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MANGROVE VEGETATION COMMUNITY STRUCTURE IN PONGKAR VILLAGE, TEBING DISTRICT, KARIMUN REGENCY, KEPULAUAN RIAU PROVINCE

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ABSTRACT

Mangrove is a type of vegetation that grows on muddy soil in tidal areas, around the river estuary, and in tropical coastal areas. To support the success of mangrove forest management, it is important to pay attention to the factors that affect the growth of mangroves. This research was conducted in October – December 2021. The purpose of the study was to determine the type, density value, frequency, and cover of mangrove vegetation and its importance value index in Pongkar Village, Karimun Regency, Kepulauan Riau Province, using survey methods and sampling and measuring environmental quality parameters waters in the field. Based on the result of the research, the types of mangrove vegetation found consisted of 6 species, namely *Avicennia alba, Avicennia marina, Rhizophora apiculata, Rhizophora mucronata, Sonneratia alba*, and *Lumnitzera littorea*. The highest density of mangrove vegetation in the Pongkar Village area is near the Military District Command (Station II) housing with a total density of 1822.22 ind/ha. The highest relative frequency value of mangroves is found in the Pelambung area of *A.alba* species with a value of 40%. The highest relative dominance value of mangroves was found at station II of *S.alba* species with a value of 63.12%. Meanwhile, the highest important value index was found at station II for *S.alba* species with a value of 152.01% and the lowest important value index was *L.littorea* which was found at station I with a value of 12.69%.

Keywords: Mangrove ecosystem, Vegetation, *Sonneratia alba.*

1. INTRODUCTION

Mangrove ecosystems are ecosystems that are located on the outskirts of the coast or river estuaries that are affected by tides, both as natural resources and as environmental protectors. They have a very important role in the economic and ecological aspects of the surrounding environment. In general, mangroves can be found throughout the Indonesian archipelago. Mangroves in Irian Jaya cover about 1,350,600 ha, in Kalimantan 978,200 ha, in Sumatra 673,300 ha, and in several other areas that have areas with beaches that have large and protected rivers[1]. Mangroves are a type of vegetation that grows on muddy soils in tidal boundary areas, around river mouths, and in tropical coastal areas. In general, mangrove vegetation thrives on sloping coastal areas or near river mouths and beaches that are protected from waves[2]. The physical functions of the mangrove ecosystem are to keep the coastline stable, protect the coast from abrasion, and reduce storms and waves, while the function of the mangrove ecosystem biologically is as a spawning ground or place to live, shelter for marine animals such as shrimp, crabs, clams and other animals.

One of the potential forests that can be utilized by the community to fulfill their daily needs is mangrove forests, which are used for mangroves to obtain firewood,

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charcoal, leaves for roofing houses, as well as fishing grounds for fish, shrimp, crabs, shellfish, and others[3].

Human activities in mangrove ecosystem areas can potentially reduce the quality and quantity of mangrove ecosystems such as a decrease in the number of stands and types of mangroves in an area. To support the success of mangrove forest management, it is necessary to pay attention to the factors that influence mangrove growth[4].

Pongkar Village is a village located in Tebing District, Karimun Regency, Kepulauan Riau Province. This village is one of the areas in Karimun Regency which has very large mangrove resources. At present, the mangrove vegetation in Pongkar Tanjung Balai Karimun Village is damaged due to over-utilization activities, such as extracting wood and building residential areas. This will cause pressure on natural resources and mangroves in this area to continue to decrease. Much research on mangroves has been carried out, including by Susilo[5] on the Coast of Menjangan Besar Island, Sitinjak[6] in Mangkapan Village, Sungai Apit District, Siak Regency. Meanwhile, there is no data regarding the structure of mangrove vegetation in the Pongkar Village area. In this regard, the authors are interested in researching the community structure of mangrove vegetation in Pongkar Village, Tebing District, Karimun Regency, Kepulauan Riau Province

2. RESEARCH METHOD

Time and Place

This research was carried out from October to December 2021. Sampling was carried out in Pongkar Village, Tebing District, Karimun Regency, Kepulauan Riau Province (Figure 1). Samples were analyzed at the Marine Biology Laboratory, Department of Marine Science Faculty of Fisheries and Marine, Universitas Riau.

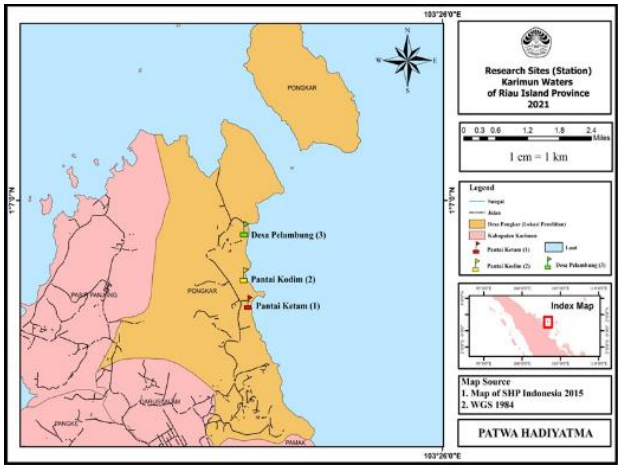

Figure 1. Map of Research Locations

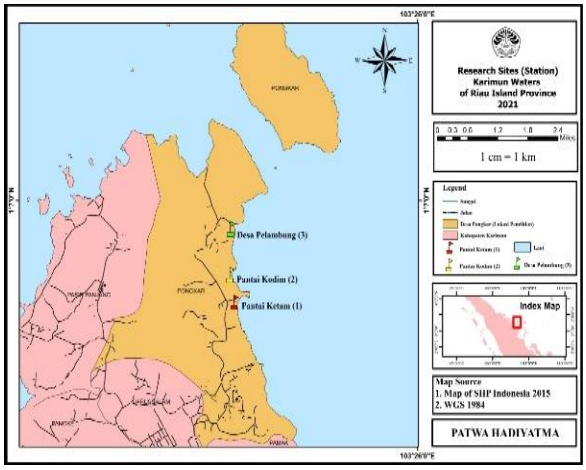

Figure 2. Research Station Map

Procedure

Location Determination

Determination of the sampling point in this study was carried out using a purposive sampling method, namely by looking at the environmental conditions and the presence of mangrove vegetation.

Sampling technique

Data collection procedures and observations of mangrove vegetation following the methods published by Bengen[7]. The complete procedure for observing mangrove forest ecosystems is as follows: At each observation station, determine observation plots/plots measuring 10 x 10 m^2 with a minimum of 3 plots (Figure 3).

In each plot of existing mangrove species, identify and count the number of individuals of each species and measure the trunk circumference of each mangrove tree at breast height (about 1.3 m).

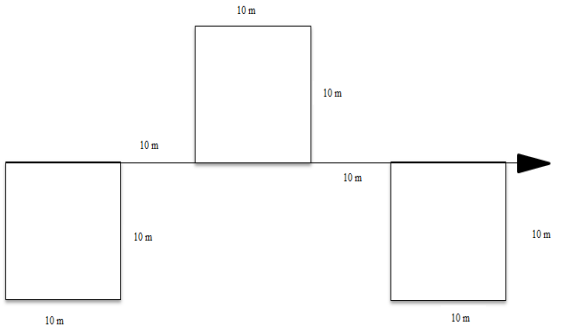

Figure 3. Data Retrieval Scheme

Measurement of Environmental Parameters

Measurement of environmental parameters consisted of measuring temperature using a thermometer, measuring salinity using a hand-refractometer, and measuring pH using pH indicator paper.

Sediment sampling

Sediment sampling to determine the type of sediment and organic matter content was carried out using a PVC pipe with a diameter of 10 cm and a depth of 10 cm. Sampling for sediment types was carried out 3 times in 1 sub-plot ±500 g of sediment samples was taken, then the samples were put into plastic bags that had been labeled.

Data Analysis

Analysis of data on the community structure of mangrove vegetation was carried out to determine the value of species density, relative density, frequency, relative frequency, species coverage, relative coverage, important value index, dominance index, and diversity index (H') with the respective formulas as follows:

Specific Density (Di)

The density of species (Di) is the number of stands of type i in a unit area[8]. Determination of specific density through the formula:

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

Information :

Di = the density of the i-th kind

ni = The total number of individuals -i

A = The total area of the sampling area (m^2)

Relative Density (RDi)

Relative density (RDi) is the ratio between the number of types of stands of type 1 and the total number of stands of all species[7]. Determination of Relative density (RDi) using the formula:

$$RDi = \left[\frac{ni}{\sum n}\right] x\ 100$$

Information :

RDi = Relative Density

ni = Total amount

Σn = Total number of stands of all types

Type Frequency (Fi)

Type frequency (Fi) is the probability of finding an i-th type in all sample plots compared to the total number of sample plots created Bengen[7] to calculate the specific frequency (Fi) the formula is used:

$$Fi = \frac{pi}{\sum f}$$

Information :

Fi = Frequency of the ith kind

pi = Number of sample plots where the i-th type is found

Σf = Total number of sample plots created (9 plots)

Relative Frequency (RFi)

Relative frequency (RFi) is the ratio between the i-th frequency with the sum of the frequencies of all types[7]. To calculate the relative frequency use the formula:

$$RFi = \left[\frac{Fi}{\sum F}\right] x\ 100$$

Information :

RFi = Relative frequency type

Fi = Number of frequencies of the ith

ΣF = Total number of frequencies of all

Closure Type (Ci)

Type closure (Ci) is the area of type i closure in a certain unit area[7]. To calculate the closing type use the formula:

$$Ci = \frac{\sum BA}{A}$$

Information :

Ci = Closure type

Σ BA = πd2/4 (d = trunk diameter at breast height (d = circumference/π), π = 3.14)

A = Total number of sampling areas (m^2)

Relative Closure (RCi)

Relative cover (RCi), namely the ratio between type I closure and the total area of closure for all types[7]. To calculate RCi, the formula is used:

$$RFi = \left[\frac{Ci}{\sum C}\right] x\ 100$$

Information :

RCi = Relative closure type

Ci = Closure of the i-type

ΣC = Total closure for all types

Significant Value Index (INP)

According to Sofian et al.[9], to calculate the importance value index of mangroves using the following formula:

$$INP = RDi + RFi + RCi$$

Information :

INP = Significant Value Index

RDi = Relative Density

RFi = Relative Frequency

RCi = Relative Closure

Sediment Fraction

Sediment fraction analysis used 2 methods, namely the wet sieving method and the pipette method. The multilevel sieve method is used to obtain Ø-1 - Ø7, while the pipette method uses volumetric pipettes to obtain Ø5- Ø7. To analyze the type of sediment fraction in each sub-plot is done by referring to Rifardi[10].

Then the sediment retained on each sieve is put into a container that has been prepared and the weight is known. Sediments retained on the Ø-1 sieve, and Ø0 and Ø1 are gravel fractions, Ø2, 3, and Ø4 are sand fractions, where Ø-1 - Ø4 are analyzed using the multilevel sieve method, while the sediment collected in the final shelter is used to analyze the fraction sludge starting from Ø5 – Ø>7 using the pipette method.

Afterward, the data obtained are tabulated to calculate the percentage of sediment particles. Classification of sediment fractions based on the proportion of particle size particles of gravel, sand, and silt by plotting the percentage value of sediment particles into the Sheppard triangle[10]. To determine the concentration of total organic matter in the sediment is carried out with a formula:

$$Li = \frac{Wo\text{-}Wt}{Wo} x\ 100\%$$

Information:

Li = Organic Matter

Wo = Weight after drying at 105°C/ before burning (g)

Wt = Weight after burning at 550°C (g)

3. RESULT AND DISCUSSION

Water Quality

The results of measuring water quality parameters when conducting research with water quality parameters measured were temperature, degree of acidity (pH), and salinity. the temperature of the 3 stations ranged from 30-32 ºC with the highest temperature at station 3, namely 32ºC, and the lowest temperature at station 2, namely 30ºC. The salinity of the 3 research stations ranged from 30-31‰ with the highest salinity at station 2, namely 31‰, and the lowest salinity at stations 1 and 3, namely 30‰. The degree of acidity (pH) of the 3 research stations ranged from 6-7.

Sediment Type

Based on the results of sediment analysis in Pongkar Village, Tebing District, Karimun Regency, Kepulauan Riau Province, the type of sediment was obtained from the percentage of sediment fractions, namely gravel, sand, and mud. The type of sediment at each station is based on the portion of gravel, sand, and silt particles classified according to Sheppard's Triangle and the percentage of

weight fraction and type of sediment at each station can be seen in Table 2.

Table 2. Percentage of Sediment Types at Each Station in Pongkar Village

Stasiun	Transek	Fraksi Sedimen			Tipe Sedimen
		Kerikil %	Pasir %	Lumpur %	
I	1(1)	35,73	33,69	30,58	Lumpur Pasir Krikil
	1(2)	26,47	35,18	38,35	Lumpur Pasir Krikil
	1(3)	46,33	26,58	27,09	Lumpur Pasir Krikil
II	2(1)	13,18	12,74	74,08	Lumpur Berkrikil
	2(2)	25,98	17,03	56,33	Lumpur Berkrikil
	2(3)	29,67	21,14	49,19	Lumpur Pasir Krikil
III	3(1)	14,16	10,07	75,77	Lumpur
	3(2)	16,13	8,65	75,21	Lumpur
	3(3)	15,54	17,35	67,11	Lumpur Berpasir

Table 3. Sediment Organic Matter Content at Each Station in Pongkar Village

Stasiun	Berat Cawan(gr)	Berat sampel setelah oven(g)	Berat Sampel Setelah Furnace(gr)	Kandungan Bahan Organik (%)	Rata-rata	Standar devisiasi
I(1)	1,35	34,97	33,61	4,04		
I(2)	1,41	33,50	32,16	4,17	4,40	0,51
I(3)	1,39	32,26	30,72	4,98		
II (1)	1,65	26,37	24,76	6,51		
II(2)	2,10	31,18	30,23	3,26	5,69	2,14
II (3)	1,43	27,59	25,68	7,30		
III (1)	1,49	24,73	22,93	7,74		
III (2)	1,39	25,95	24,29	6,75	6,95	0,71
III(3)	1,39	26,85	25,23	6,36		

Based on the results of the analysis of sediment types in Pongkar Village, Tebing District, Karimun Regency, Kepulauan Riau Province, the sediment types are gravel sand silt, gravel mud, mud, and sandy mud. The most common types of gravel sand mud sediments found at the study site were at stations I transect 1, 2, and 3, and stations II transects 3.

Organic Materials

The results of the analysis of organic matter content in Pongkar Village, Tebing District, Karimun Regency, Kepulauan Riau Province can be seen in Table 3.

Based on the analysis of the organic matter content of the sediments carried out in Pongkar Village, Tebing District, Karimun Regency, Kepulauan Riau Province, the highest organic matter content was obtained at station III with an average value of 6.95%, while the lowest organic matter content was at station I with a value an average of 4.40% and station II with an average value of 5.69%.

Density, frequency, and cover of mangrove vegetation

The results of research that has been done found 6 types of mangroves namely *Rhizophora apiculata, R.mucronata, Avicennia alba, A.marina, Sonneratia alba,* and *Lumnitzera littorea. S. alba* is the most common mangrove species found in Pongkar Village, Tebing District, Karimun

Regency, Kepulauan Riau Province and the least found is the *L. littorea* species.

Research results by Budi & Faiqoh[11] in Benoa Bay, Bali, relatively the same species but 11 species were more numerous, namely *R.mucronata, R.stylosa, R.apiculata, A.marina, A.officinalis, S.alba, S.caseolaris, Bruguiera gymnorrhyza, B.cylindrical, Xylocarpus granatum,* and *Ceriop tagal*. Suharto et al.[12] obtained the same number of species, but most of them had different species in Pasir Mempawah Hilir Village, totaling 6 species namely *A.marina, A.officinalis, R.mucronata, B.gymnorrhyza, Nypa fructans,* and *Terminalia catappa.* Yanti et al.[13] also conducted research in Karimun Regency, namely in the Tanjung Balai Karimun Coastal Area which obtained 4 types of mangroves namely *S.alba, S.caseolaris, A.anata,* and *R.lamarckii.*

Based on the results of calculating the density of mangroves at the tree, sapling, and seedling levels in Pongkar Village, it can be seen that the density of mangroves at the tree level ranges from 1588.89 – 1822.22 ind/ha. The highest mangrove density value was at station II, namely 1822.22 ind/ha, and the lowest mangrove density value was at station III, namely 1588.89 ind/ha, followed by the station I, namely 1677.78 ind/ha, which can be seen in Table 4.

Table 4. Tree-level Mangrove Vegetation Density

Tingkat Pohon				
No.	Jenis	Kerapatan (ind/ha)		
		St. I	St. II	St. III
1	*Rhizophora apiculata*	400	255,56	311,11
2	*Rhizophora mucronata*	66,67	133,33	66,67
3	*Avicennia alba*	444,44	522,22	666,67
4	*Avicennia marina*	-	-	277,78
5	*Sonneratia alba*	688,89	911,11	266,67
6	*Lumnitzera littorea*	77,78	-	-
Total		1677,78	1822,22	1588,89

The density of mangrove species at station II is higher than at stations I and III because the utilization of mangrove forests at station II is still relatively minimal. The high density of mangrove species in this research location is due to environmental conditions such as the substrate which is suitable for the existing mangrove species, the same thing was also obtained by Renta et al.[14] which obtained the highest density value of 3133.33 ind/ha.

The most common mangrove species found at each research station were *S. alba, A. alba, R. apiculata,* and *R. mucronata*. In the opinion of Susanti *in* Firdaus[15], the presence of a species in vegetation is an indication that naturally that type is considered suitable for the vegetation ecology of the area. According to Maulidi et al[16]. that the presence of silt in the composition of the sediment texture allows *Rhizhopora* sp mangroves to grow. While the sand fraction dominates the composition of the sediment texture, the type of mangrove that will grow a lot is *Avicennia* sp.

The same research was also conducted by Yanti et al.[13], that density values are much lower, namely 390–530 ind/ha at the tree level and 480-1600 ind/ha at the tiller level. Nicolas[17] obtained yields of 867-1600 ind/ha which were carried out on Salawati Island, Raja Ampat Islands Regency, West Papua Province.

Based on the results of calculating the frequency of tree-level mangroves, it can be seen that the frequency of tree-level mangroves ranges from 2–2.22. The highest mangrove frequency value is at station III with a value of 2.22, then station I with a value of 2.11, and station II with a value of 2 can be seen in Table 5.

Table 5. Tree Level Mangrove Vegetation Frequency

Tingkat Pohon				
No.	Jenis	Frekuensi		
		St. I	St. II	St. III
1	*Rhizophora apiculata*	0,56	0,33	0,44
2	*Rhizophora mucronata*	0,11	0,22	0,11
3	*Avicennia alba*	0,67	0,67	0,89
4	*Avicennia marina*	-	-	0,33
5	*Sonneratia alba*	0,67	0,78	0,44
6	*Lumnitzera littorea*	0,11	-	-
Total		2,11	2	2,22

Based on the results of calculating the dominance of mangroves at the tree level, it can be seen that the dominant values of the tree-level mangroves range from 10.70 to 16.73. The highest mangrove dominance value is found at station I with a value of 16.73, then station II with a value of 10.70, and station III with a value of 12.58 can be seen in Table 6.

Table 6. The dominance of Tree Level Mangrove Vegetation

Tingkat Pohon				
No.	Jenis	Dominansi		
		St. I	St. II	St. III
1	*Rhizophora apiculata*	4,16	1,29	2,49
2	*Rhizophora mucronata*	0,70	0,55	0,96
3	*Avicennia alba*	3,09	2,10	4,28
4	*Avicennia marina*	-	-	2,16
5	*Sonneratia alba*	8,32	6,76	2,70
6	*Lumnitzera littorea*	0,47	-	-
Total		16,73	10,70	12,58

Mangrove Vegetation Importance Value Index

The importance value index obtained at 3 research stations in Pongkar Village, Tebing District, Karimun Regency, Kepulauan Riau Province can be seen for the tree level the highest importance value index is found at station II of the *S.alba* species with a value of 152.01%. While the lowest important value index, namely the species *L. littorea* found at station I with a percentage of 12.69% can be seen in Figure 5.

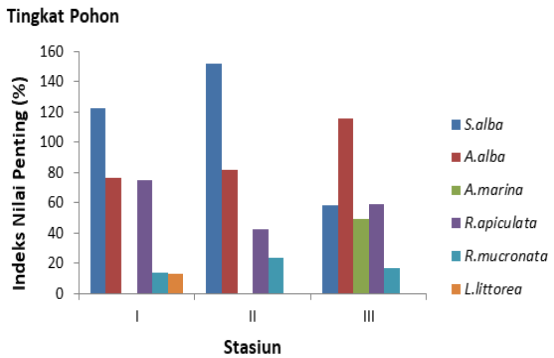

Figure 5. Tree Level Important Value Index at Each Station

The importance value index is a quantitative parameter that can be used to express the level of dominance of a species in a mangrove community. Then, the Importance Value Index reflects the role (dominance) and structure of mangrove vegetation in a location. The highest tree-level mangrove IVI value was owned by *S.alba.*

The high INP value indicates that this species is more able to compete and adapt well to the environment in Pongkar Village. IVI values for mangrove species found in the study area at each station were different. At stations I and II there are the same mangrove species with a relatively high Importance Value Index, namely the *S. alba* type, this is because the environment supports the growth of these mangrove species.

Unlike the case with station III, the highest IVI value was found in *A. alba* with a percentage of 115.94%, this was due to differences in environmental conditions in each research station. Various I-VI values were also obtained by Budi & Faiqoh[11] who conducted research in Benoa Bay, Bali with a percentage of 20.93-130.61% at the tree level, while at the sapling level with a percentage of 27.63 - 246.1%.

4. CONCLUSION

The types of mangrove vegetation found in Pongkar Village, Tebing District, Karimun Regency, Kepulauan Riau Province, consisting of 6 species, namely *A.alba, A.marina, R.apiculata, R.mucronata, S.alba,* and *L.littorea.* The highest density of mangrove vegetation types in the Pongkar Village area is near the Military District Command housing (Station II) with a total density of 1822.22 ind/ha. The highest relative frequency value of mangroves is found in the Pelambung Area under the supervision of Balai Pengelolaan Daerah Aliran Sungai dan Hutan Lindung (BPDASHL) Sei Jang Duriangkang (Station III) *A.alba* species with a value of 40%.

The highest relative dominance value of mangroves was found at station II of *S.alba* species with a value of 63.12%.

While the highest importance value index was found at station II of *S. alba* with a value of 152.01% and the lowest important value index was *L. littorea* species found at station I with a value of 12.69%.

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