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CONDITION OF THE MANGROVE FOREST AT UNIVERSITAS RIAU MARINE STATION, DUMAI

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ABSTRACT

Mangrove plant communities grow well in tropical regions and adapt to extreme environmental conditions. The coastal area of Dumai is filled with various activities in the form of industry, ports, agriculture, and settlements. The complexity of activities on the beach greatly affects the balance of the ecosystem. This study aimed to determine the composition of mangrove forest species and conditions based on density value, importance index, percentage of canopy cover, and mangrove stand height. The survey method used in this study, where the data collected is primary data. There are four species of mangroves, including *Rhizophora apiculata*, *Bruguiera gymnorriza*, *Xylocarpus granatum*, and *Sonneratia alba*. The density of mangroves is in good condition, with dense densities ranging from 2067-3266.67 ind/ha. Canopy closure in good condition ranges from 76.12-80.45%. The highest important value index is *R. apiculata*, with a value of 159.64%, and the lowest is *B. gymnorriza*, 13.77%. The highest stand was *S. alba*, with a value of 18.84 m, and the lowest was *X. granatum*, with a value of 10.60 m.

Keywords: Mangrove, Composition, Condition Mangrove

1. INTRODUCTION

Mangrove forests are high-level plantation forests that adapt very well in intertidal areas and areas with high average tidal levels to areas with the highest tides. Mangrove plant communities grow well in tropical regions. They can adapt to extreme environmental conditions, such as high temperatures, high salinity, extreme tides, high sedimentation, and increasing substrate conditions that are poor in oxygen and or without oxygen. The role and function of the mangrove forest ecosystem include a nutrient or nutrient turnover area, a habitat for various kinds of biota, and a buffer area between terrestrial ecosystems and marine ecosystems[1].

The coastal area of Dumai is filled with various activities in the form of industry, ports, agriculture, and settlements. The water area is used for shipping and fishing activities[2]. The complexity of activities on the beach greatly affects the balance of the ecosystem. The Marine Station mangrove area is one of the mangrove areas in West Dumai District, Dumai City. This mangrove area has mangrove forest areas that are mostly still maintained. However, there is no latest data on these mangroves. This study aimed to determine the composition of mangrove species found and to update data on the condition of mangrove forests based on density, important value index, percentage of header cover, and stand height at the Universitas Riau Marine Station, Dumai.

2. RESEARCH METHOD

Time and Place

This research was conducted in January 2024 in the mangrove forest area of the marine station of Universitas Riau, Dumai (Figure 1).

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Figure 1. Map of research location

Method

The method used in this study is a survey method, where the data collected is primary data, which includes density data, important value index, percentage of canopy cover, and height of mangrove stands, as well as water quality data and sediment fractions, which will then be presented in tables and figures descriptively.

Procedures

Determination of the location of the study was carried out using purposive sampling techniques, namely determining the location of the research deliberately by considering and paying attention to the research area's conditions. Station I is a mangrove located on the riverside, Station II is a mangrove area close to the seaside, and Station III is a mangrove area that leads to the Universitas Riau lecturer dormitory.

Each station has 1 line transect 50 m from the sea. In each transect, are 3 plots arranged in a zigzag manner with a size of 10x10 m² for trees, 5x5 m^2 for sapling and 2x2 m^2 for seedling.

Water quality measurements are carried out in situ or directly at the research site, and measurements are carried out at high tide in the morning. Each water quality measurement was carried out three times at one point where the data was taken. This is for the data obtained to be accurate.

Sediment sampling was carried out to determine the type of sediment fraction at each station with three repetitions of sampling, which were then mixed into one and taken using a cement spoon. Samples were taken as much as ±500 g. The samples were put into plastic bags, labelled according to the sampling location, and then put into an ice box to be taken to the Marine Chemistry Laboratory, Department of Marine Sciences, Faculty of Fisheries and Marine Sciences, Universitas Riau, for analysis.

Species of Mangroves

Mangrove species are identified by observing parts of morphology such as flowers, leaves, roots, fruits, and stems and then adjusted to the mangrove identification guidebook. The identification of this species of mangrove refers to the Guidebook for the Introduction of Mangroves in Indonesia[1].

Mangrove Density

The density of mangrove species is one of the analyses used to determine the condition of mangroves. The density value can be calculated in the following way:

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

Information:
D : Density of a species (ind/m²)
Ni : Number of individuals
A : Area of the entire plot (m²)

Measurement Diameter Breast Height

Technical measurements of the trunk diameter are divided into several conditions; measurements are carried out at the height of an adult's chest or 1.3 m above ground level. For trees with roots that are more than 1.3 m from ground level, the tree's diameter is calculated to be 30 cm above the root. Suppose the branching tree has a branching location of more than 1.3 m. In that case, the tree's diameter is calculated as 1.3 m above

ground level, and the tree is considered one. However, if the location of the branching is below 1.3 m, then the tree's diameter is calculated for each branch. Wrap the tape/ measuring tape on the tree trunk, with the position of the tape parallel for all directions, so that the data obtained is the circumference of the trunk, not the diameter; record the results and the name of the tree species, then calculate the volume and specific gravity of wood.

Important Value Index

To find out the Important Value Index obtained by calculating relative density, relative frequency, and relative dominance. The following formulas can be used to determine relative density, relative frequency, and relative dominance.

$$\text{Density} = \frac{ni}{A} \quad (1)$$

$$\text{Frequency} = \frac{pi}{\Sigma p} \quad (2)$$

$$\text{Domination} = \frac{\Sigma BA}{A} \quad (3)$$

$$\text{Relative Density} = \frac{Ni}{\Sigma n} X\ 100\% \quad (4)$$

$$\text{Relative Frequency} = \frac{Fi}{\Sigma F} X\ 100\% \quad (5)$$

$$\text{DRi} = \frac{\text{Dominance of a species}}{\text{Total Dominance of all species}} \text{X}100\% \quad (6)$$

$$\text{IVI} = \text{RD}i + \text{RF}i + \text{Dr}i \quad (7)$$

The importance value of a breed ranges from 0- 300%. This important value provides an overview of the influence or role of a mangrove plant species in the mangrove community.

Percentage of Canopy Cover

The mangrove canopy cover was calculated using the hemispherical photography method required by the front camera of the mobile phone at one point of photo taking[2]. Each 10x10 m^2 plot is divided into four quadrants where each quadrant is 5x5m^2, and 4-5 shooting points are taken in each quadrant. The collection of field data in hemispherical photography techniques in the form of photos refers to the guidelines[3]:

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1) Each 10x10 m^2 plot is divided into four small plots measuring 5x5 m^2. 2) The shooting point should be placed around the center of the small plot, between one tree and another, and shooting should be avoided right next to the trunk of one tree. 3) In each transect or stratification, a minimum of 12 points are taken, where each plot of 10x10 m^2 is taken at four shooting points 4) The position of the camera is aligned with the chest height of the researcher or the photo-taking team, and perpendicular to the sky. 5) Record photo numbers on the datasheet form to simplify and speed up data analysis. 6) Avoid double-taking photos at each point to prevent confusion in data analysis.

Data Analysis

The data obtained from the results of the study were analyzed descriptively. Determining mangrove conditions is based on the Minister of Environment Number 201 Decree of 2004 concerning Standard Criteria and Guidelines for Determining Mangrove Damage (Table 1).

Table 1. Guidelines for determining mangrove damage

Condition	Criteria	Cover Percentage	Density (tree/ha)
Good	Dense	>75%	≥ 1500
	Moderate	50-75%	≥ 1000 - 1500
Bad	Infrequently	<50%	< 1000

3. RESULT AND DISCUSSION

General Condition of the Research Area

Dumai is generally located at 1º34'25" – 1º44'08" N and 101º22'03 – 101º29'05" E. This area is in the eastern position of the island of Sumatra, which directly faces Rupat Island. Dumai City has two rivers: the Dumai River and the Masjid River. Beach conditions in the estuary area are relatively gentle.

Purnama Village is the center of government of Dumai Barat District, which, in general, is an area being intensified by developments such as micro-businesses and residential conditions that cause waste disposal and the use of mangrove land as a residential area. One of the mangrove lands that is still maintained and its natural growth is in the area after the Marine Station of Riau University, Dumai. The mangrove land is also often used as a reference for mangrove health information and a benchmark for mangrove growth in the Dumai area.

Water Quality

The results of measuring water quality parameters during research at the Marine Station of Riau Dumai University can be seen in Table 2 and Table 3.

Table 2. Water quality parameters

Parameters	Station			Average
	I	II	III	
Salinity (‰)	29.5	30	28	29.16
Temperature (^oC)	30	32	30	30.6
pH	7	7	7	7

Table 3. Sediment type at each research station

Station	Plot	Faction (%)			Types of sediments
		Gravel	Sand	Mud	
I	1	0.94	10.93	88.13	Mud
	2	0.73	7.74	91.54	Mud
	3	1.75	15.29	82.96	Mud
II	1	6.34	15.70	77.96	Mud
	2	2.50	13.46	84.04	Mud
	3	5.20	23.37	71.43	Sandy Mud
III	1	3.48	35.68	60.84	Sandy Mud
	2	9.24	31.21	59.55	Sandy Mud
	3	6.74	34.91	58.35	Sandy Mud

Salinity at three research stations was obtained on average 29.16‰, with the highest salinity at Station II, which was 30‰. The temperature at Station III ranges from 30-32 ºC, with the highest at Station II at 32 °C. As well as the degree of acidity ranges from 9-10 ppt, and the substrate at each station tends to be mud and sandy mud.

The substrates of the three research stations were predominantly mud and sandy mud. Station I is the type of sediment obtained by mud as a whole. Station III is sandy mud, while Station II is relatively mud, although some are sandy mud.

Composition Species

Based on Table 4, it can be seen that mangroves from the Rhizophoraceae family dominate with three species found, namely *R. apiculata, X. granatum,* and *B. gymnorrhiza*, and only one other species from the Sonneratiaceae family *S. alba*.

The results showed that mangrove species were most commonly found at Station II; this is thought to be because Station II is on the beach and is more exposed to tidal influences, which cause more diverse mangrove species. While the species of mangroves at Stations I and III are fewer than those in Station II, this is because they are less exposed to tides, which means the species are not too diverse. The species of mangrove most often found at each research station is *R. apiculata.* The same type, namely *R. apiculata*, was also dominant, obtained by Andrito et al.[4] in the mangrove ecosystem on the east coast of Jemaja Island, Kepulauan Anambas

Regency and Hasyim et al.[5] in the mangrove ecosystem of Sungai Sembilan District. According to Mughofar et al.[6], this area has a reasonably good carrying capacity for the growth and development of mangroves, such as environmental factors influenced by the tide's soft and muddy soil types.

The species found are far fewer when compared to Syahroni's[7] in Guntung River, Kateman District, Indragiri Hilir Regency which obtained 11 species of mangroves, namely *A.alba, A.marina, B. gymnorrhiza, B.sexangula, R.apiculata, S.alba, S. caseolaris, S.ovata, Lumitzhera littorea, L.racemosa,* and *X.granatum.*

Table 4. Species of mangroves found

Family	Species	Local Name	Station I	Station II	Station III
Rhizophoraceae	*Rhizophora apiculata*	Bakau	+	+	+
	Bruguiera gymnorrhiza	Tajang	+	+	+
Meliciaceae	*Xylocarpus granatum*	Nyireh	+	+	+
Sonneratiaceae	*Sonneratia alba*	Pedada	-	+	-

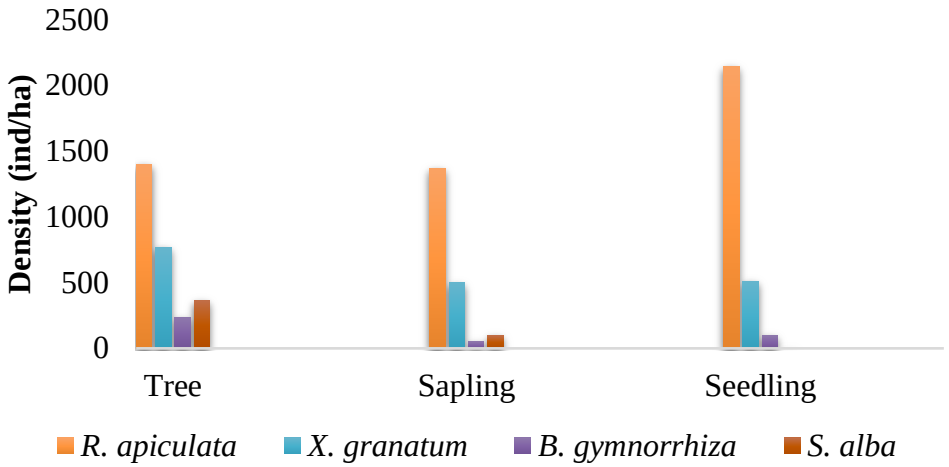

Figure 2. Tree level density at research stations

Mangrove Density

Figure 2 describes each species' average density at each mangrove level at three research stations. For the tree level, *R. apiculata* gets the highest density with a 1400.10 ind/ha value. The lowest density value of species *B. gymnorrhiza* is 233.33 ind / ha. At the tillering level, *R. apiculata* became the species that obtained the highest density value with 1366.80 ind/ha. In contrast, *B. gymnorrhiza* has the lowest density value, 55.56 ind/ha. The seedling level of *R. apiculata* species gets the highest value of 2144.54 ind/ha. The species that gets the lowest species is *S. alba,* with 0 ind/ha or no seedlings of this species found at the research station. The data from the research results at the three stations shows that mangrove density is included in the good category. This is following the standard criteria for mangrove damage and Decree of the Minister of Environment Number 201 of 2004; the criteria for the density value of mangrove species at a value of ≥ 1500 ind / ha is classified as a solid category and at a value of < 1000 it is classified as rare.

Important Value Index

The Important Value Index is a value that indicates the level of importance or ecological value of a species in a community. The Important Value Index obtained ranged from 127.31-36.51% of the

average of the three stations. The highest importance index was found in *R. apiculata*, with an average value of 127.31%, and the lowest was found in *B. gymnorrhiza*, with an average value of 39.51%. *S. alba* had an average value of 39.32%, and *X. granatum* had an average value of 96.86% (Figure 3).

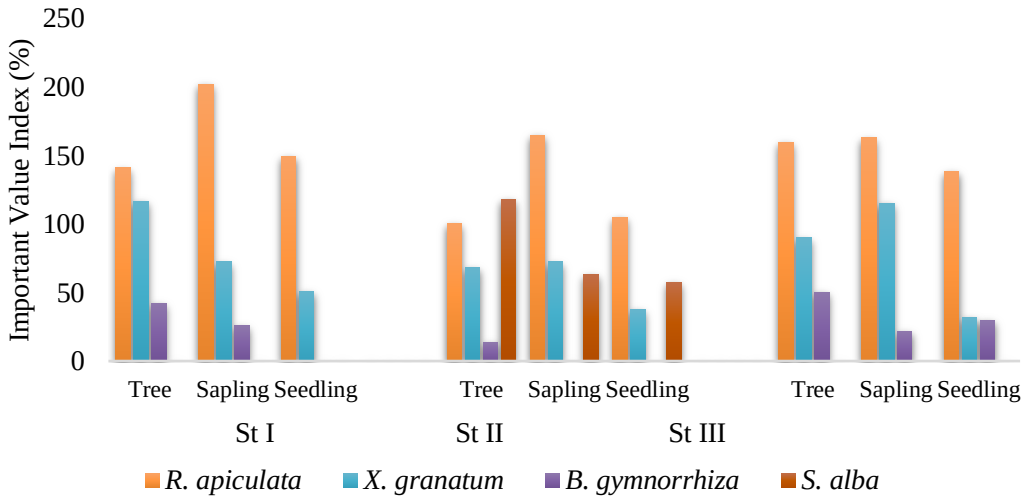

Figure 3. Index of importance

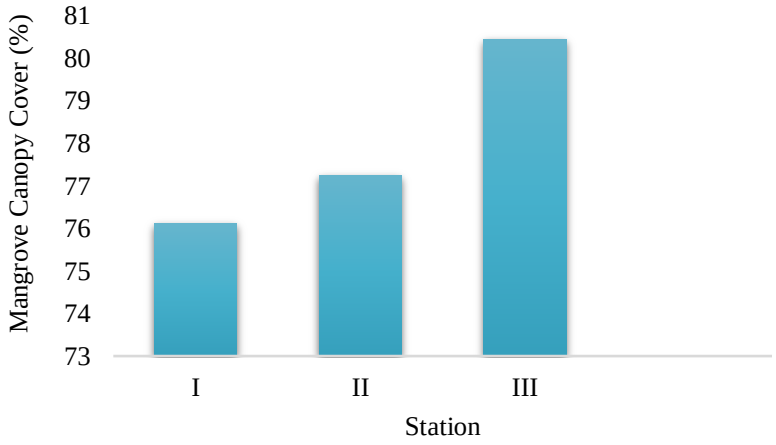

Figure 4. Percentage of mangrove canopy cover at each station using hemispherical photography method

The value of this research is lower when compared to research in Sebauk Village, Bengkalis Regency[8], which received the highest IVI at the *R. apiculata* tree level of 243.42%. The level of IVI saplings obtained is also higher, at 208.57%, from the species of *R. apiculata*. Then, at the seedling level, it is also slightly higher, which is also 150% of the species of *R. apiculata*. It is also lower than the important value obtained in Tajungan Mangrove Tourism, Kamal District, Bangkalan Regency, which received the highest importance value of 274.15 ind/ha[9].

Research in Batang Masang Beach, Agam Regency, West Sumatra[10], shows that the highest importance index at the tree level is higher, with the highest value being 172.70%. Meanwhile, the tillering level is lower, at only 147.89%.

Mangrove Canopy Cover

The mangrove canopy cover at the Marine Station of Riau Dumai University is in good condition with medium to dense cover categories with percentage values ranging from 76.12 to 80.45%. The highest canopy cover value was found at Station III, with a value of 80.45%, then Station I with 76.12%, and Station II with 77.25% (Figure

4). Based on the standard criteria for mangrove damage (Decree of the Minister of Environment Number 201 of 2004), the total percentage of mangrove cover obtained is included in the good category with moderate to solid criteria.

The mangrove canopy cover found at the Riau Dumai University Marine Station has a higher percentage value than the mangrove canopy cover value of Dompak Village, which has a percentage of 61.49-68.47% and is classified as good[11].

High Mangrove Stands

Based on the observation of mangrove height measurements, the average results of each stand at each station are obtained, as shown in Figure 5.

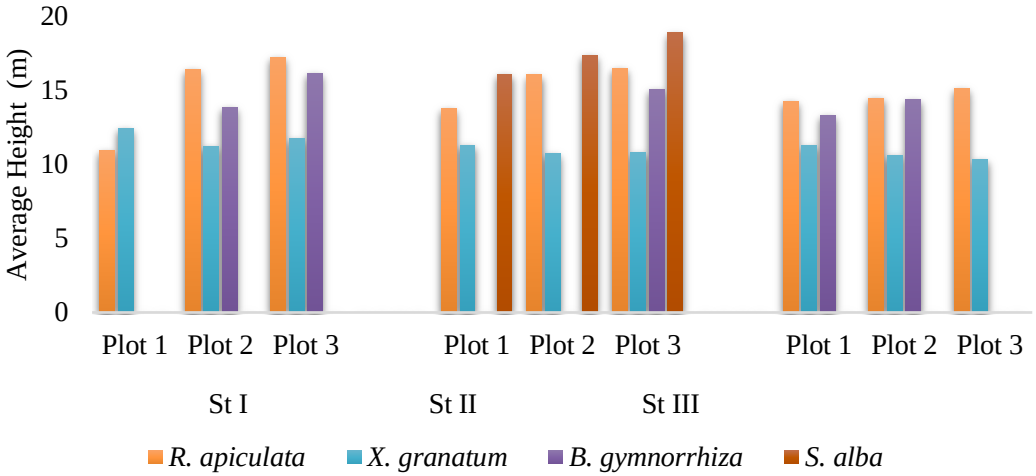

Figure 5. Average height of mangrove stand

At station I, species *X. granatum* on plot 1 had the highest average of 12.41 m. As for the species of *R. apiculata*, plot 3 has an average height of 17.19 m. For species, *B. gymnorrhiza* on plot 3 has an average height of 16.11 m. At Station II, the highest average stands of each species were all found in Plot 3, *S. alba* at 18.84 m, *R. apiculata* at 16.45 m, and *B. gymnorrhiza* at 15 m. except *X. granatum* highest at Station I with 11.28 m. At Station III, the highest average of the species *R. apiculata* was on Plot three at 15.06 m and *X. granatum* at 11.26 m on Plot 1. In contrast, the highest average of *B. gymnorrhiza* is in plot 2, with 14.39 m.

The height distribution of mangrove trees varies at each observation station. The distribution of mangrove trees is influenced by several factors, namely age, mangrove species, environmental quality of mangrove ecosystems, and substrate. In the study area, the highest mangrove in the species of *S. alba* with a height of 18.84 m. This follows the research by Sidik et al.[12], which states that S. alba can grow to a height of 20 m. At three research stations dominated by the species of *R. apiculata*, the height is between 10.93 to 17.19 m. The results of this study are more significant than those of mangroves in Benoa Bay, which have mangrove heights of up to 12.22 m[13], on the coast of the Sunda Strait, with a mangrove height of only 13 m[14].

4. CONCLUSION

Based on the results of the research that has been done, it can be concluded that The species of mangroves found in the research area of the Marine Station of Riau Dumai University consist of 4 species of mangroves, namely *R. apiculata*, *B. gymnorrhiza*, *X. granatum*, and *S. alba* and the most dominating species of the three stations is *R. apiculata*. The condition of mangrove forests is based on density, canopy cover, Important Value Index (IVI), and height of mangrove stands located at the Universitas Riau Dumai Marine Station, which are in good condition. The species commonly found at Marine Stations at

stations I, II, and III is *R. apiculata*, with an IVI value that shows the highest species of *R. apiculata* and the highest altitude value obtained by the species of *S. alba.*

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