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Structure and composition of mangrove vegetation in the Lakkang Delta and Lantebung, Makassar City, South Sulawesi, Indonesia

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Abstract

As a type of coastal vegetation, mangroves are valuable, unique, and vulnerable. Mangrove ecosystems have a distinctive vegetation structure, which consists of several characteristics sequentially, such as trees, saplings, poles, and seedlings. This study aims to assess and monitor the structure and composition of mangrove vegetation in Makassar City, South Sulawesi. Field surveys were conducted to measure and monitor mangroves in two different areas, namely coastal areas and small islands. The highest mangrove density is at Station 2, which is 0.59 ind/m^2, which is a river area. The station with the lowest density is at Station 1, which has a value of 0.23 ind/m^2, which is a coastal area. *Avicennia marina*, *Rhizophora apiculata* and *Acanthus ilicifolius* were found to have the highest importance value index. Location 1 is the least stable because it only has the *Avicennia marina* mangrove species. Meanwhile, at location 3 (Lakkang Island, a small island), there are variations in the value of each index, although it is still in the low category. This means that in general, each research location has a less stable ecosystem. Furthermore, this study can contribute to conservation, biodiversity assessment, and sustainable mangrove ecosystem management strategies.
Keywords: *mangrove vegetation, density, Importance Value Index, Diversity Index, Uniformity Index*

Introduction

The biodiversity found in coastal areas consists of three levels, namely genetic diversity, species diversity, and ecosystem diversity. One of the ecosystem diversity that is often found on the coast is the mangrove ecosystem. As one of the coastal ecosystems, the mangrove ecosystem is unique and vulnerable (Supriadi et al., 2015). The mangrove ecosystem has a distinctive vegetation structure, compiling several characteristics sequentially, such as trees, saplings, poles, seedlings, and germination, to form a series of certain zones. There are several zoning systems that affects the types of mangrove vegetation, such as Avicennia, Rhizophora, Brugueria, and Nypah (Cahyanto & Kuraesin, 2013). In general, mangroves can grow in four zones: the open zone, the middle zone, the zone that has rivers of brackish to almost fresh water, and the land border zone, which has fresh water. Differences in the formation of mangrove zoning are caused by tides and currents that carry sediment and substrate (Farista & Virgota, 2021).

Indonesia, an archipelagic country consisting of 17,508 large and small islands, has the largest mangrove ecosystem in the world, which is around 3.24 million hectares, or about 27% of the world's total mangrove forest, which reaches 16.9 million ha (Handono et al., 2014). Mangroves have various functions both ecologically, especially in coastal areas, and economically for humans. In terms of ecological functions, mangrove resources have several functions seen from several aspects, including physical, chemical, and biological aspects. Ecological function: In terms of physical protection, mangroves are a significant type of protected coastal wetland that guard against wave damage, fix sand, purify water, and encourage siltation and land creation. Wang et al. (2022) resist disasters such as wind, hurricanes, and floods (Warpur, 2016). Vegetation mangroves, prevent the shore from eroding and stabilize it, The root system of mangrove vegetation can withstand erosion caused by sea waves (Farista & Virgota, 2021). Sediments in the waves may be caught by mangroves (Raju & Arockiasamy, 2022). Chemical Aspect: Mangroves have a significant role in the carbon cycle and biodiversity (Hu et al., 2020), decreasing marine pollution, removing impurities from water, preserving the variety of marine organisms, and advancing the global carbon cycle, ecotourism, and science education (Wang et al., 2022). Biological function, habitat, spawning grounds, nursery grounds, and feeding grounds (Supriadi et al., 2015). In addition, as a provider of nutrients (nutrient cycling) and habitat for birds, reptiles, and mammals (Ardiansyah et al., 2012), aquatic biota such as fish, shrimp, and crabs (Cahyanto & Kuraesin, 2013), and for additional creatures like birds and fish (Hu et al., 2020). Additionally, mangroves govern many ecological functions, including biological control, water quality regulation, erosion control, wave attenuation, sediment accumulation, and biodiversity preservation (Machava-António et al., 2022).

In terms of economic function, there are three main sources of mangroves: forest products, coastal fisheries, and nature tourism. According to Ardiansyah et al. (2012), mangrove forests provide a very diverse and valuable product to coastal communities at the local, regional, and global levels. Some of the ecosystem services provided consist of wood products (e.g., timber, poles, firewood, and charcoal) and non-timber products (salt production, tannins, beekeeping for honey production, fisheries, aquaculture, medicines, cultural, and aesthetic values) (Machava-António et al., 2022). Tropical wetlands with mangroves have long been recognized as key nursery areas for many commercially and ecologically important consumers, such as fish and crustaceans (Muro-Torres et al., 2020).

This emphasizes the significance of mangrove forests to such ecosystems since they provide habitat to a variety of animals that are essential trophic chain components in addition to being the most significant primary food source (Muro-Torres et al., 2020). Seeing the great role and benefits of mangrove forests, not a few faunas can associate with mangrove plants and their surroundings, thus producing nutrients for organisms supported by various types of mangrove vegetation that make the mangrove vegetation area a comfortable and safe place for other living things.

Mangrove forests serve many purposes and provide many benefits that are critical to the biological, ecological, physical, and socio-economic well-being of their inhabitants (Pesiu et al., 2022). However, mangroves disappear annually by 1% to 2% (Raju & Arockiasamy, 2022). Over the past century, about 35% of the area with mangrove forests has been lost (Hu et al., 2020). Mangroves continue to be threatened by high population growth occupying coastal areas, causing an increase in demand for aquaculture and agricultural products (Pham et al., 2019). Some humans fulfill their needs by intervening in the mangrove ecosystem. This can be seen from the conversion of land (mangroves) into ponds, settlements, industries, and logging by the community for various purposes, especially in big cities, which are experiencing a faster decline (Branoff & Martinuzzi, 2020).

Several studies have been carried out related to the structure of mangroves, including one by Hilmi et al. (2015) examining the community structure, zoning, and biodiversity of mangrove vegetation in Segara Anakan Cilacap. Saru et al. (2017) studied the structure of mangrove vegetation in the Mampie wildlife reserve area, and the results showed the area was categorized as quite diverse (5-7 species). Mangrove vegetation in the area only grows in intertidal areas, where it will experience inundation at the highest tide. Pesiu et al. (2022) measured base area, stand density, the Important Value Index, species diversity, and above-ground biomass to evaluate the tree species composition and forest species variety in Terengganu's Wetlands. Al-Qthanin & Alharbi (2020), which assess the genetic diversity of natural populations, can support the improved conservation of *Avicenna marina* in the Farasan archipelago.

This study aims to assess and monitor the structure and composition of mangrove vegetation in Makassar City, South Sulawesi. A field survey was conducted to measure and monitor mangroves in two different areas, namely coastal areas and small islands. The concept of mangrove forest management requires criteria and indicators to ensure a balance between the economic, social, and ecological dimensions of development. This will provide something that the community as a whole want. Mangrove ecosystems, like other vegetative ecosystems, can be arranged in a hierarchy from an ecological point of view. The main idea of this theory is about how the hierarchical levels differ in terms of structure (Kamal et al., 2014).

Given the importance of the role and benefits of mangroves, it is necessary to apply the principles of maintaining, studying and making the best possible use of them. One of them can be done by studying the structure of mangrove vegetation. Understanding the structure of mangrove vegetation can provide important information about identifying important mangrove species for management. Pham et al. (2019) assessment and monitoring of forest biodiversity in coastal areas is very important for sustainable forest management and can explain the importance of conservation and its subsequent results that will assist the policies needed to manage and control human activities so as to produce a good balance between mangrove ecosystems and human activities.

Methodology

Study area

This research was conducted in Makassar City, South Sulawesi, Indonesia, as shown in Figures 1 and 2.

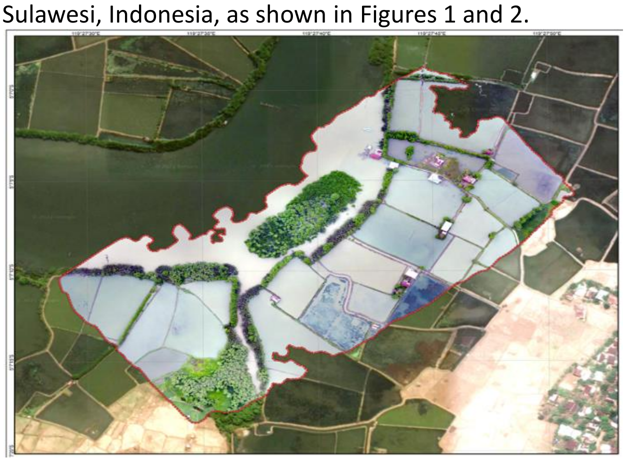

Figure 1: Lakkang Delta

Figure 2: Lantebung

Makassar City hosts 208.04 ha of mangrove forests and can potentially become an ecotourism area and an income source for coastal communities in Makassar City (Arfan et al., 2022). Measurement and monitoring of mangrove vegetation were carried out in the coastal area of Lantenbung, Bira Village, Tamalanrea District and the island of Lakkang, Lakkang Village, Tallo District. The area was chosen to represent the mangrove zoning as accurately as possible and to compare the structural properties and composition of the mangroves within it.

Data collection

The method used in this study is the ecological approach using the quadratic transect method (Warpur, 2016). Observation of the structure and composition of mangrove vegetation was carried out using the sample plot method, which is a modification of the method used by Mueller, Dumbois, and Ellenberg (Renta et al., 2016). Each research station has three plots measuring 10x10 m. Within each 10x10 m plot, a 5x5 m subplot was created, and the 5x5 m plot was made up of a 1x1 m subplot. Each plot has a different function. A 10 x 10 m plot was used to collect tree data with a tree trunk diameter of 4 cm. The 5 x 5 m plot was used to collect data on tillers (saplings) with a diameter of 1-4 cm and a height of > 1 m. while the plot measuring 1 x 1 m is used for data collection for seedlings with a height of 1 m. To identify mangrove vegetation, biological samples were taken in the form of leaf, flower, and fruit components, and the trunk circle of each mangrove tree was measured at chest height (Akbar et al., 2017).

Data analysis

Data analysis was carried out quantitatively to determine the structure and composition of mangrove vegetation. The scope of the structure of mangroves in this study includes density, frequency, dominance, important value index, diversity index, and uniformity index.

The equations for density (KR) and specific frequency (FR) follow from Handono et al. (2014) sequentially as follows:

Density (KR) = 100% x K

$$\text{where, K} = \frac{\text{Number of individual mangroves}}{\text{Total individual mangrove}}$$

Frequency Type (FR) = 100% x F

$$\text{where, F} = \frac{\text{Number of plots where species are found}}{\text{Total number of sample plots created}}$$

The equations for dominance (DR), important value index (called indeks nilai penting or INP), and diversity index (H') follow from (Renta et al., 2016) sequentially as follows:

$$\text{Dominance } (DR) = \frac{\text{Basal area of each type (BA)}}{\text{Total basal area}}\ x\ 100$$

Dominance for the seeding category

$$DR = \frac{\text{Average mean percentage of each species (Coi)}}{\text{Total percentage of all mangrove species (Co)}}\ x\ 100$$

Important Value Index (INP) = KR + FR + DR

Diversity index (H') = log N - $\frac{1}{N}\sum$ ni log ni

H' value range

H' ≤ 2,0 = Low level of diversity, high ecological pressure

2,0 < H' ≤ 3,0 = Medium level of diversity, moderate ecological pressure

H' > 3,0 = High level of diversity, low ecological pressure

The equation of uniformity index (E) and Simpson's dominance index (C) follows Supriadi et al., (2015) sequentially as follows:

$$E = \frac{H'}{H'max} \qquad H'max = \ln S$$

0 < E ≤ 0,5 = The ecosystem is under stress and uniformity is low

0,5 < E ≤ 0,75 = Ecosystem is in less stable condition and moderate uniformity

0,75 < E ≤ 1,0 = Ecosystem is in stable condition and high uniformity

$$C = \frac{1}{N^2}\sum_{i=1}^{s} n_i^2$$

Value range

0 < E ≤ 0,5 = Low dominance (there are no species that extremely dominate other species), stable environmental conditions, and no ecological pressure on biota in the location

0,5 < E ≤ 0,75 = Moderate dominance and fairly stable environmental conditions

0,75 < E ≤ 1,0 = High dominance (there are species that extremely dominate other species), unstable environmental conditions, and there is ecological pressure on biota in the location.

Results

Measurement location 1 was carried out near the river flow in the Lantenbung mangrove ecotourism area, Bira Village, Tamalanrea District, Makassar City.

Measurement location 2 was carried out in the coastal area in the Lantenbung mangrove ecotourism area, Bira Village, Tamalanrea District, Makassar City.

Measurement location 3 was carried out on Lakkang Island, Lakkang Village, Tallo District, Makassar City.

Comparison of the physical condition of each station in terms of tree density values and tree community structure is shown in Tables 4 and 5.

The results of measurements and data analysis are presented in Tables 1 to 5.

Table 1: Measurement results of mangrove vegetation structure at location 1

Tree												
Mangrove Type	**Ni**	**K (ind/m²)**	**KR (%)**	**F**	**FR (%)**	**Bai (m²)**	**D (m²/ha)**	**DR (%)**	**INP**	**H**	**E**	**C**
Avicenna marina	23	0,23	100	1	100	0,2768	27,68	100	300	0,0	0,0	1
Total	23	0,23	100	1	100	0,2768	27,68	100	300	0,0	0,0	1

Sapling												
Mangrove Type	**Ni**	**K (ind/m²)**	**KR (%)**	**F**	**FR (%)**	**Bai (m²)**	**D (m²/ha)**	**DR (%)**	**INP**	**H**	**E**	**C**
Avicenna marina	15	0,30	100	1	100	0,00	0,00	0	200	0,0	0,0	1
Total	15	0,30	100	1	100	0,00	0,00	0	200	0,0	0,0	1

Seedling												
Mangrove Type	**Ni**	**K (ind/m²)**	**KR (%)**	**F**	**FR (%)**	**Bai (m²)**	**D (m²/ha)**	**DR (%)**	**INP**	**H**	**E**	**C**
Avicenna marina	7	3,00	100	1	100	0,00	0,00	0	200	0,0	0,0	1
Total	7	3,00	100	1	100	0,00	0,00	0	200	0,0	0,0	1

Table 2: Measurement results of mangrove vegetation structure at location 2

Tree												
Mangrove Type	**Ni**	**K (ind/m²)**	**KR (%)**	**F**	**FR (%)**	**Bai (m²)**	**D (m²/ha)**	**DR (%)**	**INP**	**H**	**E**	**C**
Rhizopora apiculata	59	0,59	100	1	100	0,15	15,37	100,00	300	0,00	0,00	1,00
Total	59	0,59	100	1	100	0,15	15,37	100,00	300	0,00	0,00	1,00

Sapling												
Mangrove Type	**Ni**	**K (ind/m²)**	**KR (%)**	**F**	**FR (%)**	**Bai (m²)**	**D (m²/ha)**	**DR (%)**	**INP**	**H**	**E**	**C**
Rhizopora apiculata	10	0,40	100	1	100	0,00	0,00	0,00	200	0,00	0,00	1,00
Total	10	0,40	100	1	100	0,00	0,00	0,00	200	0,00	0,00	1,00

Seedling												
Mangrove Type	**Ni**	**K (ind/m²)**	**KR (%)**	**F**	**FR (%)**	**Bai (m²)**	**D (m²/ha)**	**DR (%)**	**INP**	**H**	**E**	**C**
Rhizopora apiculata	6	0,75	100	1	100	0,00	0,00	0,00	200	0,00	0,00	1,00
Total	6	0,75	100	1	100	0,00	0,00	0,00	200	0,00	0,00	1,00

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Table 3: Measurement results of mangrove vegetation structure at location 3

Tree												
Mangrove Type	**Ni**	**K (ind/m²)**	**KR (%)**	**F**	**FR (%)**	**BAi (m²)**	**D (m²/ha)**	**DR (%)**	**INP**	**H'**	**J'**	**D'**
Rhizopora mucronata	28	0,28	87,50	1	50	0,28	28,37	100,00	237,5	-0,12	-0,17	0,77
Nypa frutican	4	0,04	12,50	1	50	0,00	0,00	0,00	62,50	-0,26	-0,19	0,02
Total	32	0,32	100,00	2	100	0,28	28,37	100,00	300,0	0,12	0,17	0,77

Sapling												
Mangrove Type	**Ni**	**K (ind/m²)**	**KR (%)**	**F**	**FR (%)**	**Bai (m²)**	**D (m²/ha)**	**DR (%)**	**INP**	**H'**	**J'**	**D'**
Rhizopora mucronata	7	0,28	100,00	1	100	0,00	0,00	0,00	200	0,00	0,00	1,00
Total	7	0,28	100,00	1	100	0,00	0,00	0,00	200	0,00	0,00	1,00

Seedling												
Jenis Mangrove	**Ni**	**K (ind/m²)**	**KR (%)**	**F**	**FR (%)**	**Bai (m²)**	**D (m²/ha)**	**DR (%)**	**INP**	**H'**	**J'**	**D'**
Rhizopora mucronata	62	15,50	96,88	1	50	0,00	0,00	0,00	146,9	-0,03	-0,02	0,94
Acanthus ilicifolius	2	0,50	3,13	1	50	0,00	0,00	0,00	53,13	-0,11	-0,08	0,01
Total	64	16,00	100,00	2	100	0,00	0,00	0,00	200	0,14	0,10	0,94

Table 4: Physical conditions of observation stations based on tree density values

Location Point	Density (ind/ha)	Category
1	2.300	Tightly (good)
2	5.900	Tightly (good)
3	2.800	Tightly (good)

Table 5: Physical condition of observation stations based on tree community structure

Location Point	Diversity Index		Uniformity Index		Dominance Index	
	Score	Category	Score	Category	Score	Category
1	0,00	Low	0,00	Low	1,00	High
2	0,00	Low	0,00	Low	1,00	High
3	0,12	Low	0,17	Low	0,77	High

Discussion

Vegetation structure is a spatial arrangement of vegetation. The arrangement of mangrove vegetation consists of a vertical (stratification) and horizontal (individual distribution) arrangement. In this study, the stratification of mangrove vegetation in mangrove forests in Makassar is indicated by the growth rate. Based on sampling at the research site using transects, it was determined that the mangrove species encountered were *Avicenna marina, Rhizophora apiculata, Rhizophora mucronata, Nypa fructican*, and *Acanthus ilicifolius*. The calculation of the analysis of the mangrove vegetation structure is grouped into three categories: the tree category, the sapling category, and the seedling category.

In Table 1, it can be seen that at the measurement point there were 23 trees, 15 saplings, and 7 seedlings of the *Avicennia marina* species. The tree density is 0.23 ind/ha, or 2,300 ind/ha; the soil density is 0.30 ind/m^2 or 3,000 ind/ha; and the seedling density is 1.5 ind/m^2 or 15,000 ind/ha. The frequency is 1, or the relative frequency at each vegetation level is 100 %. The basalt area is 0.276 m^2, so the dominance is 27.68 m^2/ha with a relative dominance level of 100%. The importance index for the *Avicennia marina* species is 300 %. The diversity and uniformity index is 0, while the dominance index is 1. The mangrove density level at measurement location 1 is in the "good" category. The only type of mangrove found at the location is *Avicennia marina*, so that type plays an important role in the surrounding ecosystem. A value of 1 in the dominance index indicates that the species grows in groups and dominates the area where it grows.

In Table 2, it can be seen that at the measurement point there were 59 trees, 10 saplings, and 7 seedlings of the *Rhizophora apiculata* species. The tree density is 0.59 ind/m^2 or 5,900 ind/ha; the soil density is 0.40 ind/m^2 or

4,000 ind/ha; and the seedling density is 1.5 ind/m^2 or 15,000 ind/ha. The frequency is 1, or the relative frequency at each vegetation level is 100 %. The basalt area is 0.1537 m^2, so the dominance is 15.37 m^2/ha with a relative dominance level of 100 %. The Important Value Index for *Rhizpora Apiculata* is 300 %. The diversity and uniformity index is 0, while the dominance index is 1. The mangrove density level at measurement location 2 is in the good or solid category. The only type of mangrove found at the location is *Rhizophora apiculata*, so that species plays an important role in the surrounding ecosystem. A value of 1 in the dominance index indicates that the species grows in groups and dominates the growth location area, similar to location 1.

In Table 3, it can be seen that at the measurement point there were 32 trees, 7 saplings, and 64 seedlings of various types. The tree density is 0.32 ind/m^2 or 3200 ind/ha, the shrub density is 0.28 ind/m^2 or 2800 ind/ha, and the seedling density is 1.5 ind/m^2 or 15,000 ind/ha. The frequency is 1, or the relative frequency at each vegetation level is 100 %. The basalt area is 0.2837 m^2, so the dominance is 28.37 m^2/ha with a relative dominance level of 100 %. The Important Value Index of mangrove species includes *Rhizophora mucronata* (237.5 %), *Nypa fructican* (62.50 %), and *Acanthus ilicifolius* (53.13 %). At the tree level, the diversity and uniformity indexes are 0.12 and 0.17, which indicate diversity, low uniformity, and uneven distribution, while the dominance index is 0.766. The mangrove density level at measurement location 3 is classified as "good" or "solid." The types of mangroves found at the location consisted of *Rhizophora mucronata*, *Nypa fructican*, and partly *Achantus ilicifolius*, so each of these species played an important role in the surrounding ecosystem. The value of 0.766 in the dominance index indicates that these species grow in groups and dominate the area where they grow. At the seedling level, it can be seen that of *Rhizophora mucronata*, 62 individuals were most commonly found in the location. If all these seedlings grow up, then the measurement area will dominate the ecosystem and play an important role in its surroundings.

The high significance value illustrates that these species are able to compete with their environment and are called dominant species, which in this study were found at each observation point sequentially, namely *Avicennia marina, Rhizophora apiculata*, and *Rhizophora mucronata*. The *Avicennia marina* with the highest importance was also found in Maputo Bay, Eastern Africa (Machava-António et al., 2022). On the other hand, a low INP indicates that the species is less able to compete with the surrounding environment and with other species, which in this study was found at point 3 for *Nypa fructican* and *Acanthus ilicifolius*. These three types of mangrove vegetation can be reduced from year to year due to their low resistance to natural phenomena (Renta et al., 2016). Furthermore, according to Sani et al. (2019), a low INP means that its presence does not have too much influence on the ecosystem.

Assessment of physical conditions based on density shows that the higher the density value, the better the condition of mangroves. Table 4 shows that the highest tree density is at station 2 with a value of 5,900 Ind/ha, which is a river area. While the station with the lowest density is station 1, with a value of 2,300 Ind/ha, which is a coastal area. This is in line with what was stated by (Saru et al., 2017), who stated that the highest density of mangroves is found in areas that are not affected by tides at all and areas that are slightly affected by tides, while the lowest density is found in areas affected by tides. In general, all observation points are in good condition in terms of mangrove density.

Based on table 5, it can be seen that Locations 1 and 2 have a low diversity index and uniformity index because Location 1 only has *Avicennia marina* mangrove species. This type of mangrove is also the most common mangrove species in the Red Sea, *Avicennia marina*, found in patches around the coast of the Farasan Islands (Al-Qthanin and Alharbi, 2020). As for location 2, only the mangrove species *Rhizophora apiculata* were found. While at location 3, there are variations in the value of each index, although it is still in the low category because several types of mangroves were found, including *Rhizophora mucronata, Nypa fructican*, and *Acanthus ilicifolius*. This means that point 3 is somewhat more stable than points 1 and 2. As said by Sani et al. (2019), a high diversity index means that the level of species diversity in the area is also higher, which then encourages stability in an ecosystem. Meanwhile, in terms of the dominance index, all locations are high because each location is dominated by certain types. This means that in general, each research location has an ecosystem that is less stable, and there are ecological pressures. Complex geomorphological coasts, human-induced pressure, urbanization, wood harvesting, grazing, and the growth of the tourism industry all pose threats to mangrove populations (Al-Qthanin & Alharbi, 2020).

Assessing the structure and composition of mangrove vegetation to monitor mangrove conditions. However, long-term monitoring of mangrove vegetation can be initiated to better understand the dynamics of the mangrove ecosystem while trying to link current community patterns with past events. The findings of this study are urgently needed to improve management practices while conserving coastal resources and to guide and inform mangrove forest management activities and assessments. Further research, it is necessary to formulate strategies and models for sustainable mangrove ecosystem management.

Conclusion

Assessing the structure and composition of mangrove vegetation to monitor mangrove conditions observations were carried out using the sample plot method, which is a modification of the method used by Mueller, Dumbois, and Ellenberg. The calculation of the analysis of the mangrove vegetation structure is grouped into three categories: the tree category, the sapling category, and the seedling category. Based on sampling at the research site using transects, it was determined that the mangrove species encountered were Avicenna marina, Rhizophora apiculata, Rhizophora mucronata, Nypa fructican, and Acanthus ilicifolius. The mangrove density levels measured at each location are in the good category. The only type of mangrove found at location 1 is Avicennia marina, while at location 2 it is Rhizophora apiculata, so each plays an important role in the surrounding ecosystem. A value of 1 in the dominance index indicates that the species grows in groups and dominates the area where it grows. The types of mangroves found at location 3 consisted of Rhizophora mucronata, Nypa fructican, and partly Achantus ilicifolius. The value of 0.766 in the dominance index indicates that these species grow in groups and dominate the area where they grow. Furthermore, this study can contribute to conservation, biodiversity assessment, and sustainable mangrove ecosystem management strategies in Makassar.

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Author contribution

Arfan AMAL: conducted field survey, methodology, data analysis, wrote the paper, Side SYAFRUDDIN : data analysis, Nyompa SUKRI: conducted field survey, data analysis, Maru ROSMINI: conducted field survey, literature review, Sukri IRWANSYAH: conducted field survey, Faisal Juanda MUHAMMAD: conducted field survey. All authors have read and agreed to the published.

Conflicts of interest

The authors declare no conflict of interest.

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