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Research article
Impacts of environmental factors: Impact of changing environments

Structure of Mangrove Vegetation in the Coastal Area of Biru Kersik Beach, Kutai Kartanegara Regency

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Abstract: Mangroves are typical littoral plant formations often found along coastal areas in tropics and subtropics. They are also found in several warm climate regions with natural muddy soil and high salinity environments. Therefore, this study aimed to evaluate the structure of mangrove vegetation in the coastal area of Biru Kersik Beach in Kutai Kartanegara Regency, East Kalimantan Province. The study stations were determined using the quadrant transect method for groups of trees, saplings, and seedlings with an area of 10 x 10 m, 5 x 5 m, and 1 x 1 m, respectively. Subsequently, nine mangrove species, *Avicennia rumphiana*, *Rhizophora mucronata*, *Rhizophora apiculata*, *Avicennia officinalis*, *Avicennia alba*, *Aegiceras cornilatum*, *Avicennia marina*, *Scyphiphora hydrophyllacea*, and *Sonneratia alba* were retrieved. Additionally, the dominance index ranged between 0.028 and 0.034, indicating no dominant species. Diversity indexes of 0.904 and 0.549 were obtained at Stations I and II, respectively, which shows that the diversity and distribution of each species and the community stability are low. Meanwhile, Station III had an index of 1.033, indicating that its diversity, distribution of each species, and community stability are in the moderate category.
Keywords: vegetation; mangrove; dominance index; diversity index

库台卡塔内加拉摄政区比鲁·克西克海滩沿海地区红树林植被结构

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摘要:
红树林是典型的滨海植物群，常见于热带和亚热带沿海地区。它们也出现在一些温暖气候地区，具有天然泥质土壤和高盐度环境。因此，本研究旨在评估东加里曼丹省库台卡塔尼加拉县比鲁·克西克海滩沿海地区的红树林植被结构。研究站采用象限样线法确定，树群、幼树和幼苗的面积分别为10×10米、5×5米和1×1米。随后，回收了白骨壤、红树、尖叶红树、白骨壤、白骨壤、桐花树、滨海白骨壤、水椿树和白海桑9种红树植物。此外，优势指数介于0.028和0.034之间，表明没有优势种。I站和II站的多样性指数分别为0.904和0.549，表明各物种的多样性和分布以及群落

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稳定性较低。同时，III站指数为1.033，表明其多样性、物种分布和群落稳定性处于中等水平。

关键词：植被; 红树; 优势指数； 多样性指数

1 Introduction

As an archipelagic country with 17,508 islands, Indonesia has abundant aquatic resources, including mangrove forests in East Kalimantan Province with a total area of 181,671 ha[1]. Furthermore, Biru Kersik Beach, which is located in Marangkayu District, Kutai Kartanegara Regency, has a relatively high potential of becoming a mangrove forest ecosystem. Mangrove is a typical littoral plant formation, which often grows along the coastal areas of tropical and subtropical regions[1] and several warm climate areas[2]. Mangrove forests play an important role in ecology[3,4] and the economy[5]. They are also used in maintaining a range of ecosystem services[6], such as supporting community extractive industries, namely fisheries, crab farming, and timber production[7]. Furthermore, they help in the storage of carbon and function as a coastal defense against storms[8–10]. These forests also can be developed into an environmentally-based tourism destination (ecotourism)[11].

Mangrove forests can naturally grow in muddy soil and high salinity environments, especially in arboreal tropical forest ecosystems[12]. However, the growth of each plant depends on the surrounding environment, which often varies from one place to another[13]. The mangrove ecosystem is dynamic, which indicates that it is growing, developing, successive, and the zones can change. It is also unstable, easily damaged, difficult to recover, complex, and serves as a habitat for various types of terrestrial animals and aquatic biota. The diversity of the ecosystem is closely related to the mangrove vegetation structure in Biru Kersik Beach, Kutai Kartanegara Regency. Therefore, this study investigates the structure of mangrove vegetation in the coastal area of Biru Kersik Beach, Kutai Kartanegara Regency, East Kalimantan Province. The novelty of this special study is related to the structure of a specific tropical mangrove located at Biru Kersik Beach in Kutai Kartanegara Regency, East Kalimantan Province.

2 Materials and Methods

2.1 Research Period and Location

This study was conducted from October–December 2018 in Biru Kersik Beach, Marangkayu District, Kutai Kartanegara Regency. Subsequently, the water quality analysis was performed at the Laboratory of Water, Faculty of Fisheries and Marine, while the substrate was analyzed at the Laboratory of Soil, Faculty of Agriculture, Mulawarman University.

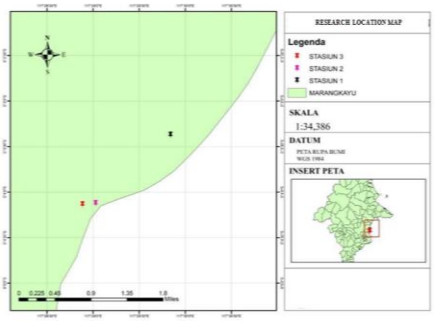

Fig. 1 Map of the research location

2.2 Equipment and Material

The equipment used consists of a Global Position System (GPS), plastic rope, identification book, distance meter, 1.3-m pipe, polyethylene plastic, bottle samples, 30-cm parallon pipe, thermometer, pH meter, refractometer, and camera. Furthermore, the materials include mangrove vegetation, water, and substrate samples.

2.3 Research Methods

A survey was carried out to determine the condition of the study site. The mangrove vegetation was then sampled using the quadrant transect method. The size of the transect line for trees, saplings, and seedlings was 10 x 10 m, 5 x 5 m, and 1 x 1 m, respectively (Fig. 2). The study site was then divided into three stations (plot), which were located on the coastal line of Biru Kersik Beach. Subsequently, the GPS coordinate of each station was recorded to obtain the coordinate of the sampling location.

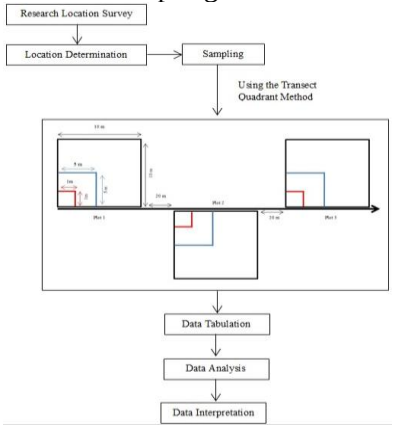

Fig. 2 Flowchart of the research

General descriptions of the study stations:

a. Station I is located in the northern part, next to the groin buildings, which serve as wave breakers and beach's abrasion protector. It also has a sloped surface and contains mangroves along the coast.

b. Stations II and III are located in the southern part and 12 m close to the transportation facilities of fishers.

2.4 Data Collection

2.4.1 Mangrove Data

The data were collected by measuring the trees' diameter, population, as well as identifying their species and number. The mangrove type was determined visually based on the shape of their leaves, fruits, and flowers using the Mangrove Identification Guidebook.

2.4.2 Water

Water samples were collected at each station using a 1-l bottle, after which they were analyzed in the laboratory.

2.4.3 Substrate

Substrate samples were collected using a 30-cm parallon pipe and then analyzed in the laboratory to determine the fraction and texture.

2.5 Data Analysis

The collected data were then calculated using the formulas to obtain their density, relative density, frequency, relative frequency, coverage, relative coverage, important value index, dominance index, and diversity index.

2.5.1 Density

Density (Di) is the number of stands of the species-i in a one-unit area[14]; the formula used is illustrated below:

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

where:
Di - the density of the species-i;
Ni - the total number of stands of the species-i;
A - total area of the sampling location (m^3).

2.5.2 Relative Density

Relative density (RDi) is a ratio between the number of stands of the species-i and the total number of frames for all species[14]. The formula is presented below:

$$RDi = [\frac{Ni}{\sum n}] \times 100\% \quad (2)$$

where:
RDi - relative density;
Ni - number of the species–i stands;
∑n - total number of stands of all species.

2.5.3 Frequency

Frequency (Fi) is the probability of a species-i to be found in a sample plot within the sampling location[14]. The formula is shown below:

$$Fi = \frac{Pi}{\sum f} \quad (3)$$

where:
Fi - the frequency of stand–i;
Pi – the number of plots with samples in which species occurred;
∑f - total number of sample plots in the study.

2.5.4 Relative Frequency

Relative frequency (RFi) is the ratio between the frequency of a species-i and that of the total species[14]. The formula is illustrated below.

$$RFi = [\frac{Fi}{\sum f}] \times 100\% \quad (4)$$

where:
RFi - relative frequency of the species;
Fi - species occurrence frequency;
∑f - total number of sample plots in the study.

2.5.5 Coverage

Coverage (Ci) is the area covered by a species-i in a certain unit area[14] and it is estimated using the following formula:

$$Ci = \frac{\sum BA}{A} \quad (5)$$

where:
Ci – coverage;
∑BA - π/4 (d) = stem diameter at breast height (d) = circumference/π, π = 3.14;
A - total area of the sample plot (m^2).

2.5.6 Relative Coverage

Relative Coverage (RCi) is the ratio between the coverage of a species-i and that of the total species[14]. The calculation is carried out using the formula below:

$$RCi = \left[\frac{Ci}{\sum c}\right] \times 100\% \quad (6)$$

where:
RCi - relative coverage;
Ci - coverage of species-i;
∑c - total coverage for all species.

2.5.7 Important Value Index

The important value index (IVI) defines the influence or roles of certain species in the mangrove ecosystem, and it often ranges between 0 and 300%. The value of the index can be calculated using the assessment below.

a. Formula for tree level:

$$INP = RDi + RFi + RCi \quad (7)$$

b. Formula for saplings and seedlings:

$$INP = RDi + RFi \quad (8)$$

Tab. 1 Criteria for IVI

IVI value (%)	Criteria
0-100	Low
101- 200	Moderate
201- 300	High

2.5.8 Dominance Index

The dominance index (D) is an index that describes the condition of the species. The value of the index can be calculated using the formula below.

$$D = \sum_{n=1}^{s} \left(\frac{Ni}{N}\right)^2 \quad (9)$$

where:
D – the Simpson dominance index;
Ni - number of individuals of species–i;
N - total number of individuals;
S - number of species.

Tab. 2 Criteria of the dominance index

Dominance Index Value	Criteria
D ≤ 0.5	There are no species that dominate other species
D ≥ 0.8	Some species dominate other species

2.5.9 Diversity Index

The diversity index was calculated using the Shannon–Wiener index formula[15]:

$$H' = -\sum pi \ln pi \quad (10)$$

where:
H' – the Shannon–Wiener index;
Pi - the proportion of species-i or importance probability of – i ($pi = \frac{ni}{N}$);
N - total number of individuals of all species.

Tab. 3 Criteria of the diversity index [15]

Diversity Index Value	Criteria
H' < 1	Low
1 ≤ H' ≤ 3.00	Moderate
H' > 3.00	High

3 Results and Discussion

The mangrove forest is the most productive system in the marine environment[16]. Furthermore, it has 75 species in Southeast Asian countries. Indonesia has the highest diversity of 45 species, followed by Malaysia and Thailand with 36 and 35, respectively[17]. Mangroves are taxonomically angiosperm plants[18] with high adaptability to the saline (salt) environment[1,19]. However, the species have varied adaptability, which depends on their growth stage[1]. The plants generally grow and develop in an environment with a salinity of 11-250/00[1] and 2-90$^0/_{00}$[3]. The absorption mechanisms in their roots and leaves also support their adaptability to these conditions. These mechanisms directly play a role in preventing the seawater intrusion and reducing soil and water salinity[1].

3.1 Mangrove Vegetation

Mangrove vegetation is influenced by the maritime climate in the coastal biosphere, tides, salinity, and substrate properties[3]. The results showed that the mangrove vegetation consisted of 5 families and nine species, as shown in Tab. 4.

Tab. 4 Mangrove species on Biru Kersik Beach

Family	Genus	Species	Local Name
Avicenniaceae	Avicennia	*Avicennia rumphiana*	*Api-Api*
		Avicennia marina	
		Avicennia alba	
		Avicennia officinalis	
Rhizophoraceae	Rhizophora	*Rhizophora apiculata*	*Bakau*
		Rhizophora mucronata	
Sonneratiaceae	Sonneratia	*Sonneratia alba*	*Pedada*
Rubiaceae	Scyphiphora	*Scyphiphora Hydrophyllaceae*	*Duduk*
Myrcinaceae	Aegisceras	*Aegisceras cornilatum*	*Gedangan*

The *Avicennia marina* species can tolerate high salinity and grows on mud substrate[1]. Meanwhile, *Rhizophora mucronate* has higher adaptability to environmental factors compared to others. It also grows in an environment with pH, humidity, and moisture content in the ranges of 6.2–6.6, 67-245%, and 45-196%, respectively[1]. *Sonneratia alba* can grow along the sandy and rocky coastal line, but it tends to dominate the sandy area. Subsequently, *Rhizophora mucronate* and *Avicennia marina* species are widely distributed in muddy areas[20].

3.2 Distribution of Mangrove Vegetation on Biru Kersik Beach

Vegetation is an assemblage of plants, consisting of several species in one region, where they interact. Differences in their distribution are caused by environmental conditions such as substrates, salinity, wave crashes, and tides[1].

Furthermore, the distribution of mangrove vegetation at Stations I, II, and III is illustrated in the tables below.

3.2.1 Distribution of Mangrove Vegetation at Station I

Based on the distribution of mangrove vegetation for each tree, *Rhizophora apiculate* had the highest RDi, RFi, RCi, and INP of 32.26%, 26.67%, 35.65%, and 94.57%, respectively (Tab. 5).

Tab. 5 Distribution of mangrove vegetation for trees

Species	Di	RDi	Fi	RFi	Ci	RCi	INP
Avicennia rumphiana	2.00	19.35	0.60	20.00	9.546	33.40	72.75
Rhizohora mucronata	2.00	19.35	0.60	20.00	1.728	6.05	45.40
Rhizohora apiculata	3.33	32.26	0.80	26.67	10.189	35.65	94.57
Avicennia officinalis	2.33	22.58	0.60	20.00	7.048	24.66	67.24
Avicennia alba	0.33	3.226	0.20	6.67	0.032	0.11	10.00
Aegiceras cornilatum	0.33	3.226	0.20	6.67	0.032	0.13	10.02
Total	10.33	100	3.00	100	28.58	100	300

The distribution of mangrove vegetation for saplings revealed that *Rhizophora mucronate* species had the highest RDi, RFi, and INP of 46.15%, 33.33%, and 79.49%, respectively (Tab. 6).

Tab. 6 Distribution of mangrove vegetation for saplings

Species	Di	RDi	Fi	RFi	INP
Avicennia rumphiana	1.00	23.08	0.40	22.22	45.30
Rhizohora mucronata	2.00	46.15	0.60	33.33	79.49
Rhizohora apiculata	1.00	23.08	0.40	22.22	45.30
Avicennia officinalis	0.33	7.692	0.40	22.22	29.91
Total	4.33	100	1.80	100	200

The distribution of mangrove vegetation for the seedlings showed that the highest RDi and IVI values of 44.44% and 64.44% were obtained from *Avicennia rumphiana*. Furthermore, the highest RFi of 30.00% was recorded in *Rhizophora mucronata* and *Avicennia officinalis*, as shown in Tab. 7.

Tab. 7 Distribution of mangrove vegetation for seedlings

Species	Di	RDi	Fi	Rfi	INP
Avicennia rumphiana	4.00	44.44	0.40	20.00	64.44
Rhizohora mucronata	2.33	25.93	0.60	30.00	55.93
Rhizohora apiculata	1.00	11.11	0.20	10.00	21.11
Avicennia officinalis	1.33	14.81	0.60	30.00	44.81
Avicennia alba	0.33	3.70	0.20	10.00	13.70
Total	9.00	100	2.00	100	200

3.2.2 Distribution of Mangrove Vegetation at Station II

The mangrove species found at Station II were *Avicennia officinalis, Avicennia rumphiana,* and *Avicennia marina.*

The distribution of mangrove vegetation for trees revealed that the highest RDi, RCi, and IVI were obtained from *Avicennia marina* species with values of 50.00%, 71.62%, and 150.19%, respectively. Furthermore, the highest RFi of 57.14% was recorded in *Avicennia officinalis* species, as shown in Tab. 8.

Tab. 8 Distribution of mangrove species for trees

Species	Di	RDi	Fi	RFi	Ci	Rci	INP
Avicennia officinalis	4.33	46.43	0.80	57.14	8.681	27.41	130.99
Avicennia rumphiana	0.33	3.57	0.20	14.29	0.305	0.96	18.82
Avicennia marina	4.67	50.00	0.40	28.57	22.68	71.62	150.19
Total	9.33	100	1.40	100	31.667	100	300

The distribution of mangrove vegetation for saplings revealed that the highest RDi, RFi, and IVI were obtained from *Avicennia officinalis* species with values of 87.50%, 75.00%, and 162.50%, respectively, as shown in Tab. 9.

Tab. 9 Distribution of mangrove species for saplings

Species	Di	RDi	Fi	Rfi	INP
Avicennia officinalis	2.33	87.50	0.60	75.00	162.50
Avicennia marina	0.33	12.50	0.20	25.00	37.50
Total	2.67	100	1.00	100	200

The distribution of mangrove vegetation for seedlings showed that the highest RDi, RFi, and IVI values were recorded in *Avicennia officinalis* species: 50.00%, 40.00%, and 90.00%, respectively. Furthermore, the highest relative frequency of 40.00% occurred in *Avicennia marina* species, as shown in Tab. 10.

Tab. 10 Distribution of mangrove species for seedlings

Species	Di	RDi	Fi	RFi	INP
Avicennia	2.33	50.00	0.40	40.00	90.00

officinalis					
Avicennia rumphiana	0.33	7.14	0.20	20.00	27.143
Avicennia marina	2.00	42.86	0.40	40.00	82.857
Total	4.67	100	1.00	100	200

3.2.3 Distribution of Mangrove Vegetation at Station III

The distribution of mangrove vegetation for trees in station III revealed that the highest RDi, RFi, RCi, and IVI were obtained from *Sonneratia alba* species with values of 44.00%, 27.27%, 63.91%, and 135.18%, respectively, as shown in Tab. 11.

Tab. 11 Distribution of mangrove species for trees

Species	Di	RDi	Fi	RFi	Ci	RCi	INP
Sonneratia alba	3.67	44.00	0.60	27.27	20.63	63.91	135.18
Avicennia rumphiana	0.67	8.00	0.20	9.09	5.731	17.75	34.84
Avicennia mucronate	1.67	20.00	0.40	18.18	4.313	13.36	51.54
Avicennia officinalis	1.00	12.00	0.40	18.18	1.457	4.514	34.70
Scyphiphora hydrophyllacea	0.67	8.00	0.40	18.18	0.119	0.368	26.55
Avicennia marina	0.67	8.00	0.20	0.90	0.031	0.097	17.19
Total	8.33	100	2.20	100	32.29	100	300

The distribution of mangrove vegetation for saplings in station III showed that the highest RDi, RFi, and IVI occurred in Avicennia officinalis species with values of 58.82%, 40.00%, and 98.82%, respectively. Furthermore, the highest relative frequency of 40.00% was recorded in the Sonneratia alba species, as shown in Tab. 12.

Tab. 12 Distribution of mangrove species for saplings

Species	Di	RDi	Fi	RFi	INP
Sonneratia alba	0.67	11.76	0.40	40.00	51.76
Rhizophora apiculata	1.67	29.41	0.20	20.00	49.41
Avicennia officinalis	3.33	58.82	0.40	40.00	98.82
Total	5.67	100	1.00	100	200

The distribution of mangrove vegetation for seedlings in station III revealed that the highest RDi of 37.84% was obtained from the *Rhizophora mucronate* species, while the highest RFi and IVI were recorded in *Avicennia officinalis* with values of 42.86 % and 72.59%, respectively, as shown in Tab. 13.

Tab. 13 Distribution of mangrove species for seedlings

Species	Di	RDi	Fi	RFi	INP
Avicennia officinalis	3.67	29.73	0.60	42.86	72.59
Rhizophora apiculata	4.00	32.43	0.40	28.57	61.00
Rhizophora mucronata	4.67	37.84	0.40	28.57	66.41
Total	12.33	100	1.40	100	200

The important value index obtained for Biru Kersik Beach was in the medium category. Furthermore, the highest IVI value of 94.57% at Station I at the tree level was recorded in *Rhizophora apiculata*. This species predominantly grows on soft substrates (mud) and has a high salinity tolerance[13]. Its ability to adapt to loamy substrates is supported by the presence of stilt roots, which support the stem in a muddy substrate. They also help the plant maintain an upright position when exposed to strong winds, waves, and erosion[1]. *Avicennia marina*, which grew on mud substrates, had the highest IVI value at Station II at the tree level with a value of 150.19%. The species can tolerate low salinity up to a level of $90^0/_{00}$[1]. Furthermore, *Sonneratia alba*, which grew on mud-sand substrates, had the highest IVI value of 135.50% at Station III at the tree level. This species can also grow on coral reef fragments[1].

The distribution of mangrove vegetation for seedlings at Station III revealed that the highest RDi of 37.84% was obtained from the *Rhizophora mucronate* species, while the highest RFi and IVI were recorded in *Avicennia officinalis* with values of 42.86% and 72.59%, respectively, as shown in Tab. 13.

3.3 Structure of Mangrove Vegetation on Biru Kersik Beach

Calculating the dominance and diversity index is a way to determine the mangrove vegetation structure. Furthermore, the diversity of species and the construction of the forests are influenced by climate, tidal amplitude, and geomorphology[2,21]. Geomorphology is the location where the growth and development of mangroves occur. Its factors include tides, erosion, sedimentation, and soil types[1]. Tab. 14 shows the dominance and diversity index obtained on Biru Kersik Beach.

Tab. 14 Dominance and diversity indices

Station	Dominance Index	Diversity Index
I	0.030	0.904
II	0.028	0.549
III	0.034	1.033

The calculation result revealed that the highest dominance index was recorded at Station III with a value of 0.034. This indicates that there are no dominant mangrove species in the coastal area of Biru Kersik Beach. The index value was influenced by the number of individuals or species in the area[22]. The diversity index values obtained at stations I and II were in a low category, which indicates that the diversity, individual distribution, and community stability were low. Meanwhile, the index recorded at Station III was in the medium category, which indicates that the diversity, individual distribution, and community stability were moderate. Mangrove forests' composition, growth, and structure vary based on geophysics, geography, geology, hydrographic, biogeographical, climatic, edaphic, and other environmental factors[3].

3.4 Mangrove Zoning Pattern on Biru Kersik Beach

Mangrove forests can form plant communities and zoning, which are influenced by physical environmental factors such as inundation frequency, soil type, species dominance, waves crashing, tides, and salinity. Furthermore, the interaction between the physical environment and plant species causes the formation of certain vegetation zones; hence, each region has a different pattern[1]. The results showed that the distribution pattern of mangrove vegetation at Station I was divided into sea-facing and middle zones. The sea-facing zone was dominated by *Avicennia rumphiana, Avicennia officinalis, Avicennia alba,* and *Aegiceras cornilatum* species, while the intermediate zone was covered with *Rhizophora mucronata* and *Rhizophora apiculata* species. The sea-facing zone tends to have high salinity, soft muddy substrate, and contains vegetation with strong roots (pioneer zone). The root system helps the mangroves withstand waves and sedimentation accumulation[1]. The middle zone or *Rhizophora* zone is located behind the *Avicennia* zone. It has low salinity, a soft muddy substrate, and is inundated at high tide[1].

The zoning pattern at station II is a sea-facing zone, which is dominated by *Avicennia officinalis, Avicennia rumphiana,* and *Avicennia marina* species. Meanwhile, the zoning pattern at station III is a front zone that is close to the sea and dominated by *Avicennia rumphiana, Avicennia officinalis, Avicennia marina,* and *Sonneratia alba.* It is also associated with the mangrove species *Rhizophora mucronata, Rhizophora apiculata*, and *Scyphiphora hydrophyllaceae*.

3.5 Substrate

A substrate is a solid material derived from the weathering of rocks, sediments, which consist of biogenic materials derived from organisms, autogenic materials derived from marine chemical processes, and residual detritus material[23]. The results showed that the substrate consisted of three fractions, namely sand, silt, and clay, while its textures were sand, sandy loam, and loamy sand. The clay fraction content was greater than the sand and silt fraction. Tab. 15 shows the substrate analysis results at Stations I, II, and III.

Tab. 15 The substrate analysis results

Station	Fraction			Texture
	Sand	Dust	Clay	
I	4.30	3.05	92.65	Sand
II	6.75	17.08	76.17	Sandy Loam
III	7.31	11.97	80.72	Loamy Sand

The mangrove substrate is affected by waterlogging because it is located in the tidal zone[24]. The plants grow well on soft substrates or muddy areas, but some species can grow on sandy, rocky, gravel, peat soils, or regions with coral fragments[25].

3.6 Environmental Parameters

Environmental factors play an important role in supporting the growth of all living beings[26], including mangroves. Furthermore, temperature, rainfall, and cyclone frequency affect the structural variability of the plants on local and regional scales[2]. The parameters measured include temperature, salinity, and pH. Tab. 16 shows the measurement results of environmental parameters at Stations I, II, and III.

Tab. 16 The environmental parameter measurement analysis results (Decision of the Minister of Environment and Forestry No. 51 of 2004)

Parameter	Unit	Station			Marine Water Quality Standard for Aquatic Biota
		I	II	III	
Temperature	^{0}C	28	28	29	28-30
Salinity	ppt	28	30	28	33-34
Water pH	-	7.77	7.57	7.34	7–8.5
Soil pH	-	6.46	6.28	6.71	-

The temperature was measured as an environmental parameter and ranged between 28 and 29ºC. The optimum value obtained for mangroves was 28-32ºC, implying that all stations can support their growth. Salinity at all stations was relatively high, and it was within the range of 28-30 ppt. The high values obtained are related to the tidal fluctuations at the study station. The temperature and salinity of mangrove forests are affected by tides[1]. The degree of water acidity ranged from 7.34 to 7.77, and the variation of pH indicates that the environmental conditions at all stations were slightly alkaline. Meanwhile, the soil pH was neutral, and the values ranged between 6.28 and 6.71.

4 Conclusions

The novelty of this special study is related to the structure of a specific tropical mangrove located at Biru Kersik Beach in Kutai Kartanegara Regency, East Kalimantan Province. The research conducted was limited to a certain location, namely Biru Kersik Beach in Kutai Kartanegara Regency, East Kalimantan Province. Based on the results of the study, the Biru Kersik Beach in Kutai Kartanegara Regency, East Kalimantan Province, has a relatively high potential to be developed into mangrove forest ecosystems. Furthermore, the mangrove species found in the area include *Avicennia rumphiana, Rhizophora mucronata, Rhizophora apiculata, Avicennia officinalis, Avicennia alba, Aegiceras cornilatum, Avicennia marina, Scyphiphora hydrophyllacea*, and *Sonneratia alba.* The dominance index ranged between 0.028 and 0.034, which indicates that there are no dominant species. The diversity indices at Stations I and II were 0.904 and 0.549, respectively. These values were categorized as low, indicating that each species' diversity, individual distribution, and community stability were low. However, Station III had a medium diversity index of 1.033; which indicates that each species' diversity, individual distribution, and community stability were moderate. The structure of mangrove vegetation was influenced by environmental parameters such as temperature, salinity, and water and soil pH.

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