Mangrove Species Diversity, Stand Structure, and Zonation — A Case Study at Pahawang Kecil Island

Rizka Nabilah¹, Fajar Islam Sitanggang², Yeni Rahayu²

¹ Landscape Architecture, Institut Teknologi Sumatera, Lampung Selatan, Indonesia
² Biology, Institut Teknologi Sumatera, Lampung Selatan, Indonesia

Email: rizka.nabilah@arl.itera.ac.id

Abstract. Pesawaran Regency is an administrative area of Lampung Province which has the potential marine tourism with mangrove resources in Pahawang Kecil Island. Pahawang Kecil island is a coastal natural tourist destinations located in Punduh Padada District, Pesawaran Regency. The mangrove ecosystem is a community of mangrove vegetation associated with fauna and microorganisms. There are various components of life in the ecosystem. In addition, the main function of mangroves is to protect stability of the shoreline from sea waves. In fact, the conversion of mangrove ecosystems become a tourist area and fish pond area continues. This impact to the local government and community members to rehabilitation mangroves. However, this preventive activity to rehabilitation are failed. This failure caused by not according to the mangrove planting area. Planting mangrove is not in the green belt area. Thus, it is necessary to have a preliminary study of landscape typology mangrove vegetation. In accordance with the presidential regulation Number 37 of 2012 which explains that the preservation of mangrove ecosystems is by accommodating deep mangrove ecosystems Regional Spatial Planning and zoning of coastal areas and small islands. The purpose of this study was to identify the condition of mangrove vegetation and create the mapping typology of mangrove vegetation on Pahawang Kecil Island. The research was carried out on vegetation parameters using the combination method of lines and checkered lines with measurement of diameter, height and number of individuals. In addition, measurements of the inundation height of each were carried out in research sites. Pahawang Kecil has the Rhizophora stylosa species with the highest volume level of mangrove vegetation, namely 3.2538.15 m³ / ha. The location of Pahawang Kecil Island was identified in 10x10 meter dominance species mangrove Rhizophora stylosa with a relative density with a value of 94.12%, relative frequency value of 8.47%, and an important value of 105.96%.

Keywords : mangrove, Pahawang Kecil Island, Rhizophora stylosa, species, vegetation.

1. Background

Maritime tourism is an industry that development in Lampung province. Based on the Provincial Strategic Plan for Tourism and Creative Economy, Lampung has 7 Tourism Leading Areas, one of which is the Pahawang Island Tourism Area. The landscape visits of both domestic and foreign tourists to Lampung Province in 2016 reached 7.5 million people. Increased tourist visits to a number of destinations tourism in Lampung by 35.8% until November 2016 [1]. Mangrove forest ecosystem in Lampung mostly as a result of conversion become an tourism site. (Ariditria et al., 2014 reported in Maringgai district, East Lampung, the economic value of mangrove forests is around 10 billion rupiah per year. The increasing number of tourists visiting has led to the opening of areas for
tourism. One of the impacts is the conversion of mangrove areas into tourist areas. With the occurrence of this, makes the mangrove area reduced, so it will raises various problems. One of the effects is a reduction in the barrier area beach waves. The scale of the trees closest to the edge of the beach mass is greater potential to dampen wave fluctuations [3]. Mangrove forests in Sumatra are spread across almost the entire East coast, including Lampung. The length of the Lampung coastline is approximately 1,150 km and has approximately 69 islands [4]. Mangrove forests and coral reefs and seagrass meadows Lampung can be found mainly in the West Coast, Semangka Bay, Lampung Bay, Strait Sunda, and the East coast. Pesawaran Regency also has great potential to become an ecotourism site because it has 22 types of mangroves, major, 4 minor mangrove species, and 8 associated mangrove species [5]. Island Village Pahawang, Pesawaran District, has a systematic development of mangrove forest areas which is quite neatly arranged in terms of administration, regulation and activities. This is because of the forest mangroves on Pahawang Island have experienced a significant decrease due to this destruction and exploitation of land in 2006 [6]. Biggest variety in the composition of the mangrove community is the distribution pattern of species across the zone intertidal which varies substantially between geographic areas. Mangrove zoning abnormal indicates an unstable ecosystem condition [7]. According to Law number 27 of 2007 concerning Management of Coastal Areas and Small islands state that the carrying capacity of the coastal area is the ability to support the life of humans and other living creatures. Besides, it has a function ecosystem ensures the existence, availability, and sustainability of Coastal Resources with still maintain and improve the quality of value and diversity. Mangrove ecosystem is a habitat that is important in nutrient recycling and carbon exchange, in addition important for the life of pisces and crustaceans [8]. Ecologically mangrove ecosystems also have different functions strong as a food chain in aquatic ecology.

The specific objective of this research is to identify the condition of mangrove vegetation in Pahawang Kecil Island, South Lampung Regency, Lampung Province. The urgency of this research as a guide map for the condition of mangrove vegetation on Pahawang Island. Mapping knowledge according to the area, can provide planting information on the green belt area or green belt for planting mangroves properly. Mangrove restoration is an important strategy to reverse the decline in mangrove areas and rebuild ecosystem services mangroves that are lost due to degradation. Therefore, it is necessary to have condition information vegetation in accordance with the mangrove area on Pahawang Kecil Island.

2. Research Methodology

Field data collection by measuring stem diameter, tree height, number of individuals, vegetation conditions, and environmental data. Observation of mangrove vegetation conditions using the lanes and checkers method. The route method distance is 50 m. Observation of mangrove zoning types will be carried out on a representative part of the transect. Transect method to be carried out in accordance with the vegetation data from image.
Image information about plot design of vegetation data collection in the field (Figure 1) Plot size 2x2 m to measure seedlings of understorey vegetation, shrubs and herbs using plant diameter <2 cm. Plot size 5x5 m for vegetation measurement at shrub level with data collected in the form of the number of individuals, diameter and height of trees with a diameter of 2-10 cm. Plot size 10X10 m for measurement of tree level vegetation with data collected in the form of the number of individuals, diameter, and tree height of woody plants with a diameter criteria above 10 m.

2.1 Vegetation Condition Data

Vegetation analysis data carried out in the field is processed into INP data (Value index). The vegetation data used are the relative density (KR), relative frequency (FR) and relative dominance (DR) of a species in the area. The vegetation count was carried out with the formula:

a. Density : Number of individuals..............................................(1)
   Plot area

b. Relative density : Relative species x 100%
   Density of all species.........................................................(2)

c. Frequency : Number of plots occupied by the species
   ...........................................................(3)

d. Relative frequency : Number of plots occupied by the species x 100%
   Number of all plots occupied by the species..................(4)

e. Dominance : Basal area of the species
   ...........................................................(5)
   All of area

f. Relative dominance : Basal area of the species x 100%
   ...........................................................(6)
   All of area

g. Value index : Relative density + Relative frequency + Relative dominance.................(7)

3. Results and Discussion

Based on the data (Table 1.) Rizophora stylosa in 2x2 meter have 67.57% density relative, 6.78% frequency relative, 8.44% dominace relative, and 82.79% value index. Plot 5x5 meter have have Rizophora stylosa 24.24% density relative, 8.47% frequency relative, 48.25 % dominace relative 48.45, and 80.96 % value index. Plot 10x10 meter have have Rizophora stylosa 94.12% density relative, 8.47% frequency relative, 3.38 %, and 105.96 % value index. Mangrove forest is a forest type that grows in tidal areas (especially sheltered beaches, lagoons, river estuaries) that are inundated at high tide and are free inundation at low tide where the plant community is tolerant of salt [9]. Mangrove ecosystems play a very important role in three main functions, namely functions economic, social and ecological functions [10]. Several ecological functions of the ecosystem The main mangroves include shelter, nesting and natural habitat various types of biota, germplasm sources, foraging areas, reproductive zones of biota, and marine biota spawning grounds [11]. In its function as a food chain, the mangrove ecosystem can support the life of various kinds of aquatic living things, in including blood clams, Polymesoda erosa, great egret, and other aquatic animals [12]. Decrease in area and quality mangrove land will have a negative impact on the surrounding environment from an ecological, economic, and social communities around. The high degree of population differentiation between regions and low genetic variation within populations recorded here highlights
the need for appropriate conservation measures for this species, both in terms of incorporating further populations into protected areas, and the restoration strategies for separate regions.

Table 1. Density relative, Frequency relative, dominance relative, and value index

| Plot (meter) | Species          | Density relative (%) | Frequency relative (%) | Dominance Relative (%) | Value index (%) |
|-------------|------------------|----------------------|------------------------|------------------------|-----------------|
| 2 x 2       | *Rizophora stylosa* | 67.57                | 6.78                   | 8.44                   | 82.79           |
| 5 x 5       | *Rizophora stylosa* | 24.24                | 8.47                   | 48.25                  | 80.96           |
| 10 x 10     | *Rizophora stylosa* | 94.12                | 8.47                   | 3.38                   | 105.96          |

*Rizophora stylosa* and *Rizophora mucronata* are the dominant species in Pahawang Kecil. *Rizophora stylosa* has a volume of 9.76 m³. *Rizophora mucronata* has a volume of 0.76 m³ (Table 2).

Table 2. Volume of Mangrove Species

| Location         | Species           | Volume (m³) | Volume (m³/ha) |
|------------------|-------------------|-------------|----------------|
| Pahawang Kecil   | *Rizophora stylosa* | 9.76        | 3.2538.15      |
|                  | *Rizophora mucronata* | 0.76      | 2.550.93       |

![Figure 2. Mangrove Volume in Pahawang Kecil (m³/ha)](image)

Volume mangrove in Pahawang Kecil is 93% *Rizophora mucronata* and 7% *Rizophora stylosa* (Figure 2). In Pahawang Kecil, *Rizophora stylosa* volume about 3.2538,15 m³/ha and *Rizophora mucronata* about 2550.93 m³/ha (Tabel 2) Pahawang Kecil has the *Rhizophora stylosa* species with the highest volume level of mangrove vegetation, namely 32538.15 m³ / ha. The high density of mangrove vegetation indicates that the vegetation community is in an undisturbed condition [13]. The value of mangrove habitat needs to be integrated into land use planning in environmental decision making. Changes in land use of mangrove habitats are used as an indicator of
environmental quality, for example these changes can affect soil microbial biomass [14]. Rainfall that increases slowly can result in increased growth and biodiversity. Meanwhile, if there is very little rainfall, it will result in a significant decrease in the area of mangrove areas. In addition, if there is less rainfall, it will reduce net primary productivity, nurseries, and the growth of mangrove vegetation. An increase in surface temperature will also affect the phenological dynamics of mangroves [15].

4. Conclusion

Pahawang Kecil has the *Rhizophora stylosa* species with the highest volume level of mangrove vegetation, namely 3.2538.15 m³/ha. The location of Pahawang Kecil Island was identified in 10x10 meter dominance species mangrove *Rhizophora stylosa* with a relative density with a value of 94.12%, relative frequency value of 8.47%, and an important value of 105.96%. The front mangrove zoning is the dominant species in Pahawang Kecil. This means that this area has a high intensity of coastal water area.

5. Acknowledgements

Thank you to simlitabmas program of the Kemenristekdikti, to the finance funding for this research. Thanks to Landscape Architecture and Biology Study Program at Institut Teknologi Sumatera for their support and advice in developing this research. Thank you to the Natural Resources and Environmental Management Study Program of IPB for its assistance in field research and analysis data of mangrove.

References

[1] Badan Pusat Statistik Lampung. 2016. Potensi Pariwisata Bahari. Lampung.
[2] Arifita RI, Qurimi R, Herwanti S. 2014. Nilai ekonomi total hutan mangrove Desa Margasari Kecamatan Labuhan Maringgai Kabupaten Lampung Timur. Jurnal Sylva Lestari, 2(3), 19-28
[3] Mendelsohn, I. A., and McKee, K. L. 2000. Saltmarshes and mangroves, Pp. 501-536. In M. Barbour and W. D. Billings (eds.), North American Terrestrial Vegetation, 2nd edition, Cambridge University Press, Cambridge.
[4] Aswandy I, Pratiwi R. 2010. Keanekearagaman fauna krustasea pada ekosistem lamun Teluk Lampung. Dalam: Pramudji, Fahmi dan Ruyitno (editor) Status sumber daya laut di perairan Teluk Lampung. 40-50. Jakarta: Lembaga Ilmu Pengetahuan Indonesia.
[5] Muklisi B, Hendrarto H, Purnawati. 2013. Keanekearagaman jenis dan struktur vegetasi mangrove di Desa Sidodadi Kecamatan Padang Cermin, Kabupaten Pesawaran, Provinsi Lampung. Prosiding Seminar Nasional Pengelolaan Sumber Daya Alam dan Lingkungan, 218-225. Semarang: Universitas Diponegoro. 19.
[6] Davinsky R, Kustanti A, Hilmanto R. 2015. Kajian pengelolaan hutan mangrove di Desa Pulau Pahawang Kecamatan Marga Punduh Kabupaten Pesawaran. Jurnal Sylva Lestari, 3(3), 95-106.
[7] Suprajaka, Poniman A, Suhartono. 2005. Konsep dan model penyusunan tipologi pesisir Indonesia menggunakan teknologi Sistem Informasi Geografi. Malaysian Journal of Society and Space 1: 76–84.
[8] Woodroffe CD, Lovelock CE, Rogers K (2013) Mangrove shorelines. In: Masselink G, Gehrels R (eds) Coastal environments and global change. AGU WILEY, UK, pp 251–267
[9] Kusmana C, Wilarso S, Hilwan I, Pamoengkas P, Wibowo C, Triyana T, Triswanto A, Yunasfi, Hamzah. 2003. Teknik Rehabilitasi Mangrove. Bogor: Fakultas Kehutanan IPB.
[10] Kustanti A. 2011. Manajemen Hutan Mangrove. Bogor: IPB Press.
[11] Rahmawaty. 2006. Upaya pelestarian mangrove berdasarkan pendekatan masyarakat. [Skripsi]. Medan: Fakultas Pertanian Universitas Sumatera Utara.
[12] Kelana PP, Setyobudi I, Krisanti M. 2015. Kondisi habitat Polymesoda eosa pada kawasan ekosistem mangrove Cagar Alam Leuweung Sancang. Jurnal Akuatika, VI (2), 107-117.
[13] Saputra SE, Setiawan A. 2014. Potensi ekowisata hutan mangrove di Desa Merak Belatung Kabupaten Belitung Selatan. Jurnal Sylva Lestari, 2(2), 49-60.
[14] Li, W., El-Askary, H., Qurban, M. A., Li, J., ManiKandan, K., & Piechota, T. (2019). Using multi-indices approach to quantify mangrove changes over the western Arabian Gulf along Saudi Arabia coast. Ecological Indicators, 102, 734-745. doi:10.1016/j.ecolind.2019.03.047
[15] Alatorre, L. C., Sánchez-Carrillo, S., Miramontes-Beltrán, S., Medina, R. J., Torres-Olave, M. E., Bravo, L. C., … Uc, M. (2016). Temporal changes of NDVI for qualitative environmental assessment of mangroves: Shrimp farming impact on the health decline of the arid mangroves in the Gulf of California (1990–2010). Journal of Arid Environments, 125, 98-109. doi:10.1016/j.jaridenv.2015.10.010