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STRUCTURE OF MANGROVE VEGETATION IN PANGKAL BABU VILLAGE, TUNGKAL ILIR, TANJUNG JABUNG BARAT

Struktur Vegetasi Mangrove Di Desa Pangkal Babu Tungkal Ilir Tanjung Jabung Barat

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ABSTRACT

Mangrove ecosystems play an important role in coastal and marine management. Coastal areas with large river estuaries whose water flows contain a lot of substrate for growth can be optimally covered by mangroves. This study aims to determine the structure of mangrove vegetation density in Pangkal Babu Village. This research was conducted from December 2024 to January 2025 using the Transect Line Plot method with a purposive sampling approach at three observation stations. Each transect consisted of three plot sizes (10×10 m, 5×5 m, and 1×1 m) used to observe the growth rate of trees, seedlings, and saplings. The data included species identification, number of individuals, species density, relative density, species frequency, relative frequency, species cover, and importance value index (IVI). Qualitative and quantitative analyses were performed to describe the condition of the mangrove community structure at each station. The results showed that there were nine mangrove species found at the three stations in Pangkal Babu Village, *namely Sonneratia alba, Avicennia marina, Avicennia alba, Rhizophora apiculate, Rhizophora mucronate, Bruguiera gymnorrhiza, Acanthus ilicifolius, and Nypa fruticans.* Station 1 had low mangrove density with a total of only 26 individuals/ha, dominated by *Sonneratia alba* with a density of 416.67 ind/ha and the highest INP of 280.04%. Meanwhile, Station 2 showed.

Keywords: Density, Importance Value Index (IVI), Mangrove

ABSTRAK

Ekosistem mangrove memiliki peranan penting dalam pengelolaan kawasan pesisir pantai dan lautan. Wilayah pesisir yang memiliki muara sungai yang besar yang aliran airnya banyak mengandung substrat sebagai pertumbuhannya dapat ditumbuhi oleh mangrove secara optimal. Penelitian ini bertujuan untuk mengetahui bagaimana strukur vegetasi kerapatan mangrove di Desa Pangkal Babu. Penelitian ini dilaksanakan pada bulan Desember 2024 hingga Januari 2025 menggunakan metode Transect Line Plot dengan pendekatan purposive sampling pada

tiga stasiun pengamatan. Setiap transek terdiri atas tiga ukuran plot (10×10 m, 5×5 m, dan 1×1 m) yang digunakan untuk mengamati tingkat pertumbuhan pohon, anakan, dan semai. Data meliputi identifikasi jenis, jumlah individu, kerapatan jenis, kerapatan relatif, frekuensi jenis, frekuensi relatif, penutupan jenis, serta indeks nilai penting (INP). Analisis dilakukan secara kualitatif dan kuantitatif untuk mengFigurekan kondisi struktur komunitas mangrove di setiap stasiun. Hasil penelitian menunjukkan bahwa terdapat 9 jenis mangrove yang ditemukan di 3 stasiun di Desa Pangkal Babu, yaitu *Sonneratia alba, Avicennia marina, Avicennia alba, Rhizophora apiculate, Rhizophora mucronate, Bruguiera gymnorrhiza, Acanthus ilicifolius, dan Nypa fruticans*. Pada Stasiun 1 memiliki kerapatan mangrove yang rendah dengan total individu hanya 26 individu/ha, didominasi oleh *Sonneratia alba* dengan kerapatan 416,67 ind/ha dan INP tertinggi 280,04%. Sedangkan Stasiun 2 menunjukkan kerapatan tertinggi di antara ketiga stasiun dengan jumlah individu mencapai lebih dari 1.800 ind/ha (didominasi *Avicennia marina* sebanyak 101 individu dengan kerapatan 1683,33 ind/ha). Dan Stasiun 3 memiliki tingkat kerapatan sedang dengan total individu sekitar 87 individu/ha, serta lima jenis mangrove yang menunjukkan keanekaragaman lebih tinggi dibanding stasiun 1 dan 2.

Kata Kunci: Indeks Nilai Penting (INP), Kerapatan, Mangrove

INTRODUCTION

The province of Jambi has 3,989.3 hectares of mangrove forest spread across several districts. Tanjung Jabung Barat District is one of the districts in Jambi Province that has mangrove forest. The mangrove forest in this area covers 689.8 hectares, which is divided into several areas, one of which is located in Tungkal 1 Village, Pangkal Babu (Halvina, 2021). This area is densely covered with mangrove plants and is subject to frequent tides. Several types of plants grow in the Pangkal Babu mangrove area, namely mangrove (*Rhizophora* sp.), pidada (*Sonneratia* sp.), api-api (*Avicennia* sp.), tancang (*Bruguiera* sp.), nyirih (*Xylocarpus* sp.), buta-buta (*Excoecaria* sp.), and so on (Silvana, 2020).

Mangrove ecosystems have an important role in managing coastal and marine areas both from an economic and ecological perspective (Muarif *et al*., 2016). Coastal areas with large river estuaries whose water flows contain a lot of substrate for growth can be optimally covered by mangroves (Arifin, 2002). The condition of the mangrove vegetation habitat, which includes species density and composition, will affect the physical, biological, and chemical characteristics of the water, which in turn will determine the structure of the community of organisms associated with the mangrove area, one of which is the macrozoobenthos community (Nontji, 2005).

(Bayudana *et al*., 2022) states that 80% of mangroves influence the survival of macrozoobenthos, therefore it can be interpreted that the greater the density of mangroves, the higher the abundance of macrozoobenthos. Studies on the analysis of mangrove vegetation structure density have not been widely researched, so this study is expected to provide information on the structure of mangrove vegetation in the mangrove area of Pangkal Babu Village. The structure of mangrove vegetation in this study was demonstrated using the Importance Value Index (IVI). The Importance Value Index (IVI) value was obtained by summing the relative density, relative dominance, and relative frequency of each observed mangrove species. This parameter looks at the level of contribution or ecological role of a mangrove species in a community, thus reflecting the level of dominance and its influence on the balance of the mangrove ecosystem as a whole (Al Idrus, 2014).

METHODS

Place and Time

This research was conducted in Pangkal Babu Village, Tungkal I Subdistrict, Tungkal Ilir District, Tanjung Jabung Barat Regency from December 2024 to January 2025.

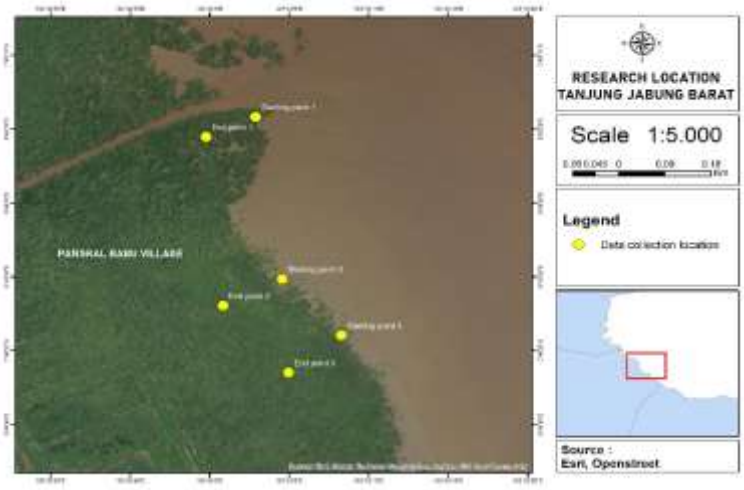


Figure 1. Data Collection Location

Materials

The tools used in this study were GPS (Global Positioning System), a 1.5 m measuring tape, plastic bags, writing instruments, rope, a camera, and boat shoes. The research method used was purposive sampling data collection, namely Transect Line Plot (TLP), which was drawn perpendicular to the coastline from the foremost mangrove, conducted at 3 stations. Then, each transect was placed in alternating plots, namely 100 m2 (10 m x 10 m); 25 m2 (5 m x 5 m); and 1 m2 (1 m x 1 m), where the 10 m x 10 m plot was used to measure trees with a diameter >10 m, while the 5 m x 5 m plot was used for seedlings with a diameter of 2-10 cm, and the 1 m x 1 m plot was used for seedlings with a diameter < 2 cm. The data collected included the identification of mangrove species, mangrove density, and the number of mangroves in the mangrove forest.

Research Procedures

The first stage of the research involved conducting a field survey of the area to be studied. Next, ropes were adjusted to the specified size at the research site, and samples of mangrove species were taken in the form of photographs of roots, trunks, leaves, and fruits found in the mangrove area. Measurements were taken of the trunk diameter and height of saplings using a tape measure at each station 1, 2, and 3. After the data was collected, it was recorded in a book for the process of identifying the types of mangroves found in the mangrove area of Pangkal Babu Village using a mangrove identification book.

Data analysis

Mangrove sampling at each station was conducted using a zigzag transect (line transect). The line transects used consisted of three plots of varying area and length: 100 m2 (10x10 m), 25 m2 (5x5 m), and 1 m2 (1x1 m). Indah *et al*. (2024)stated that the length of the line transects could be 10 m, 25 m, 50 m, or 100 m. The line thickness was usually 1 cm. Segments were then created along the line, each with a length of 1 m, 5 m, or 10 m.

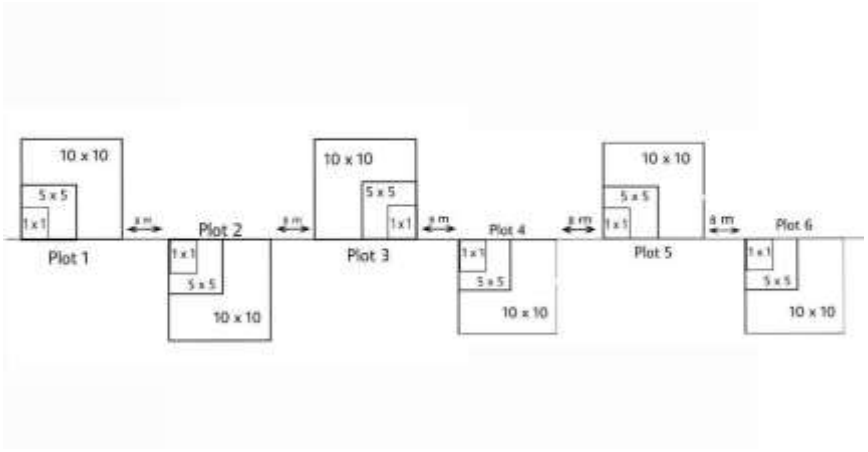


Figure 2. Mangrove observation plot

Data analysis in this study involved analyzing mangrove vegetation data using qualitative and quantitative methods to obtain a comprehensive picture of the condition of the ecosystem under study. Qualitative analysis was conducted to describe the composition of mangrove vegetation types. Meanwhile, quantitative analysis was used to measure ecological parameters, including diversity index, species density, relative density, species frequency, relative frequency, species cover, relative cover, and importance value index using the following formulas:

a. Diversity Index

Mangrove diversity is calculated based on Shannon-Wiener information theory. In (Niken *et al*., 2023), diversity is calculated using the Shannon Wiener diversity index with the following formula:

$$H' = -\sum_{i=1}^{S} \text{pi} \ln \text{pi} \qquad pi = \frac{ni}{N}$$

Explanation:
H’ = Diversity Index
Pi = (ni/N) = Proportion of Each Species (i = 1,2,3,…)
Ni = Number of Individuals of Species i
S = Number of Species
N = Total Number of Individuals
The diversity index categories are as follows:
H’ < 1 = Low Diversity Index
1 < H’ < 3 = Medium Diversity Index
H’ > 3 = High Diversity Index

b. Species Density (Di)

Species density (Di) is the number of stands of species i in a unit area (Bengen, 2000).Species density is determined using the following formula:

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

Explanation:
Di = Density of species i
Ni = Total number of individuals i
A = Total sampling area (m^2)

c. Relative Density (RDi)

Relative Density (RDi) is the ratio between the number of individuals of species i and the total number of individuals of all species (Bengen, 2000). Relative density (RDi) can be determined using the following formula:

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

Explanation:
RDi = Relative Density
ni = Total Number
∑n = Total Number of All Species

d. Frequency Type (Fi)

Frequency Type (Fi) is the probability of finding a type i in all sample plots compared to the total number of sample plots made (Bengen, 2000). To calculate the frequency type (Fi), the following formula is used:

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

Explanation:
Fi = Frequency of Type i
Pi = Number of Sample Plots Where Type i is Found
∑f = Total Number of Sample Plots Created (3 plots)

e. Relative Frequency (RFi)

Relative Frequency (RFi) is the ratio between the frequency of type i and the total frequency of all types (Bengen, 2000). Relative frequency can be calculated using the following formula:

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

Explanation:
RFi = Relative Frequency of Type
Fi = Frequency of Type i
∑f = Total Number of Sample Plots Created (3 plots)

f. Type cover (Ci)

Type cover (Ci) is the area of type cover i in a given unit area (Bengen, 2000). Type cover can be calculated using the following formula:

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

Explanation:
Ci = Closing Type
∑BA = $\pi d^2/4$ (d = Chest Height Trunk Diameter), (d = Circumference/π, π = 3,14)
A = Total Area of Sample Collection (m^2)

g. Relative Cover (RCi)

Relative Cover (RCi) is the ratio between the cover of type i and the total cover area for all types. To calculate RCi, the following formula can be used:

$$RCi = \left(\frac{Ci}{\sum c}\right) x\ 100$$

Explanation:
RCi = Relative Closing
Ci = Type Closing
C = Total Closing for All Types

h. Importance Value Index (IVI)

According to (Sofian *et al*., 2012),the formula for calculating the mangrove importance index is as follows:

1. The tree level can be calculated using the formula:

$$INP = RDi + RFi + RCi$$

2. The level of seedlings and stakes can be calculated using the formula:

$$INP = RDi + RFi$$

Explanation:
IVI = Important Value Index
RDi = Relative Density
RFi = Relative Frequency
RCi = Relative Closing

RESULTS

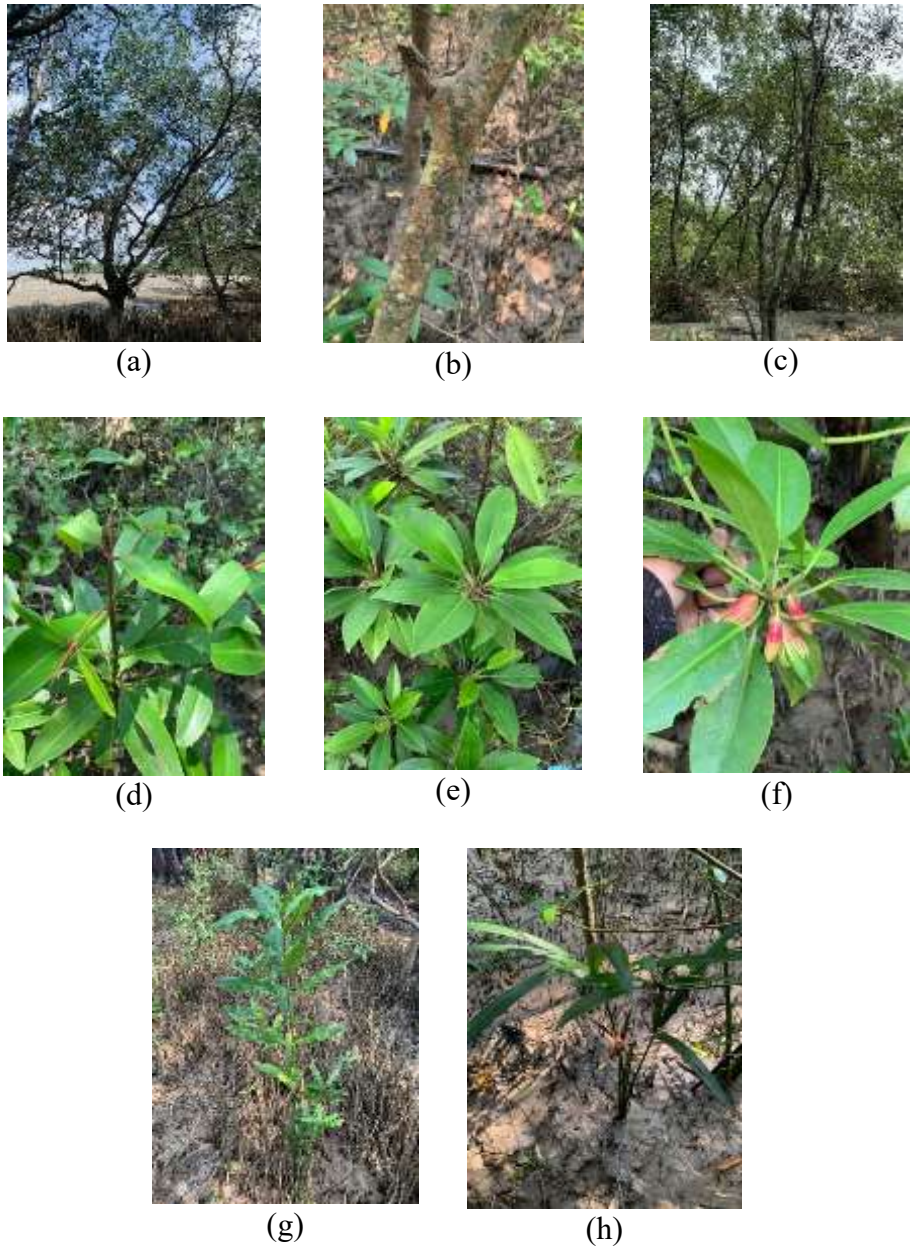
Table 1. Presence of Mangrove Species at the Research Site

Type	Station 1			Station 2			Station 3		
	Tree	Sapling	Seedling	Tree	Sapling	Seedling	Tree	Sapling	Seedling
Acanthus ilicifolius	-	-	-	-	+	-	-	+	-
Avicennia alba	+	+	-	+	+	+	+	+	+
Avicennia marina	-	-	-	+	+	+	+	+	+
Bruguiera gymnorrhiza	-	-	-	-	-	-	+	-	-
Nypa fruticans	-	-	-	-	+	+	-	+	+
Rhizophora apiculata	-	+	-	+	+	+	+	+	+
Rhizophora mucronata	-	-	-	+	+	-	+	+	-
Sonneratia alba	+	+	-	-	-	-	-	-	-

Description
+ : Indicates the presence of mangrove species
- : Indicates no mangrove species

Table 2. Importance Value Index (IVI) of Tree Level Vegetation Types

Stasiun	Type	Number	Di(ind/ ha)	RDi (%)	Fi (%)	RFi (%)	Ci (%)	RCi (%)	INP (%)
1	*Sonneratia alba*	25	416,67	96,15	1,00	85,71	161,44	98,17	280,04
	Avicennia alba	1	16,67	3,85	0,17	14,29	3,01	1,83	19,96
2	*Avicennia alba*	25	416,67	18,80	0,83	38,46	89,43	53,85	111,11
	Avicennia marina	101	1683,33	75,94	1,00	46,15	75,05	45,19	167,29
	Rhizophora mucronata	4	66,67	3,01	0,17	7,69	0,95	0,57	11,27
	Rhizophora apiculata	3	50,00	2,26	0,17	7,69	0,63	0,38	10,33
3	*Avicennia alba*	20	333,33	22,99	0,67	26,67	61,59	57,64	107,29
	Avicennia marina	57	950,00	65,52	1,00	40,00	42,45	39,72	145,24
	Rhizophora apiculata	3	50,00	3,45	0,33	13,33	0,66	0,62	17,40
	Bruguiera gymnorrhiza	3	50,00	3,45	0,33	13,33	1,20	1,13	17,91
	Rhizophora mucronata	4	66,67	4,60	0,17	6,67	0,95	0,89	12,16



(a) (b) (c)

(d) (e) (f)

(g) (h)

Figure 2. Spesies Found at the Research Site

DISCUSSION

Based on Table 1, the identification results at three observation stations in the Pangkal Babu mangrove area of Tungkal Satu Village, various different types of mangrove species were found at each station, totaling 8 types of mangroves. At station 1, 3 types of mangroves were recorded with the tree and sapling categories, namely *Avicennia* alba, *Rhizophora* apiculata, and *Sonneratia* alba. The *Sonneratia* alba species was only found at station 1, indicating that this species has certain habitat preferences that were not found at other stations. According to Shinta *et al*., (2022) *Sonneratia* alba is a dominant mangrove species that grows in muddy coastal areas and river estuaries that are influenced by tides, showing a habitat preference for salt waters with mud to sand substrates. At station 2, 6 types of mangroves were found with the tree, sapling and seedling categories, namely Acanthus ilicifolius, *Avicennia* alba, *Avicennia* marina, Nypa fruticans, *Rhizophora* apiculata, and *Rhizophora* mucronata.Usman *et al*., (2013)

stated that *Rhizophora* mucronata is a type of mangrove that is able to grow optimally on substrates with thick sandy mud characteristics.

Seven mangrove species were found at station 3, almost identical to those at station 2. *Avicennia* Alba and *Rhizophora* apiculata were species that were evenly distributed across the three stations across all growth phases (trees, sapling, and seedlings), indicating that both species have high adaptability to varying environmental conditions. Meanwhile, Nypa fruticans was only found at the tree stage at stations 2 and 3, indicating a low likelihood of natural regeneration at these locations. These findings indicate that mangrove species diversity is influenced by environmental factors at each station, including substrate conditions, tides, and human activities. The reduction in the area of mangrove forests can cause problems in the form of coastal erosion which occurs due to the influence of waves and sea currents (Khoirunnisa *et al*., 2017).

Based on Table 2, the results of the study indicate variations in the composition of mangrove species and the Importance Value Index (IVI) at three observation stations in the tree category. At station 1, two types of mangrove were found, namely *Sonneratia* alba and *Avicennia* alba. The *Sonneratia* alba species has 25 individuals with a density of 416.67 ind/ha, a dominance of 96.15%, a frequency of 1.00%, and the highest IVI value of 280.04%. Martuti *et al*. (2018) stated that the tree vegetation community in the mangrove ecosystem generally consists of species such as *Avicennia* spp. and *Sonneratia* spp. These mangrove species are able to thrive in flat areas with muddy substrates and are highly resistant to ocean waves thanks to their robust root systems. In contrast, *Avicennia* alba was only found with one individual with a much lower IVI of 19.96%. This indicates that *Sonneratia* alba strongly dominates the mangrove community at station 1. According to (Agustina *et al*., 2016) plant species that dominate a community tend to have a high importance index value, dominant species in a community will show a high level of ecological importance based on the calculation of the importance index.

Four mangrove species with a more diverse composition were found at station 2. The dominant species was *Avicennia* marina with 101 individuals (IVI = 167.29%), followed by *Avicennia* alba (IVI = 111.11%), *Rhizophora* mucronata (IVI = 11.27%), and *Rhizophora* apiculata (IVI = 10.33%). *Avicennia* marina had the highest density of 1,683.33 individuals/ha, while the two *Rhizophora* species had much lower densities. This indicates that the mangrove community at station 2 is dominated by *Avicennia* marina, but there is still significant species diversity. *Avicennia* marina is commonly found in foreshore zones that are routinely submerged and inundated by tidal action (Kartika *et al*., 2018). This species has a high adaptability to extreme salinity conditions, enabling it to survive and grow optimally in environments with high salt content. Its dominant presence in foreshore areas is closely related to the dynamic characteristics of its habitat due to tidal influences. Furthermore, A. marina exhibits a wide tolerance to salinity variations, even growing well in conditions close to freshwater, up to salinity levels reaching approximately 90% (Mazuki *et al*., 2012)

Meanwhile, at station 3, five mangrove species were found, with *Avicennia* marina again being the dominant species (IVI = 145.24%), This species shows high adaptability to various environmental conditions, including variations in salinity and temperature (Nadira *et al*., 2021). Followed by *Avicennia* alba (IVI = 107.29%). The other three species, namely *Rhizophora* apiculata, *Bruguiera* gymnorrhiza, and *Rhizophora* mucronata, had relatively balanced IVI values, ranging from 12.16% to 17.91%, respectively. The species diversity at station 3 indicates that this habitat has a fairly balanced mangrove community structure, although there is still dominance by the *Avicennia* marina species. Overall, the three stations show variations in mangrove community structure. *Avicennia* marina and *Avicennia* alba are the most frequently occurring species and dominate at several stations. IVI values are used as indicators of the dominance of a species in the community, where higher values indicate a greater ecological

role in the mangrove community structure. Mangrove species with a high Importance Value Index (IVI) indicate that they play a dominant ecological role and contribute significantly to the stability of the mangrove ecosystem in their habitat. Conversely, if a species has a low IVI, its presence is considered to have a relatively small impact on the structure and function of the ecosystem (Sidiyasa, 2007)

CONCLUSION

The mangrove species found at 3 stations in Pangkal Babu Village are 8 types of mangroves consisting of *Sonneratia* alba, *Avicennia* marina, *Avicennia* alba, *Rhizophora* apiculate, *Rhizophora* mucronate, *Bruguiera* gymnorrhiza, Acanthus ilicifolius, and Nypa fruticans. At Station 1, the mangrove density is low with a total of only 26 individuals/ha, dominated by *Sonneratia* alba with a density of 416.67 ind/ha and the highest INP of 280.04%. Meanwhile, Station 2 shows the highest density among the three stations with the number of individuals reaching more than 1,800 ind/ha (dominated by *Avicennia* marina with 101 individuals with a density of 1683.33 ind/ha). And Station 3 has a medium density level with a total of around 87 individuals/ha, as well as five types of mangroves that show higher diversity than stations 1 and 2.

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