SUBSTRATE CHARACTERISTICS AND ITS IMPACT ON DISTRIBUTION OF MANGROVE SPECIES : A Case Study In Sungai Barong Kecil In The Sembillang National Park At Banyuasin, South Sumatra

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ABSTRACT

The composition and density of vegetation in the mangrove areas affected soil conditions. Areas with a smooth distribution of substrat particles contain higher organic matter, and is characterized by the growth of mangrove better and more diverse. How environmental conditions affect the distribution of mangrove substrats observed in this study. The study was conducted in the area of Sungai Barong Kecil and Sungai Barong Besar which is part of the Sembilang National Park, Banyuasin District, South Sumatra. The study was conducted in May and June 2014. Location determined substrats by purposive sampling with particular consideration, and samples were taken using a modified PVC pipe at a depth of 10-30 cm, while the checkered line method with parallel lines used for observation shoreline mangrove distribution. Physical parameters such as salinity environmental chemistry, pH, and moisture. Analysis was performed on substrat particle size, substrat organic matter content, as well as the condition and type of mangrove. The results showed that the Sungai Barong Kecil area tend to have a much smoother distribution of substrat particles (clay content and higher dust). This leads to more easily grow mangroves and mangrove species were found to be more diverse (Avicennia marina, Avicennia alba, Rhizophora mucronata and Avicennia officianalis). Avicennia marina is the dominant species that indicates that the species is highly adaptable to various environmental conditions.

***Key words**: Avicennia alba, Avicennia marina, Avicennia officianalis, Rhizophora mucronata, substrate.*

INTRODUCTION

Mangrove is one of the coastal ecosystems that have ecological and economical role. In general, mangrove forests grow in coastal areas that are always flooded with a sea of mud and sand substrate, sometimes mangroves can grow on sheltered beach. Nybakken (1992) stated that mangrove describe a variety of tropical coastal communities dominated by a few species of trees or shrubs characteristic that has the ability to grow in salty waters. Mangrove forest is a community of tropical and subtropical vegetation dominated some mangrove species that can grow and develop in tidal areas and muddy beaches (Bengen, 2004), or forest vegetation growing among the tidal line (Steenis, 1978). Hutabarat & Evans (2003) states that the mangrove is a plant that can form a sludge land, resistant to high salinity and water immersion.

The composition and density of stands that grow in mangrove area is strongly influenced soil conditions. Generally, soil with clay content and high dust has more dense than soil stands with clay content and low dust. The main environmental factors for the growth of mangroves is salinity level, temperature, pH, season, tidal influence, drainage and condition of the substrate or substrat (Alkaf, 2003).

Intricate root system of mangrove cause can withstand the brunt of the high sea waves. Type rooting (pneumatophore) is also able to precipitate mud allowing the expansion of mangrove forests and holding organic matter (Pramudji, 2001). Slow movement of water around the mangrove roots causing fine particles tend to settle, and forms associated with mangrove roots mangrove adaptation process (Nybakken, 1992). The formation of substrat in mangrove forests prevent coastal erosion and a decline far shoreline. Banyuasin of coastal waters are part of Bangka Strait and is a strategic area in the development of coastal areas. The area is utilized as a fishing activity area, settlement, and is planned as a harbor area. Increased utilization of coastal areas has disrupted the balance of coastal dynamics. Problems that may arise in the coastal areas of abrasion and substratation (Affandi and Surbakti 2012).

Sungai Barong Besar and Sungai Barong Kecil is a zone utilization, conservation and protection of mangroves. Mangrove conservation that have occurred but without regard to the composition of the vegetation should be restored in a manner appropriate management, including the choice of a variety of mangrove vegetation appropriate to the substrate, cultivation, and conservation. One of the contributing factors to the high fixed composition of mangrove vegetation is mangrove substrate. The substrate is where the roots of the mangrove can grow. Characteristics of a good substrate to determine the number of mangrove stands that can grow and evolve (Arief, 2003).

MATERIALS AND METHODS

Tools and Materials

The tools used are global positioning system (GPS), digital camera, handrefractometer, soil tester, and PVC pipe. The materials used are substrat sample and mangrove sample.

Methods

The study was conducted in the Sungai Barong Kecil in Sembilang National Parks, Banyuasin regency, South

Sumatra. Analysis of substrat and organic content or nutrients carried in Laboratory of Soil, Agriculture Faculty, while the identification of mangrove conducted at the Laboratory of Ecology, Biology Department, Mathematics and Natural Sciences Faculty, University of Sriwijaya, Indralaya.

Research and plot location determined by purposive sampling based on regional characteristics and vegetation conditions. The plot was used to observe the condition of the mangrove, type, density, and the importance of mangroves. In each study site was made 3 plots (Figure 1).

The substrate was taken by purposive sampling in each plot using PVC with depth of ± 10-30 cm (Indah *et al*., 2008). Mangrove conditions observed by density, frequency, dominance and importance value index. The method used is transect method (Kusmana 1997) (Figure 2).

Location	Plot	Ordinate
Barong Kecil River Area	I	02^0 09' 50,1" LS 104^0 54' 17,3" BT
	II	02^0 09' 50,1" LS 104^0 54' 16,6" BT
	III	02^0 09' 49,0" LS 104^0 54' 15,3" BT

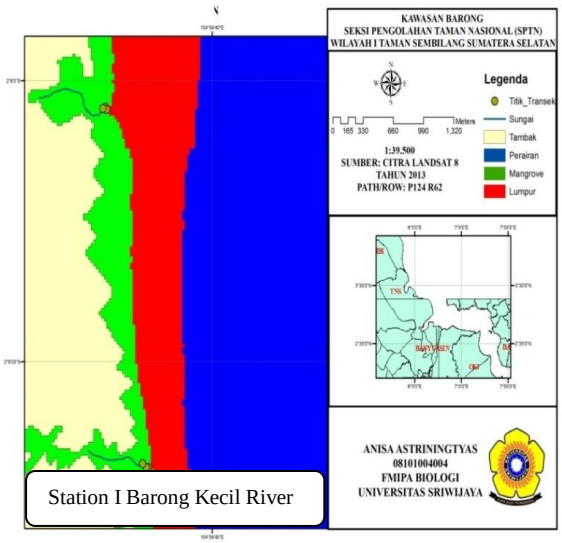


Figure 1. Location of research sampling and ordinate point

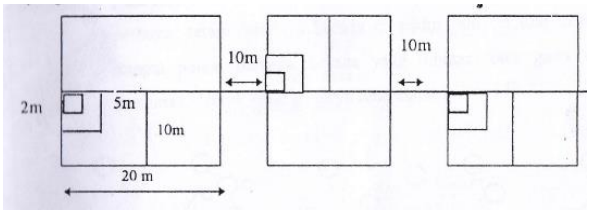


Figure 2. Transect Method

Analysis of substrate texture fraction

Percentage fractions were analyzed using Shepard triangle (Indah *et al*., 2008; Putra, 2010). Corner points indicates the percentage of one faction and each edge represents the percentage weight of each fraction (Figure 3).

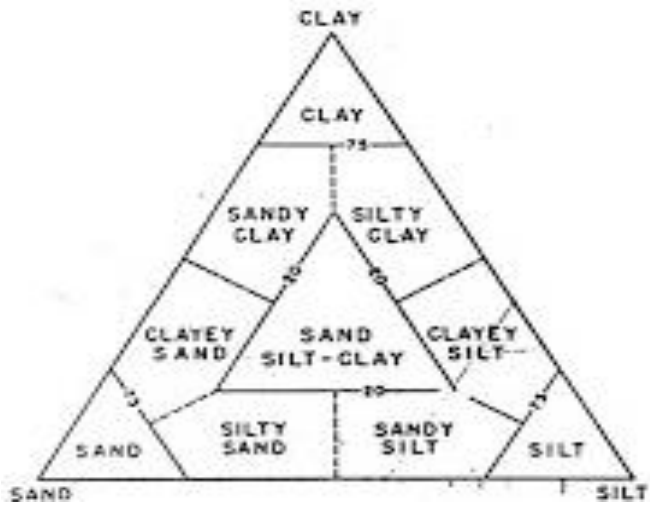


Figure 3. Shepard Triangle (Putra, 2010)

Analysis of Organic Materials

Organic matter observed is C, N, Mg, K, Ca, and P.

Condition and type of Mangroves

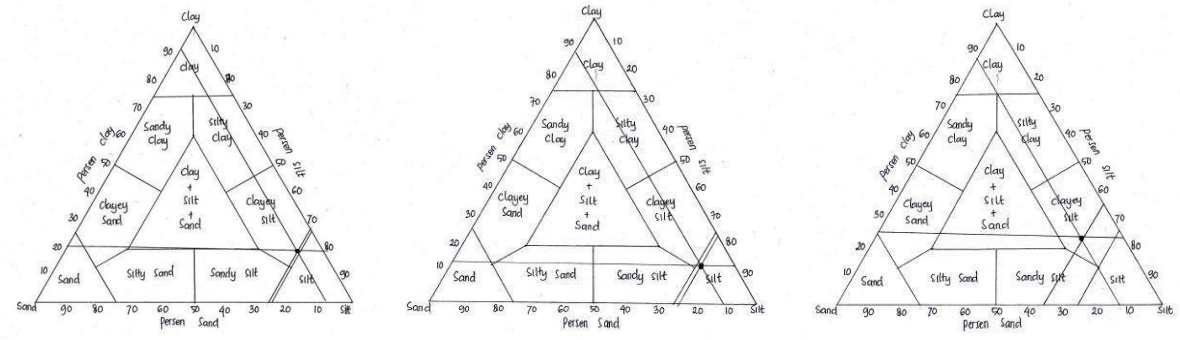
Mangrove species observed by density, relative density, frequency, relative frequency, dominance, and relative dominance. Important value is the sum value of the relative density, relative frequency and relative dominance (Kusmana, 1997).

RESULT

Fraction substrate

Table 1 shows the characteristics of mangrove forests in the river substrate Small Barong. Fraction of the substrate in the study area are sand, silt, and clay with varying proportions. The percentage of fractions of sand, silt, and clay is 13.14%; 62.17%; and 26.83%. The percentage of each fraction is shown in Figure 4 a. The condition of the substrate with the type of clay mud is usually occupied by *Avicennia marina*. Mangrove species grow well in high salinity.

The percentage sand, silt, and clay fraction for *Avicennia alba* is 9.88%; 75.62%; and 14.5%. Fraction high dust causes the substrate becomes mud (Figure 4 b). As *A. marina*, *A. alba* is grown in the region with high salinity (coastal areas). *Avicennia officinalis* grown in areas with percentage 10.11% of sand; 75.43% of dust; and 14.46% of clay (Figure 4c). Therefore this kind of *Avicennia* spp. known as a pioneer mangrove.



(a) (b) (c)

Figure 4. Characteristic Substrat (a) *A. marina*; (b) *A. alba*; (c) *A. mucronata*

Table 1. Characteristics substrat of mangrove forest at Sungai Barong Kecil area

Location	**Species of mangrove**	**% Fraction Texture**		
		Sand	**Dust**	**Clay**
Sungai Barong Kecil	*Avicennia marina*	13,14	62,17	26,83
	Avicennia alba	9,88	75,62	14,50
	Rhizophora mucronata	10,31	71,29	18,40
	Avicennia officianalis	10,11	75,43	14,46

Table 2. The content of organic matters of mangrove at Sungai Barong Kecil area

Location	**Species**	**Organic matters (%)**		**Nutrients**			
		C-organic	**N- total**	**P**	**K**	**Ca**	**Mg**
Sungai Barong Kecil	*Avicennia marina*	2,73	0,16	12,75	2,56	17,45	2,08
	Avicennia alba	3,00	0,27	26,85	2,56	14,85	2,40
	Rhizophora mucronata	2,85	0,20	14,55	2,88	14,80	3,25
	Avicennia officianalis	3,35	0,29	24,30	2,88	14,15	2,23

Table 3. Salinity, acidity, and humidity at Sungai Barong Kecil area

Location	**Environmental factors**	**Sub sampling**					
		I	**II**	**III**	**IV**	**V**	**VI**
Estuary of Sungai Barong Kecil	Salinity	16	16	16	18	17	15
	Acidity	6,3	6,4	6,8	6,6	6,9	6,6
	Humidity	30	30	12%	20%	20%	20%

Rhizophora mucronata found in this region occupies the area with the percentage of 10.31% sand; 71.29% of dust; and 18.40% clay (Figure 5).

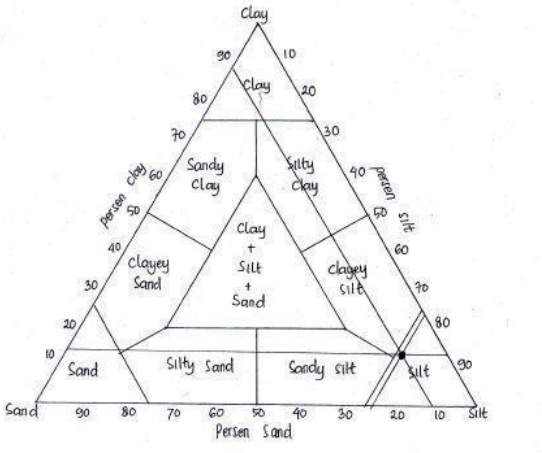


Figure 5. Characteristic Substrat of Rhizophora mucronata

Organic materials

Generally, the value of C-organic in the study area is high. The value of the highest C-organic of 3.35% was found in the region occupied by *Avicennia officinalis*. Value of C-organic in the region is 3.00% of *A. alba* and *A. marina* was 2.73%, while the area of *Rhizophora mucronata* is 2.85%. The content of N-total varies between 0.15 to 0.29%. This value is an indication of the level of fertility of the mangrove areas at TNS. The area occupied by *Avicennia alba* and *Avicennia officinalis* tend to have higher value of N-total (0.27% and 0.29%) compared to *Avicennia marina* (0.16%) and *Rhizophora mucronata* (0.20%) area.

Magnesium (Mg) is an element needed in small quantities, but should be available for an important role in plant metabolism. The highest value is 3.25 Mg me / 100 g was found in the area of *Rhizophora mucronata*, and slightly decreased in the region *Avicennia alba* (2.4 me/100g), *Avicennia officinalis* (2.23me/100 g), and *Avicennia marina* 2,08 me/100 g. Phosphorus values varies at each region is 26.85 me /100 g in the *Avicennia alba* area, 24.3 me/100 g in the *Avicennia officinalis*, 12.75 me/100 g in the *Avicennia marina* and 14.55 me/100 g in the area of *Rhizophora mucronata*. Potassium and calcium values varies between 2.56me/100g - 2.88me/100g and 14.15me/100g - 17.45me/100g. Data on the condition of organic matter, salinity, pH and moisture at Sungai Barong Kecil area shown in Tables 2 and 3.

DISCUSSION

Mangrove is a vegetation that can grow on a variation of the substrate (sand, clay, and silt) where the condition of the organic material also varies following the substrate composition. Mangrove generally grows in the mud clay mixed with organic matter, but also found growing in areas with peat or substrate type with high sand content. (Marcello, 2012). Darmadi et. al., (2012), explains that the characteristics of the substrate determines the life of the mangrove community. Mangrove substrate typically characterized by a wet substrate, high salt content, low oxygen content, particle substrates grainy, and rich in organic matter.

According to Fajar *et. al*., (2013), mangroves grow well in the conditions of the substrate containing gravel, sand, sandy clay, dust, and silt clay on the 4-35 ‰ salinity levels and pH 6-7, and *Avicennia marina* is a mangrove species have high adaptations on the substrate with the type of silt clay.

The root system of breath on the Avicennia officinalis able to hold abrasion and litter easily to decompose and impact on increasing the organic matter content. The content of organic matter on the muddy substrates are generally higher than the content of organic material on a substrate of sand. the porosity of mud causes the organic material can be detained. Kushartono (2004) describes the organic material is a component of substrate of the bottom of waters. Generally the substrate at mangrove areas contain organic materials such as carbon, nitrogen, and phosphorus.

Mangrove area has a typical zoning although the boundary is not clear. Zoning of mangrove affected by the substrate as a growing medium. Halidah and Harwiyandin (2013) describes the mangrove on the the outer zoning usually is dominated *Avicennia* spp. This species has a high adaptability so that it can grow at swamps, muddy shore, and the substrate with a high salt content. Therefore, *Avicennia* spp. often called as a pioneer mangrove.

The high vegetation density increases litter production and process of decomposition of organic matter. Jesus (2012) describes The high C-organic on the mangrove areas affected parts of mangroves a dead, and the leaves or branches that fall. The content of C-organic at mangrove areas usually higher than other areas on land, so that the decomposition of plant and animal waste faster in the region.

The higher content of organic matter in the soil, the higher content of N-total. Nitrogen is one of the important elements that indicate the level of soil fertility. Kushartono (2004) describes the total-N content in the soil is less than 0.01% is an indication of very infertile soil, total-N content between 0,11- 0,15% is an indication of poor soil, and total-N content ranges from 0 , 16 - the 0.20% is an indication of infertile land, while the content of the N-toal> 0.21% is an indication of very fertile soil. Based on substrate criteria in the Sungai Barong Kecil region shows good substrate for supporting the growth of mangroves. The content of magnesium with a value of 0.2% supporting to fertility (Salisburry and Ross, 1985).

Deficiency Mg, P, K, and Ca causing chlorosis, leaf blush, as well as the ends and edges of the leaves are rolling. Deficiency of P causes the canopy becomes dark

green, red or purple (Lakitan, 2010). Physiological disorders is not found in mangrove vegetation was observed. This suggests that the nutrient content of Mg and P were in sufficient quantities. Lakitan (2010) describes phosphorus and magnesium are very important in the chain of nucleotides, an important role in the dark reactions of photosynthesis, respiration, and other metabolic and membrane-forming phospholipids. Clay is a substrate that contains elements of P less than other types of substrates.

Based on the characteristics of the substrate and the organic material was observed in the area of research known that mangrove *Avicennia marina* is dominant and is found in all levels of life. While the types of *Avicennia alba* is a distribution of vegetation with the least. *Avicenni*a spp. usually grow well in coastal areas, have a strong root system, grows in mud substrate with a high salt content. This is consistent with the explanation Arief (2003) which states Avicennia zone grows in the outermost layer of mangrove forests or coastal, has very strong roots that can survive the pounding waves.

CONCLUSION

Distribution of mangrove species is influenced by the distribution of substrat particles. Particle size finer substrats contain higher organic matter, and is characterized by the growth of mangrove better and more diverse. Sungai Barong Kecil tend to have a much smoother distribution of substrat particles (clay and dust) that has a more diverse species of mangrove (*Avicennia marina*, *Avicennia alba*, *Avicennia officianalis*, and *Rhizophora mucronata*), and *Avicennia marina* is the dominant species.

ACKNOWLEDGEMENTS

This research was funded by the Fundamental Research Grant with contract number : 211/UN9.3.1/LT/2014

REFERENCE

Affandi, KA dan Heron S. 2012. Distribusi Sedimen Dasar di Perairan Pesisir Banyuasin, Sumatera Selatan. *Maspari Journal*. Vol 4(1) : 33-39.

Arief A. 2003. *Hutan Mangrove Fungsi Dan Manfaatnya. Kanisius.* Yogyakarta : 47 hlm.

Badan Pusat statistik Banyuasin [BPS]. 2013. *Banyuasin Dalam Angka*. BAPEDDA dan PM Kabupaten Banyuasin. 406 hlm

Gunarto. 2004. Konservasi Mangrove Sebagai Pendukung Sumber Hayati Perikanan Pantai. *Jurnal Litbang Pertanian*. Vol 23 (1) : 56-63.

Indriyanto. 2010. *Ekologi Hutan*. Jakarta. Bumi Aksara : 210 hlm.

Kusmana C. 1997. Metode Survey Vegetasi. Bogor. ITB : 55 hlm.

Khatib A, Yolly A, dan Angga EW. 2013. Analisis Substratasi dan Alternatif Penanganannya di Pelabuhan Selat Baru Bengkalis. Konferensi Teknik Sipil 7. UNS : Surakarta**.**

Noor, RY., M. Khazali, dan I N.N. Suryadiputra. 1999. *Panduan Pengenalan Mangrove di Indonesia*. PHKA/WI-IP. Bogor : 220 hlm.

Nontji A. 2005. *Laut Nusantara*. Jakarta. Djambatan : 372 hlm.

Nugroho RA, Sugeng W, Rudhi P. 2013. Studi Kandungan Bahan Organik dan Mineral (N, P, K, Fe dan Mg) Sedimen di Kawasan Mangrove Desa Bedono, Kecamatan Sayung, Kabupaten Demak. *Jurnal Of Marine Research*. Vol 2 (1) : 62-70.

Poerbandono dan Eka D. 2005. *Survei Hidrografi*. Bandung. PT. Refika Aditama : 166 hlm.

Suroso, M. Ruslin A. dan M. Candra R. 2007. Studi Pengaruh Substratasi Kali Brantas Terhadap Kapasitas dan Usia Rencana Waduk Sutami Malang. *Jurnal Rekayasa Sipil*. Vol 1 (1) : 33-42.

Susiati, H dan Antonius BW. 2008. Studi Awal Pemanfaatan Citra Satelit untuk Identifikasi Distribusi Sedimen di Perairan Semenanjung Muria. *Prosiding Seminar Nasional ke-14 Teknologi dan Keselamatan PLTN Serta Fasilitas Nuklir* ISSN : 0854 - 2910 hal 357-365.

Suwignyo RA, Munandar, Sarno, T.Z. Ulqodry dan E.S. Halimi. 2011. *Pengalaman Pendampingan dalam Pengelolaan Hutan Mangrove pada Masyarakat.* Fakultas Pertanian dan FMIPA Universitas Sriwijaya. Balai Pengelolaan Hutan Mangrove Wilayah II Direktorat Jenderal Bina Pengelolaan Daerah Aliran Sungai dan Perhutanan Sosial, Kementerian Kehutanan, Palembang. 22 hlm.

Wahyudi dan Dikor J. 2004. Studi Simulasi Substratasi Akibat Pengembangan Pelabuhan Tanjung Perak Surabaya. *Jurnal Teknologi Kelautan*. Vol 8 (2) : 74-85.

Wibisono, M.S. 2011. *Pengantar Ilmu Kelautan.* Jakarta. UI-Press : 259 hlm.

Widjojo, JB S. 2010. Transportasi Sedimen Oleh Kombinasi Aliran Permanen Beraturan dan Gelombang Seragam. *Media Teknik Sipil*. Vol X : 75.

Tuheteru, FD dan Mahfudz. 2012. *Ekologi, Manfaat & Rehabilitasi, Hutan Pantai Indonesia.* Balai Penelitian Kehutanan Manado. Manado, Indonesia. 178 hlm.