The International Journal of Social Sciences World
TIJOSSW is Available Online at:
https://www.growingscholar.org/journal/index.php/TIJOSSW
Vol. 2 No. 01, June 2020, pages: 95~102
DOI: https://doi.org/10.5281/zenodo.3964175
ISSN **2690-5167**
Growingscholar Publisher

The Vegetation of Mangrove Forest in *Mandeh* Bay, West Sumatera- Indonesia

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Article history:
Received: April 24th, 2020, **Accepted**: May 21st, 2020, **Published:** June 30th, 2020

Keywords

Mangrove;
Indonesia;
Mandah Bay;
West Sumatera;
Vegetation Analysis;

Abstract

Due to the lack of scientific, environmental information, the area of mangrove forest in *Mandeh* bay, West Sumatra- Indonesia, is threatened to a destructive purpose. Therefore, the analysis of Mangrove vegetation is important to be conducted. In the analysis, We used belt transect to gather structural data and aerial photographic using UAV for spatial data. We measure IVI (Important Value Index) to analyze composition and structure, Diversity Index (Shannon-Wienner) to calculate diversity. As the results, it is revealed that the species composition and structure of *Bukik Ameh* mangroves consists of four family, four genus, five species, and 54 individual. Moreover, it has a pole with six families, eight genera, nine species dan 840 individual. It also has trees with six families, eight genuera, nine species and 644 individual. Also, the family of *Rhizophoraceae* were dominated by trees, pole and seedling. The first transect has six zonation pattern, i.e. zone *Schyphyphora hydropillaceae,* zone *Bruguiera gymnorhyza,* zone *Rhizophora mucronata,* zone *Avicennia alba, and* zone *Rhizophora apiculata*. The second and the third transect have three-zone pattern, namely zone *Schyphyphora hydropillaceae, Rhizophora mucronata, a*nd *Rhizophora apiculate.* The finding is proposed as documentation to be kept, and if possible, to be preserved by the local government.

1. Introduction

Mangroves can generally be found on coastal plains, including estuary areas, delta areas and other sediment fields. Mangroves can only grow confined to a narrow elevation range in tides (McKee et al. 2012). This suitable range of intertidal habitats is called growth space accommodation. It is a functional stage and

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geomorphological complexity of the sedimentary system. The distribution of coastal mangroves changes over time, involving a balance between the addition of sediment or substrate, the increase and decrease of the coastline, erosion, stabilization of vegetation, mangrove productivity and decomposition and the influence of ocean waves (FitzGerald et al. 2008).

Mangrove vegetation typically shows a zoning pattern. Some experts claim that it is closely related to the type of soil or substrate (mud, sand or peat), dealing with the sea (against the waves of the sea), salinity and the effects of tides. Most mangroves live and grow well on muddy substrates, especially in areas where silt accumulates with anaerobic soil reactions. Mangroves are scattered throughout tropical and subtropical oceans and only grow on beaches that are protected from ocean waves directly (Chapman, 1977; Bunt & Williams, 1981). Mangroves include trees and shrubs that colonize the intertidal zone of the upper coastline along tropical and subtropical coastlines. This plant has certain morphological, physiological and reproductive adaptations that allow it to grow in conditions that are high in salinity and lack of dissolved oxygen. Some mangroves that grow on the beach directly facing the sea are directly affected by sea wave activity. However, most mangroves in protected and muddy locations grow well which are sometimes inundated by tides (Giri et al., 2011).

Mangrove ecosystem in Indonesia are in critical condition due to almost 5.9 Mha from 8.6 Mha are damaged. The current mangrove ecosystems in Indonesia, approximately 2.7 Mha are in good condition (Mukhtar et al., 2017). This good condition mangrove area can also be found at Bukik Ameh, Mandeh Bay, West Sumatra and consist of 1642 ha areal. Due to the lack of scientific, environmental information on this area, it is important to understand the mangrove zonation pattern and their vegetation as consideration toward environmental policies and development.

Mangroves in Sumatera are divided into four zones. The front zone is an area directly facing the sea. Moreover, the types of mangroves can adapt to high salinity and sand substrate dominated by genus *Avicennia* and *Sonneratia*. The middle zone, this zone has the characteristics of being protected from waves and thick mud. This zone generally develops in large intertidal areas, which are flooded at high tide and not flooded at low tide, dominated by the genera *Rhizophora*, *Ceriops* and *Bruguiera*. The rear zone is a zone that is located in the deepest and directly adjacent to the mainland. This zone is also a transition zone between mangrove forests and coastal forests. The back zone is dominated by *Ceriops tagal* and *Lumnitzera* sp. Zones which are affected by freshwater, are associated mangroves, also referred to as transitional zones between plants that live in saltwater and freshwater. Species commonly found are *Pandanus odoratissima, Lumnitzera racemosa,* and *Xylocarpus moluccensis* (Kusmana, 2010).

Mangrove zoning patterns along the intertidal zone provide an excellent environment for studying the ecology of coastal vegetation. Some of the environmental factors observed can affect several mangrove conditions including, the spatial distribution of mangrove plants, mangrove zoning, the succession of mangrove plants due to land development, responses to different geomorphological, physiological adaptations to environmental gradients, dispersal or fruit dispersal, intertidal zone differentiation, threats from animals such as mangrove crabs and competition between species (Rivera-Monroy et al., 2004).

Tomlinson (1986) defines that zoning, as a series of vegetation, is formed along with the development of mangrove forests. Local environmental factors such as salinity, sedimentation, pH and temperature determine the condition of mangroves. Variations in environmental factors and their fluctuations greatly determine the survival or death of mangrove individuals. As a result, biodiversity is very low because only a few plants tolerate salinity, temperature, tidal frequency, sedimentation and soil chemistry. In addition, the diversity of mangrove species is highly dependent on the adaptation of the species and the improvement of community stability, as well as the age of the mangrove.

2. Materials and Methods

2.1 Study Site

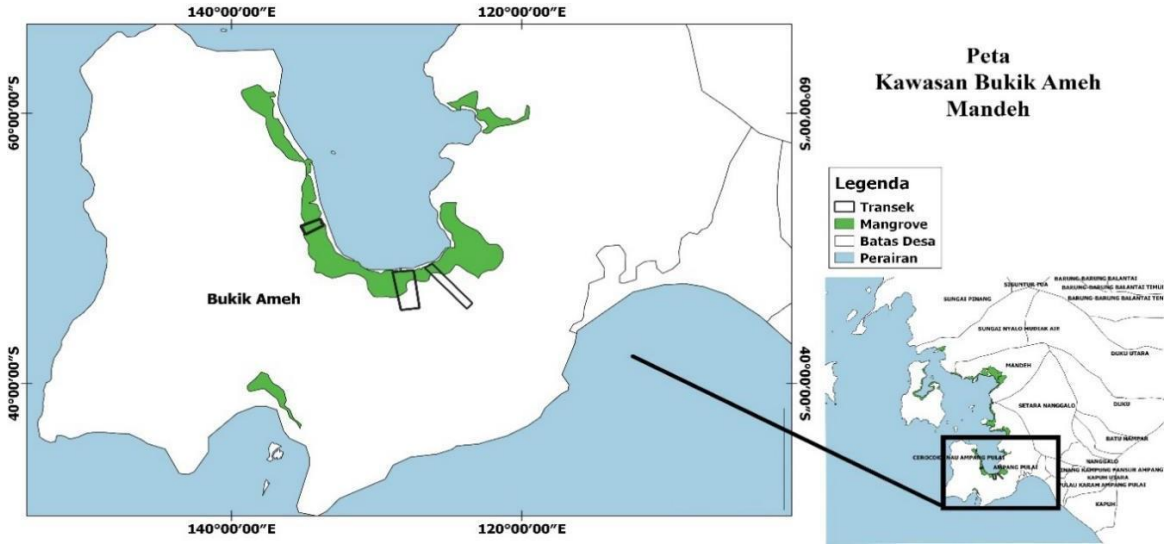


Figure 1. Location of the study area at Bukik Ameh, Mandeh Bay, West Sumatra, Indonesia

The mangrove vegetation area of Bukik Ameh was located in Districts Koto XI Tarusan, West Sumatera. This area is around Carocok Bay near Port of Tarusan, Mandeh (S 1°13'18" E 100°23'24") has a wide area of ± 5,794.89 km^2 or 13.70% of the total area of West Sumatra Province, including around 25 islands (small), and a wide area (sea) ± 84,312 km^2 with a beach length of ± 234 km which has 47 small islands with an area of ± 1212.67 km^2. It is located 50 km south of the provincial capital, city of Padang, West Sumatra, Indonesia.

2.2 Sampling Procedure

Quadrat method was used for the structural analysis of mangrove. The observation plot was made of 3 lines with different distances. Each plot measured 10 x 10 m for trees, 5 x 5 m for a sapling and 2 x 2 m for the seedling. In each plot, we measured the diameter at breast height (DBH, 1.3 m above the substrate). In each plot, species density, frequency and dominance were calculated according to Muller-Dombois and Ellenberg. All data is recorded in the tally sheet that has been made. As for species that have not been identified to be sampled for further identification in Herbarium, Department of Biology, University of Andalas and matched with herbaria are existing mangrove plants.

2.3 Data Analysis

The importance value index (IVI) was calculated by adding the values of relative density, relative frequency, and relative basal area. The Importance Value Index (IVI) which indicates the structural importance of each species in the community was obtained by adding the percentage values of Relative Frequency (RF), Relative Dominance (RDom) and Relative Density (RD), where:

RF = (Number of occurrence of the species/Number of occurrence of all the species) x 100 %
Rdom = (Total basal area of the species/ Total area of all the species) x 100 %
RD = (Number of individuals of the species/Number of individuals the species) x 100 %

$$H' = -\sum_{i=1}^{s} Pi \ln Pi \qquad Pi = \frac{ni}{N}$$

H' = Spesies diversity, ni = importance a species, N = Importance Value All Spesies

3. Result and Discussion

3.1 Species Composition

Species found all growth category (tree, sapling and seedling) were *Rhizophora apiculata* and *Rhizophora mucronata*. The detail of species composition shown in Table 1. The mangroves in Bukik Ameh comprised nine species under 11 genera belonging to 6 families and 1.538 individual. The species identified were *Rhizophora apiculata* Blume., *R. Mucronata* Poir, *Avicenia alba* Blume., *Schyphiphora hydropillaceae* C.F.Gaertn., *Lumnitzera littorea* Jack., *Bruguiera gymnorrhiza* (L.) Lamk., *Sonneratia alba* J.Sm., *Xylocarpus granatum* J.Koenig., *Ceriops tagal* (Perr.).

Table 1: Spesies composition of mangrove forest in Bukik Ameh

Family	Genus	Spesies	Transect 1			Transect 2			Transect 3		
			T	Sp	Sd	T	Sp	Sd	T	Sp	Sd
Rhizophoraceae	Rhizophora	*R. apiculata*	0	0	0	0	0	o	0	0	0
		R. mucronata	0	0	0	0	0	0	0	0	0
	Ceriops	*C. tagal*	0	0	-	-	-	-	-	-	-
	Bruguiera	*B. gymnorrizha*	0	0	-	-	-	-	-	-	-
Sonneratiaceae	Avicenia	*A. alba*	0	0	0	0	0	0	0	0	-
Rubiaceae	Scyphyphora	*S. hydropillaceae*	0	0	-	0	0	0	0	0	-
Combreraceae	Lumnitzera	*L. littorea*	0	0	-	0	-	-	0	-	-
Lythraceae	Sonneratia	*S. alba*	0	0	-	-	0	0	-	-	-
Meliaceae	Xylocarpus	*X. granatum*	0	0	-	-	-	-	-	-	-

Note: T= Tree, Sp = Sapling, Sd = Seedling, O = Found, - = Not Found

Table 2: Comparison tree species composition of Bukik Ameh, Mandeh Bay to another mangrove forest

No.	Location	Number Family	Number Genus	Number Species	Sources
1.	Bukik Ameh, Mandeh Bay	6	8	9	This research, 2020
2.	Mandeh Forest Bay	6	8	9	Mukhtar, 2017
3.	Karimunjawa National Park	3	4	5	Hartoko *et al*, 2015
4.	Kuala Selangor, Malaysia	6	6	8	Zhila *et al*, 2014
5.	Pagai, Mentawai	5	5	7	Afriandi, 2011
6.	Sematan, Serawak	9	12	18	Ashton and Machintosh, 2002

3.2 Structure Important Value Index

The result of the analysis of vegetation plant species revealed a structural analysis of mangrove of Bukik Ameh. It is revealed that *Rhizophora apiculata* is the highest species.

Tabel 3: Important Value Index (IVI) of mangrove forest in Bukik Ameh

Species	Important Value Index (%)		
	Bukik Ameh		
	Trees	Saplings/Poles	Seedlings
Rhizophora apiculata	224	385	291

Rhizophora. mucronata	178	285	217
Ceriops tagal	4	6	-
Bruguiera gymnorrizha	53	43	-
Avicennia alba	227	117	51
Scyphiphora hydropillaceae	164	29	10
Lumnitzera littorea	31	1	-
Sonneratia alba	8	18	29
Xylocarpus granatum	12	11	-

Based on IVI then obtained species *Avicennia alba* will dominate location for trees stage followed in a row by species *Rhizophora apiculat, Rhizophora mucronata,* dan *Scyphiphora hydropillaceae*
From the table above it can be seen that the mangrove community for sapling growth rates in Bukik Ameh is composed of 9 species of mangroves, as well as the level of trees. *Rhizophora apiculata* is the most dominant type, found as many as 388 individuals with an IVI of 385.91%. Then followed by *Rhizophora mucronata* found as many as 250 with an IVI of 285.52. At the same time, the lowest IVI is owned by *Lumnitzera littorea*, which is 1.89% because only 1 individual was found.

Rhizophora apiculata is the dominant species at the level of the sapling, due to the large number and environmental factors that support the growth of this species. *Rhizophora apiculata* can compete to obtain more nutrients than other types so that the volume of the stem is large enough and the broad canopy causes a higher level of mastery than other types. The dominance of mangrove species is different from each in an area if the size of the trunk that is getting bigger will expand its dominance (Mukhtar, 2017).

3.3 Community Structure (With Spatial Data)

The species diversity index value for the tree category (H'= 4.33), tillers category (H' = 3.51) and tillers category (H '= 3.08). According to Maguran (2004) if H '<1 means low species variation, if 1 ≤ H' ≤ 3 means various types are medium if H '>3 means various types are high. Overall, the highest value of mangrove species in Bukik Ameh is included in the height category in the level of trees, saplings and seedlings.

3.4 Diversity Pattern

Diversity pattern mangrove in Mandeh Bay scatters design (Fig.2 (a) and (b)) with dominated by species *Rhizophora apiculata.* The highest mangrove diversity index at each growth level is in Bukik Ameh, and this is related to the extent of the research area which reaches 1 hectare and the number of species and individuals found at this location. In Carocok Tarusan found ten species of mangroves, in the village of Mandeh, found five species of mangroves, on Cubadak Island only found four species of mangroves and in the Kapo-kapo Bay found six species of mangroves. High species diversity is an indicator of the stability or stability of an environment.

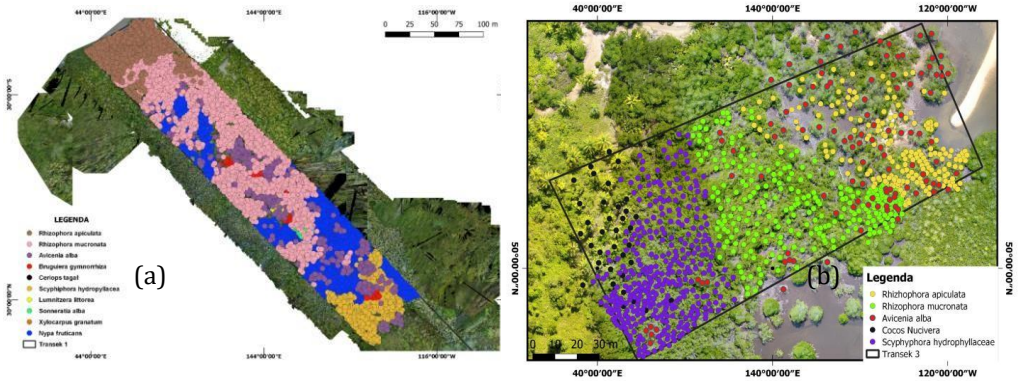


Figure 2. Diversity pattern of Mangrove in Mandeh Bay of transect 1 (a) and transact 3 (b)

High stability indicates high complexity. It is due to the high interaction so that it will have a higher ability to deal with interference with its components. If the diversity index is stable, then each species will have the opportunity to be able to carry out a more orderly, efficient and productive life cycle. By paying attention to the diversity in the community, it is obtained a picture of the maturity of organism in the community. As a result, it is known that the diversity is high.

3.4 Spatial Variation of Floristic Distribution

In the first transect, there are nine mangroves, namely *Rhizophora apiculata, Rhizophora mucronata, Avicennia alba, Scyphyphora hydropillaceae, Lumnitzera littorea, Bruguiera gymnorrizha, Sonneratia alba, Xylocarpus granatum, Ceriops tagal.* In the first transect there are 6 clear mangrove zoning. In the first zone (I) by the Schyphiphora hydropillaceae zone, the second zone (II), the *Bruguiera gymnorriza* zone, the third zone (*Rhizophora mucronata* and the fourth zone (IV), the *Avicenia* alba zone, the fifth zone (V), the *Rhizophora mucronata* zone, and the *Rhizophora mucronata* zone, and the fourth zone (IV). The six (VI) type is Rhizophora apiculata.

In transect two, it is found five types of mangroves, namely *Rhizophora apiculata, Rhizophora mucronata, Avicennia alba, Scyphyphora hydropillaceae* and *Lumnitzera littorea*. The third zonation mangroves in the first zone (I) is *Schyphipora hydropillace* which is a mangrove that grows predominantly along the pituitary river almost to the endless freshwater river until the river is almost waterless. In the second zone (II), *Rhizophora mucrona* is one of the most important and most widespread mangrove species and dominates 90% of the total mangrove ecosystem found on the west coast of the island of Sumatra (Kordi, 2012). In the third zone (III), the type is *Rhizophora apiculata*.

In transect three, it is found five mangrove species, namely *Rhizophora apiculata, Rhizophora mucronata, Avicennia alba, Scyphyphora hydropillaceae* and *Lumnitzera littorea*. The structure of zonation in transect three is the same as trancest two. It, usually, consists of *Schyphipora hydropillaceae* zone, *Rhizophora,* and *Rhizophora aphata*.

4. Conclusion

The assessment of the species composition and structure of Bukik Ameh mangroves revealed for seedling consists of four family, four genus, five species, and 54 individual. Moreover, it has a pole with six families, eight genera, nine species dan 840 individual. It also has trees with six families, eight genuera, nine species and 644 individual. Also, the family of *Rhizophoraceae* were dominated by trees, pole and seedling. The first transect has six zonation pattern, i.e. zone *Schyphyphora hydropillaceae,* zone *Bruguiera gymnorhyza,* zone *Rhizophora mucronata,* zone *Avicennia alba, and* zone *Rhizophora apiculata*. The second and the third transect have three-zone pattern, namely zone *Schyphyphora hydropillaceae, Rhizophora mucronata, an*d *Rhizophora apiculata***.**

References

Afriandi, R. (2011). Komposisi dan Struktur Hutan Mangrove Sejati di Kecamatan Sikakap, Pulau Pagai Selatan, Kabupaten Kepulauan Mentawai. Skripsi Sarjana Biologi. Universitas Andalas.

Ashton, E.C and D.J. Macintosh. (2002). Preliminary assessment of the plant diversity and community ecology of the Sematan mangrove forest, Sarawak, Malaysia. *For. Eco. Man*. 166: 11-129

Bunt, J.S dan W.T Williams, (1981). Vegetational Relationship in The Mangroves of Tropical Australia. Marine Ecology Progress Series. 4, pp. 349-359.

Chapman, V. J. Editor. (1977). West Coastal. *Ecosystems of The World: 1*. Elsevier Scientific Publishing Company.

FitzGerald, DM, Fenster MS, Argow BA, Buynevich IV. (2008). *Coastal impacts due to sea-level rise. Annu.Rev. Earth Planet. Sci.* 36:601–47.

Giri C, Ochieng E, Tieszen LL, Zhiu Z, Singh A, et al. (2011). *Status and distribution of mangrove forests of the world using earth observation satellite data*. *Glob. Ecol. Biogeogr.* 20:154–59

Hartoko, A; S. Chayaningrum; D.A. Febrianti; D. Ariyanto and Suryanti. (2015). Carbon Biomass Algorithms Development for Mangrove Vegetation in Kemujan, Parang Island Karimunjawa National Park and Demak Coastal Area, Indonesia. *Procedia Environmental Sciences* 23 (2015) 39 – 47. IPB. Bogor

Kordi, K.M. (2012). Ekosistem Mangrove: potensi, fungsi dan pengelolaan. Rineka Cipta. Jakarta

Kusmana, C. (2010). *Respon Mangrove Terhadap Pencemaran.* Fakultas kehutanan

McKee KL, Rogers K, Saintilan N. (2012). *Response of salt marsh and mangrove wetlands to changes in atmospheric CO2, climate, and sea level*. In *Global Change and the Function and Distribution of Wetlands*, ed. BA Middleton, pp. 63–96. New York: Springer

Mukhtar, E., Rahmi, F.Y., Okdianto, I., Novarino, W., Syamsuardi & Chairul. (2017). Ecological Study of Mangrove Forest in Mandeh Bay, West Sumatra, Indonesia: I. Structure and Composition of True Mangrove. *RJPBCS*. 8(2) : 107-111

Rivera-monroy, v. H., r. R. Twilley, e. Medina, e. B. Moser, l. Botero, a. M. Francisco, and e. Bullard. (2004). Spatial variability of soil nutrients in disturbed riverine mangrove forests at different stages of regeneration in the San Juan River Estuary, Venezuela. Estuaries 27:44–57

Tomlinson, PB. (1986). The Botany of Mangroves. Cambrige University Press. Massachusetts.

Zhila, H; M. Z. Rozainah and H. Mahmood. (2014). Biodiversity and biomass of a natural and degraded mangrove forest of Peninsular Malaysia. *Environ Earth Sci* (2014) 71:4629–4635

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