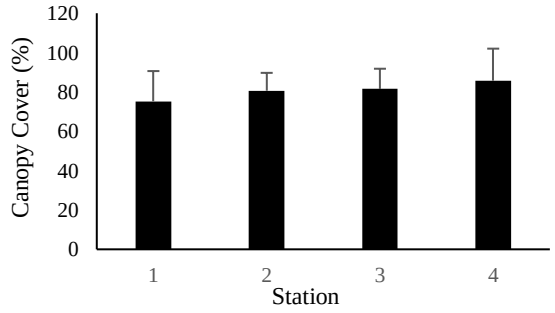

Figure 3. Canopy cover of mangrove in Lantebung mangrove ecotourism area

On the inside, the composition of mangrove species consisted of *A. marina*, *R. mucronata* and *E. agallocha*. Species of *A. marina* and *R. mucronata* had almost the same contribution, while species of *E. agallocha* were found in small amounts. The three species of mangroves, respectively, contributed to the total density of 54.3%, 35.9% and 9.8% (Figure 4). In the middle part (Station 2 and Station 3), it is dominated by A. *marina*, ranging from 95.8-100.0 %. On the outside, the mangrove vegetation was dominated by *R. mucronata* with a contribution of 73.9%, while *A. marina* contributed 26.1%. Although the planting of mangrove species was carried out using the species of *R. mucronata*, the discovery of the type of A. marina on the outside indicated an indication of mangrove seedlings that grew naturally from the species on the inside. The spread of mangroves can occur from one location to another, allowing the seedlings that grow to develop differently from the parent tree species in that location (Stocken et al., 2019). In addition to falling from the mother tree, the dispersal of mangrove seedlings may be assisted by tidal currents, wind and animals (Van der Stocken et al., 2015). The distance from the parent tree to the mangrove seedling distribution area caused by water currents and wind depends on the time of release of the seedlings from the parent (Stocken et al. 2017).

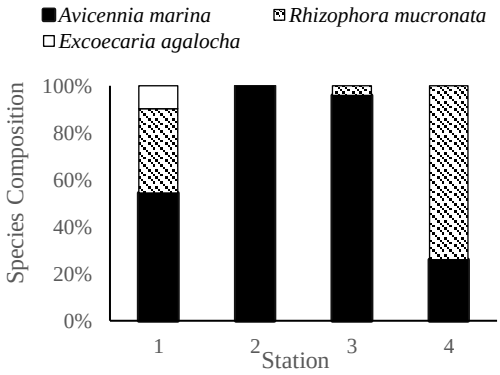

Figure 4. Species composition of mangrove in Lantebung mangrove ecotourism area

Sediment Organic Matter

The organic matter content of the sediments shows variations based on the relative position of the vegetation to the land. The further outward, the lower the sediment organic matter content. The range of organic matter content is 5.77-7.40% with an average of 6.68±0.68% (Figure 5). This value is the average organic matter content of the sediment surface layer to a depth of 50 cm. Variations in organic matter content are more clearly visible up to a sediment layer depth of 30 cm, while at a layer of 30-50 cm, the variation is not too high (Figure 6).

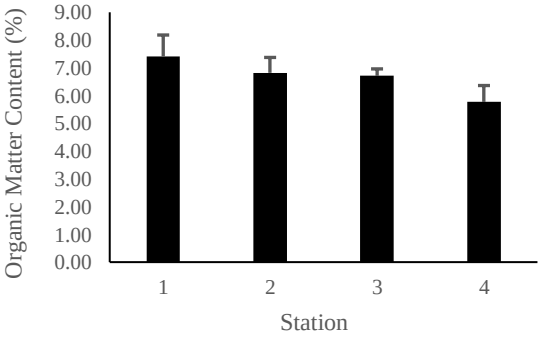

Figure 5. Average of organic matter content in the 0-50 cm sediment layer

Up to the 30 cm sediment layer (0-10 cm layer, 10-20 cm layer and 20-30 cm layer), higher organic matter content was still visible on the inside (Station 1), followed by the middle part (Station 2 and Station 1). 3) and the lowest on the outside (Station 4). The high content of organic matter on the inside is caused by the mangrove vegetation that grows older than in the middle and outside. Mangrove vegetation begins to grow on the inside and will

expand outward using fallen seedlings. In the Lantebung mangrove ecotourism area, mangroves which are the result of planting start from the edge in the middle of the vegetation. Most of the organic matter in the mangrove ecosystem comes from the existing mangrove vegetation. Thus, the time span for accumulation of organic matter from litter in the interior of the vegetation is longer than in other parts. This causes the highest organic matter content. On the other hand, on the outside, the age of mangrove vegetation is relatively younger so that the time span for accumulation of organic matter is shorter. Research conducted by Chen et al. (2018) proved that the age of the vegetation greatly influences the organic matter content of mangrove sediments. The high density of mangroves on the outside of the vegetation does not cause higher organic matter compared to the inside because of the younger age of the mangroves. This is different in several locations, for example mangrove vegetation in Mamuju, where the relationship between density and organic matter shows a positive correlation (Syukri et al. 2018).

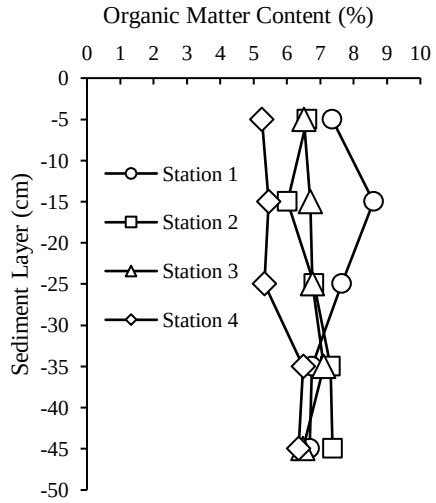

Figure 6. Profile of organic matter content based on the sediment layer

In sediment layers ranging from 30-50 cm, the organic matter content is relatively the same and does not very much. It is suspected that this condition will occur in the layers of sediment below it. This indicates that the organic matter at the top of the sediment is still strongly influenced by other factors, both external and internal. External factors are related to sources of organic matter such as from mangrove vegetation through directional debris, or from outside the mangrove ecosystem. The amount of litter that falls or the amount of organic matter that enters from the outside greatly affects the organic matter content in the sediment. In addition, another external factor that can affect the organic matter content of the sediment at the top (especially on the surface) is the presence of litter-degrading bacteria (Sari et al. 2016). The litter decomposition process will take place well on the surface, but getting to a deeper layer of sediment, the decomposition process will decrease until finally it does not happen again (Armentano and Menges, 1986; Alongi, 2009). Internal factors, among others, relate to the quality (nutrient content) of litter and organic materials from outside that enter the mangrove ecosystem. The quality of the litter will affect the results of the decomposition carried out by bacteria. Litter quality is partly influenced by mangrove species (Yulma et al. 2013; Isman et al. 2018).

If we refer to the mangrove area (specifically for the block which is used as a mangrove tourism area) which is 6.5 ha and the average sediment organic material is 42,598 grams per m2, then overall it reaches a sediment layer of 50 cm, the total organic matter in the area reaches 2,769 tons (Table 1). In the Lantebung mangrove ecotourism area, mangrove planting is still being carried out, both by the community independently and in community collaboration with other institutions, both government and private. Thus, the potential for additional carbon stocks in sediments continues to occur

Table 1. Total of sedimen organic matter in the Lantebung mangrove ecotourism area, Makassar

Station	Organic Matter Content (%)	Bulk Density (g/cm^3)	Organic Matter (g/m^2)	Mangrove Area (ha)	Total of Organic Matter (ton)
1	7.40 ± 0.78	1.28 ± 0.03	47.360		
2	6.82 ± 0.56	1.26 ± 0.03	42.966	6.5	2.769
3	6.71 ± 0.25	1.26 ± 0.02	42.273		
4	5.77 ± 0.59	1.31 ± 0.03	37.794		
	Average		42.598		

CONCLUSION

The content of organic matter in the upper sediment layer of mangrove vegetation depends on the age of the mangrove vegetation. The older the mangrove vegetation, the higher the organic matter content. However, in deeper sediment layers, the organic matter content is relatively the same at different ages of mangrove vegetation. The total organic

matter in the Lantebung mangrove area which is used as an ecotourism area (6.5 ha) is 2.769 tons or an average of 426 tons per hectare.

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