Mangrove Biodiversity in Tatengesan Village, Pusomaen District, Southeast Minahasa

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Abstract. Mangrove forest is a type of forest that grows in coastal areas and river estuaries and has three functions, namely ecological, social, and economic functions. The purpose of this study was to determine the level of diversity of mangrove species in Tatengesan Village, Pusomaen District, Southeast Minahasa Regency. Observations were made on a transect with a size of 50 x 25 m consisting of 4 plots. Mangrove sampling was carried out using a plot with a size of 10 x 7 m, using a purposive sampling method. Ecological index analysis includes species. There are 7 mangrove species namely *Bruguiera gymnnorhiza*, *Rhizophora mangle*, *Kandelia obovata*, *Avicennia marina*, *Rhizophora mucronata*, *Languncularia racemose*, and *Ceriops tagal*. The species diversity index at the biological level is low.

Keywords: biodiversity; mangrove; Tatengesan Village

I. INTRODUCTION

Indonesia is an archipelagic country consisting of 17,504 islands, with a coastline of 81,000 km and a sea area of around 5.8 million km² [1]. Mangrove forests are one of the natural resources that play an important role in coastal areas, both in maintaining the productivity of coastal waters and in supporting the lives of the surrounding population [2]. The existence of mangrove forests in coastal areas, especially as green belts along the coast, is very important for maintaining the health of fisheries, and agricultural and settlement ecosystems behind them [3].

Mangrove ecosystems have the potential for biodiversity from a biological, economic, tourism, and strategic point of view. Mangrove forests consist of three objectives, namely ecological, social, and economic. From an ecological point of view, mangrove forests are places for various marine biota to develop, including fish, crabs, snails, shellfish, and other creatures. Mangroves also provide ecological protection, such as for the break of water, wind, and sea invasions, as well as for providing breeding places for marine biota. From a physical point of view, mangrove forests are not only a protector in balancing the ecosystem. In addition, mangroves can also be used as a prospective natural tourist attraction and have the potential to protect coastlines from rising sea levels and absorb carbon dioxide from the atmosphere. From a socio-economic perspective, people who live near mangrove forests can use mangroves to produce chemicals and medicines. The physical role of mangroves on the coast includes storing rainwater and protecting the shoreline from storms, strong winds, erosion, flooding, and sea dispersal by absorbing trash.

Tatengesan is a village located in Posumaen District, Southeast Minahasa Regency, North Sulawesi with the village boundaries as follows: the south is bordered by Tatengesan Induk Village, the north is bordered by Wioi Village, the east is bordered by Bentenan Village, and the west is bordered by with Makalu Village [4]. Tatengesan Village also has a fairly extensive mangrove area, but due to a lack of knowledge about forest management and benefits, the mangroves there have not been utilized optimally. The purpose of this study was to determine the level of diversity of mangrove species in Tatengesan Village, Pusomaen District, Southeast Minahasa Regency.

II. METHOD

Study Site

This research was conducted from April to May 2022 in Tatengesan Village, Pusomaen District, Southeast Minahasa Regency, North Sulawesi Province.

The tools that will be used in this study are a camera, tape measure, scissors, soil 4 in 1, raffia rope, specimen labels, and stationery. The materials to be used are mangrove species.

Research Procedure

The type of research used is quantitative descriptive research, where this research can provide an overview, and description, to determine the level of diversity (biodiversity) of mangroves found in Tatengesan Village, Pusomaen District, Southeast Minahasa Regency. This research was conducted by direct observation of the mangrove ecosystem.

The implementation of this research consisted of two stages, namely the preparatory stage including the preparation process of the tools to be used in the research, and the implementation stage.

a. Determine the Point of Research Location

Determining the location point is done by surveying the research location, in this preliminary survey observations are made of the conditions of the research location. At the research stage, the location of the research was determined using a purposive sampling method. This method is a method of determining the location deliberately which is considered representative. This method is used because the distribution of mangroves in this study area is in groups.

b. Identification Stage

Mangrove sampling uses the quadrant transect method, which is a technique of measuring and observing along the path made by giving the distance between plots [5]. In this study, transects were drawn with a size of 50×25 m, the use of the transect is used as a research limitation, and on the transect 4 observation plots were made with a size of 10×7 m with a distance between plots of 5 meters (Figure 1).
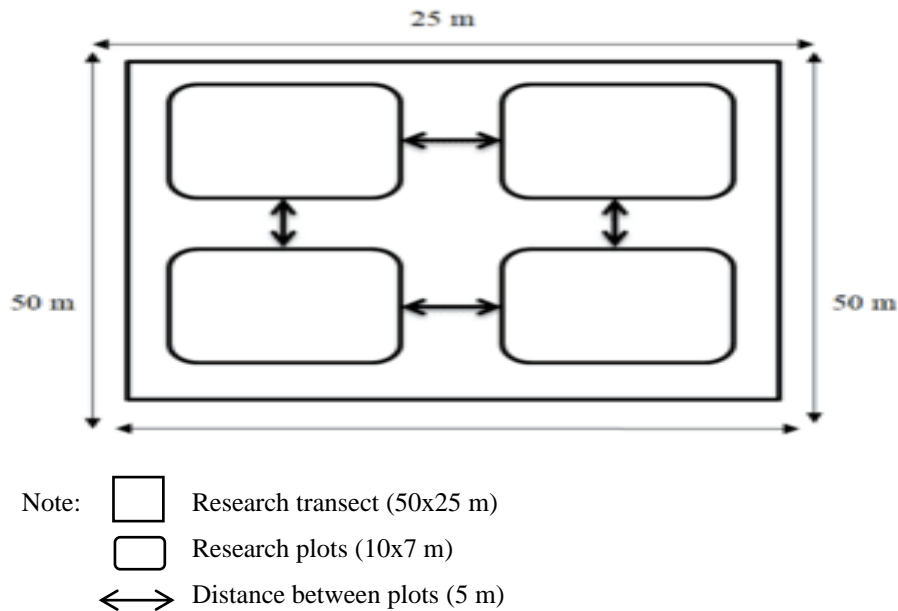

Note: ☐ Research transect (50x25 m)
         ☐ Research plots (10x7 m)
         ⟷ Distance between plots (5 m)

Fig. 1. Study site

Data Management and Analysis Techniques

1. Absolute Density

$$Di = Ni / A$$

Di = Absolute density of species (individuals/m²)
Ni = Number of individuals of type (i)
A = Sampled plot area (m²) [6]

2. Relative Density

RDi = Relative Density (%)
Ni = Number of individuals of type i (ind)
$\sum ni$ = the total number of individuals (ind) [7]

3. Relative Dominance [8]

$$DR = \frac{Amount\ of\ dominance\ of\ a\ type}{total\ Dominance} \times 100\%$$

4. Important Value Indeks (IVI) [6]

INP = Relative Frequency + Relative Density + Relative Dominance

5. Diversity Index

The number of species or genera in an ecosystem found in waters is expressed by the diversity index (H´) [9].

$$H' = - \sum \left[\frac{n_i}{N} \ log \ \frac{n_i}{N} \right]$$

H´ = Diversity index / Shanon – Wiener index
Ni = Number of individuals of each species
N = Total number of individuals

6. Uniformity Index

This index shows the distribution of a species that is evenly distributed or not [10].

E = Uniformity index/evenness index
H´ = Diversity index
S = Number of types

Benchmark :
0<E'< 0,5 = Depressed Community
0,5<E'<0,75 = Labile Community
0,75<E'<1,0 = Stable Community

III. RESULTS AND DISCUSSION

Results

Number of Mangrove Species Found in Tatengesan Village, Pusomaen District, Southeast Minahasa Regency

There were 7 mangrove species in Tatengesan Village, Pusomaen District, Southeast Minahasa Regency (Table 1). Based on the results of data analysis on mangrove species in Tatengesan Village, it can be seen that the individual ratios in each plot are different. The distribution of mangroves is most abundant in plot II while the least is found in plot IV.

TABLE 1
NUMBER OF MANGROVE SPECIES FOUND IN TATENGESAN VILLAGE, PUSOMAEN DISTRICT, SOUTHEAST MINAHASA

| No | Mangrove Species | Number of mangrove species | | | | Total |
		Plot I	Plot II	Plot III	Plot IV	
1	*Rhizophora mangle*	8	9	9	0	26
2	*Bruguiera gymnorrhiza*	18	10	13	3	44
3	*Kandelia obovata*	6	7	10	2	25
4	*Avecennia marina*	7	6	6	0	19
5	*Rhizophora mucronata*	0	15	17	8	40
6	*Langucularia racemosa*	0	0	0	6	6
7	*Ceriops tagal*	5	9	0	0	14
	Total	44	56	55	19	174

TABLE 2
TYPE COMPOSITION RELATIVE FREQUENCY, RELATIVE DENSITY, DIVERSITY INDEX, UNIFORMITY INDEX, RELATIVE DOMINANCE, AND IVI

No	Mangroves Species	Relative Frequency (%)	Relative Density (%)	Relative Dominance (%)	Diversity Index (H')	Uniformity Index	IVI
1	*Bruguiera gymnorrhiza*	14,58	14,94	14,2	0,2001	0,283	43,72
2	*Rhizophora mangle*	20,83	25,28	14,2	0,2111	0,347	60,31
3	*Kandelia obovata*	20,83	14,36	14,2	0,1989	0,278	49,39
4	*Avicennia marina*	14,58	10,91	14,2	0,1885	0,241	39,69
5	*Rhizophora mucronata*	14,58	22,98	14,2	0,2103	0,337	51,76
6	*Languncularia racemosa*	4,16	3,44	14,2	0,1878	0,115	21,8
7	*Ceriops tagal*	10,41	8,04	14,2	0,1762	0,202	32,65

Mangrove Species in Tatengesan Village, Pusomaen District, Southeast Minahasa Regency

1. *Bruguiera gymnorrhiza*

The *Bruguiera gymnorrhiza* mangrove tree is medium-sized with a tree height that can reach 35 meters, has knee-high roots with root lengths ranging from 15-20 cm which are brown, roots extend to the sides, the bark is gray to black with a rough surface, there are lenticels, and the leaves are green to dark in color that is up to 10 cm long, 4.5 cm wide, and elliptical with a tapered tip [11].

2. *Rhizophora mangle*

Support plant roots, viviparous plant seeds, have a single leaf, yellow flowers, with a plant height of up to 24 meters. The bark is thick and brownish-gray [12].

3. *Avicennia marina*

The tree has a maximum height of 25 meters, a horizontal root system pencil-shaped, erect aerial roots with many lenticels, bark green to gray, glandular spots on the underside of leaves, white to gray, finely exfoliated, elliptical elongated shape, and pointed to rounded ends. Fine muddy sand habitat [13].

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4. *Rhizophora mucronata*

The height of the tree can grow up to 30 meters, the lower surface of the leaves is yellowish and there are scattered small black spots. elliptical leaves widened to elongated round with a tapered leaf tip. has aerial roots and taproot, brown to blackish skin. Habitat: Muddy, sandy mud sometimes on sandy reefs [14].

5. *Ceriops tagal*

Tree height can reach 20 meters. The taproot is short, piled at the base of the tree, the bark is gray to black, the leaves are glossy green, inverted-oval in shape, and the ends are rounded [15].

6. *Kandelia obovata*

The bark is grayish to reddish brown, smooth surface, and has lenticels. The edges of the leaves are wrinkled inwards. The tips of the leaves are rounded to slightly pointed [16].

7. *Laguncularia racemosa*

This native evergreen tree is generally found further upland than black (*Avicennia germinans*) and red (*Rhizophora mangle*) mangroves and can reach heights of 30 to 40 feet in full sun. Leaves are simple, opposite, and between 1 and 3 inches long. The tops and undersides of the leaves are light green with a thick, leathery, and smooth exterior. One distinguishing characteristic of the white mangrove is the presence of two glands on the petiole just below the leaf base, where excess salt is excreted. The bark is light brown with vertical ridges and can grow a single- or multi-stemmed trunk. Inconspicuous and fragrant white flowers bloom almost year-round, occurring as spikes in leaf axils or on the tips of branches. Oblong fruit pods are green to brownish and about ¾ inches in length. Each pod contains one seed and the fruit ripens in the fall [17].
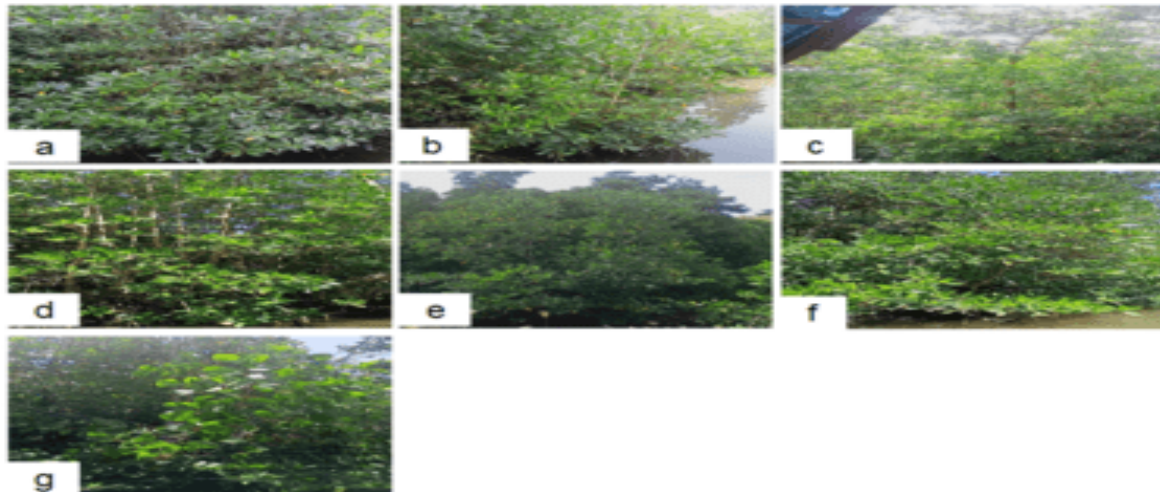

Figure 2. Mangrove Species: a. *Bruguiera gymnorrhiza,* b. *Rhizophora mangle,* c. *Avicennia marina,* d. *Rhizophora mucronata* Lamk, e. *Ceriops tagal,* f. *Kandelia obovata* and g. *Laguncularia racemosa* (Personal Documentation, 2022).

Discussion

The distribution on the 4 plots is different. Plot 2 is the location with the highest number of mangrove species (56 species). On the other hand the smallest number of species (19 species). The most common mangrove species found in the study area were *Rhizophora mangle* and *Rhizophora mucronata*.

Factors that Influence the Mangrove Ecosystem

The factors causing the low mangrove community in the study area are said to be depressed based on the results of data analysis. This is related to several environmental factors, including currents in the mangrove area. Environmental factors that also influence the occurrence of growth include the availability of fresh water, substrate stability, and nutrients which are environmental elements that can affect growth [18].

In addition, the factor is the low level of diversity of mangrove species in the waters of Tatengesan Village, Pusomaen District, Southeast Minahasa Regency because the mangrove area in the area is mostly located in deep waters and there is parking space such as fishing boats around mangrove trees and local people use them. as sea transportation. Some use mangrove trees as firewood, building materials, and so on.

Mangrove Diversity Index, Relative Density, IVI, and Dominance Index

Diversity index Based on the results of the diversity index presented in Table 2, the diversity of mangrove species is less than 2 (H < 2). This condition indicates low species diversity which means low community stability. Species diversity tends to be high in older communities and lower in newly formed communities

[19]. Based on the results of research on the mangrove ecosystem in Tatengesan Village, Pusomaen District, Southeast Minahasa Regency, it is in a depressed condition.

The highest density was obtained by *Rhizophora mangle* at 25.28% while the lowest density was obtained by *Languncularia racemosa* at 3.44%. This is because the growth and development ability of mangroves at maturity is different compared to their propagules. Based on research conducted by Thampanya [20], propagules that have become shoots only have a vitality of 8-40% in 1 year of their life cycle.

Based on Table 2, it is known that the Important Value Index (IVI). The Biodiversity Index value is obtained to describe the level of diversity of mangrove vegetation in an area [21]. IVI is a number that identifies the location of plant species in a community [22]. Dominance Index based on Table 2 shows that the most dominant type of mangrove is *Rhizophora mangle*. This is because *Rhizophora mangle* has a good adaptation to extreme areas. The dominant (ruling) species in a plant community will have a high importance value index so that the most dominant species will have the largest important value index [23].

VIII.CONCLUSION

Based on the findings of research conducted in Tatengesan Village, Pusomaen District, Southeast Minahasa Regency, there are 7 species of mangroves, namely *Bruguiera gymnorrhiza, Rhizophora mangle, Kandelia obovata, Avicennia marina, Rhizophora mucronata, Languncularia racemosa,* and *Ceriops tagal*. The most dominant type is *Rhizophora mangle* with a mangrove vegetation biodiversity index of 1,803 which is classified as low.

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