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# Community structure of mangrove ecosystem in Dulangeya Village, Gorontalo province

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## Article Info

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**Abstract**
Dulangeya Village is one of the coastal villages in Boalemo Regency, Gorontalo Province which has mangrove ecosystem potential. This study aims to identify mangrove species and analyze the community structure of mangrove ecosystems in Dulangeya Village, Botumoito District, Boalemo Regency, Gorontalo Province. This research was conducted in January-March 2023. Data taken include species density, relative density, species frequency, relative frequency, species closure, relative closure, and importance value index. The method used was direct observation. Data collection on mangrove vegetation was carried out using 100m long line transects at 4 stations. Each transect consists of plots with a size of 10x10m. The results showed that there were 7 types of mangroves found in Dulangeya Village. Tree level density is classified as moderate and for sapling and seedling level is classified as good. The highest species frequency for tree level is Rhyzopora apiculata, while for sapling and seedling level is *Ceriops decandra*. The Importance Value Index (IVI) for the tree level obtained values ranging from 5.247 - 127.159. This shows that mangrove trees have a fairly important value for the lives of the people of Dulangeya Village.

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**Keywords:** Dulangeya Village, Important Value Indeks, Mangrove

## Introduction

Mangrove ecosystems are one of the marine resources that have many benefits and functions for the environment and humans (Karimah, 2017) [7]. Mangrove ecosystems have a role in controlling the environmental quality of coastal areas, including functioning as abrasion barriers, absorbing waste, and providing environmental tourism services (Dahuri *et al*, 2004; Ratini, 2016) [12]. Coastal communities have long utilized mangrove plant parts for medicinal purposes, food, building materials, preservatives and coloring fishing nets commonly used by fishermen.

Mangroves are almost exclusively distributed in the tropics (Hogarth, 2015; Ikhsanudin, 2018) [6]. This can be seen in the distribution of mangroves in the world, most of which are in tropical and warm climate countries. Indonesia with its geographical conditions, oceanographic characteristics and archipelago typology is very distinctive as a country that has high mangrove diversity and the largest area in the world. Because of their high capacity for adaptation, mangrove communities show a high level ecological stability even though the physical and geological condition of the intertidal zone are prone to experiencing dramatic change (Alongi, 2015; Rahim, *et al*, 2023) [11].

Dulangeya Village is one of the villages in Botumoito District, Boalemo Regency, Gorontalo Province that has a lot of natural potentials that can be used for ecotourism, one of which is a quite extensive mangrove ecosystem. Mangrove ecosystems in Dulangeya village are often used by the surrounding community as building materials and also as ecotourism. Until now, there has been no study of the mangrove ecosystem in Dulangeya village.

This study aims to analyze the community structure of mangrove ecosystem constituents in Dulangeya Village which includes the number, species, density, frequency, and importance value index.

## Research Methods

### Research Time and Site

This research was conducted for 3 months from January to March 2023 in Dulangeya Village, Botumoito Sub-district, Gorontalo Province. Dulangeya Village is one of the coastal villages located in Boalemo Regency, Gorontalo Province with geographical boundaries of 0.48846°N, 122.24211°BT. The research location map is presented in Figure 1.

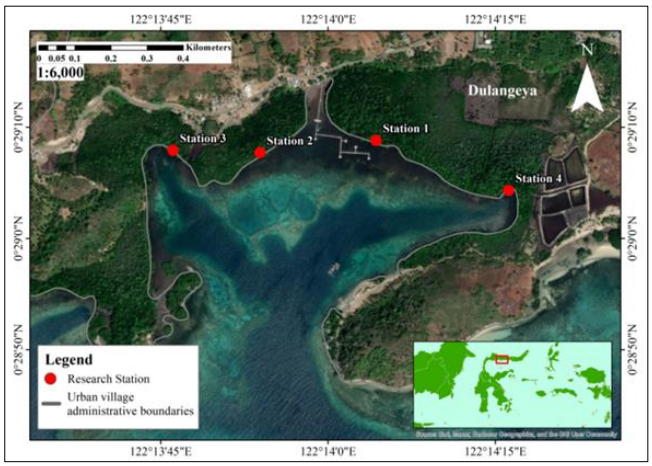


**Fig 1:** The research location map

### Tools and Materials

The tools and materials and their uses used in this study are presented in Table 1.

**Table 1:** Tools and materials and their uses

| Tools and materials | Uses |
|---|---|
| Mangrove identification book | For mangrove identification |
| Thermometer | For measuring temperature |
| Refraktometer | Salinity measurement |
| pH meter | pH measurement |

### Sampling Technic Method

The method used in this research is direct observation. Sampling for mangrove vegetation was done with a 100m long line transect or line transect as many as 4 stations. Determination of the station is based on the type of activity or activity that occurs around the station point. Stations 1 and 2 are adjacent to the boat mooring which is used as a tourist site, station 3 is adjacent to the house, and station 4 is adjacent to the pond. Each transect consists of plots with a size of 10x10m. Then identified each type of mangrove found in each plot based on mangrove identification book.

### Data Analysis

To find out the community structure of mangrove vegetation, the parameters measured were mangrove denisity, relative density, frequency, relative frequency, species coverage, relative coverage, and important value index. They were using the following formula:

$$\text{Species density (ind/ m}^2\text{)} = \frac{\text{number of individuals}}{\text{total sampled areas}}$$

$$\text{Relative density (\%)} = \frac{\text{number of individuals in each species}}{\text{total individuals of all species}}$$

$$\text{Species frequency} = \frac{\text{number of plots in which a species occurs}}{\text{total sampled plots}}$$

$$\text{Relative frequency} = \frac{\text{frequency of a species}}{\text{several frequencies for all species}}$$

Important value index = relative density + relative frequency + relative coverage

## Result

### Mangrove Environmental Conditions

Based on the measurement results, the water conditions in Dulangeya Village are generally still favorable for mangrove growth. Water conditions in Dulangeya Village are presented in Table 2.

**Table 2:** Water condition of Dulangeya Village

| No. | Parameters of oceanography | Value | | | |
|---|---|---|---|---|---|
| | | St. 1 | St. 2 | St. 3 | St. 4 |
| 1 | pH | 7.6 | 7.5 | 8.1 | 7.95 |
| 2 | Temperature | 28.8 | 27.4 | 30.6 | 30.55 |
| 3 | Salinity | 32 | 29.3 | 30 | 30 |

Based on the Decree of the Minister of Environment No. 51 of 2004 concerning seawater quality criteria for mangroves, a good pH ranges from 7-8.5, temperature ranges from 280C-320C, and salinity up to 34.

### pH

The measurement results show that the pH value in the waters of Dulangeya Village ranges from 7.5 - 8.1. Siringoringo *et al*, (2018) [15] have measured pH levels in the Ciasem Protected Forest Area and obtained results ranging from 6.7 - 7.6. Each water area has a different pH value because it is influenced by the oceanographic and geomorphological characteristics of the area (Schaduw, 2018) [13].

### Temperature

The measurement results showed that the temperature value ranged from 27.40C - 30.60C. The appropriate temperature for mangrove growth is more than 200C in the tropics (Aksornkoae, 1993; Schaduw, 2018) [13]. Water temperature measurements in the coastal mangrove forest of Amahai, Central Maluku Regency, ranged from 290C - 300C (Wailisa *et al*, 2022) [17]. Darwati *et al*. (2022) [2] stated that differences in water temperature in an area can occur due to season, the circular position of the sun, and wind movement/circulation. In addition, the temperature affects physiological periods such as photosynthesis and evaporation, also affects salinity around mangroves (Maulidia, *et al*, 2022) [8].

### Salinity

The salinity value in the waters of Dulangeya Village ranges from 29.3%0 - 32%0. This value is different from the results of salinity measurements in the waters of Kampung Sejahtera Bengkulu City which have values ranging from 16%0 - 20%0 (Putri *et al*, 2021) [10]. Pratiwi *et al*. (2022) [9] stated that the lower the salinity value obtained, the closer to the river and the higher the salinity value obtained, the farther from the river area.

### Mangrove Vegetation

The composition of mangrove species found in Dulangeya Village is 7 species, namely *Rhizopora styllosa*, *Rhizopora*

*mucronata, Rhizopora apiculata, Bruguiera gymnorhiza, Brugueira cilindrica, Ceriops decandra, Ceriops tagal, Scyphiphora hydrophyllacea.*

**Station 1**

Mangrove species found at station 1 are 5 species with different values of relative density (RD), relative frequency (RF), and importance value index (IVI). (Table 3).

**Table 3:** Mangrove vegetation of station 1

| Categories | Name of species | RD (%) | RF (%) | IVI (%) |
|---|---|---|---|---|
| Seedlings | *Rhizophora styllosa* | 2.17 | 3.33 | 5.50 |
| | *Rhizophora mucronata* | 1.44 | 6.67 | 8.11 |
| | *Rhizophora apiculata* | 47.65 | 30.00 | 77.65 |
| | *Bruguiera gymnorhiza* | 19.86 | 30.00 | 49.86 |
| | *Ceriops decandra* | 28.88 | 30.00 | 58.88 |
| Saplings | *Rhizophora styllosa* | 5.21 | 11.76 | 16.97 |
| | *Rhizophora mucronata* | 1.67 | 2.94 | 4.61 |
| | *Rhizophora apiculata* | 11.46 | 11.76 | 23.22 |
| | *Bruguiera gymnorhiza* | 17.71 | 32.35 | 50.06 |
| | *Ceriops decandra* | 63.96 | 41.18 | 105.13 |
| Tree | *Rhizophora styllosa* | 11.21 | 15.09 | 30.89 |
| | *Rhizophora mucronata* | 13.55 | 16.98 | 66.11 |
| | *Rhizophora apiculata* | 50.93 | 30.19 | 127.16 |
| | *Bruguiera gymnorhiza* | 13.55 | 20.75 | 43.87 |
| | *Ceriops decandra* | 10.75 | 16.98 | 31.97 |

For the seedling category, the highest relative density value is owned by *Rhizophora apiculata*, the relative frequency value for *Rhizophora apiculata*, *Bruguiera gymnorhiza* and *Ceriops decandra* species has the same high value. The highest importance value index is owned by *Rhizophora apiculata*.

The sapling category for relative density, relative frequency and importance index with the highest value is owned by *Ceriops decandra*. Furthermore, for the tree category, *Rhizophora apiculata* has the highest value for relative density, relative frequency, and important value index. This shows that station 1 is dominated by *Rhizophora apiculata*.

**Station 2**

Mangrove species found at station 2 are 7 species with different values of relative density, relative frequency, and importance value index (Table 4).

**Table 4:** Mangrove vegetation of station 2

| Categories | Name of species | RD (%) | RF (%) | IVI (%) |
|---|---|---|---|---|
| Seedlings | *Rhizophora styllosa* | 37.80 | 25.00 | 62.80 |
| | *Rhizophora mucronata* | 13.72 | 20.83 | 34.55 |
| | *Rhizophora apiculata* | 0.61 | 4.17 | 4.78 |
| | *Bruguiera gymnorhiza* | 13.41 | 20.83 | 34.25 |
| | *Ceriops decandra* | 34.45 | 29.17 | 63.62 |
| Saplings | *Rhizophora styllosa* | 1.41 | 9.52 | 10.94 |
| | *Rhizophora mucronata* | 1.41 | 4.76 | 6.18 |
| | *Bruguiera gymnorhiza* | 31.80 | 28.57 | 60.37 |
| | *Brugueira cilindrica* | 1.77 | 4.76 | 6.53 |
| | *Ceriops decandra* | 57.24 | 38.10 | 95.34 |
| | *Ceriops tagal* | 6.36 | 14.29 | 20.65 |
| Tree | *Rhizophora styllosa* | 31.30 | 20.00 | 85.85 |
| | *Rhizophora mucronata* | 15.65 | 16.67 | 66.44 |
| | *Rhizophora apiculata* | 19.13 | 23.33 | 64.73 |
| | *Bruguiera gymnorhiza* | 10.43 | 13.33 | 25.77 |
| | *Ceriops decandra* | 14.78 | 16.67 | 36.54 |
| | *Ceriops tagal* | 8.70 | 10.00 | 20.66 |

*Rhizophora styllosa* has the highest value for relative density in the seedling category, while *Ceriops decandra* dominates with the highest relative frequency and importance index values for the seedling category.

The saplings for the *Ceriops decandra* species dominate at station 2 with the highest relative density, relative frequency, and importance index values among other species. As for the tree category, the highest relative frequency value is owned by *Rhizophora apiculata*, and *Rhizophora styllosa* which has the highest relative density value and importance value index at station 2.

**Station 3**

Mangrove species found at station 3 are 7 species with different values of relative density, relative frequency, and importance value index (Table 5).

**Table 5:** Mangrove vegetation of stasiun 3

| Categories | Name of species | RD (%) | RF (%) | IVI (%) |
|---|---|---|---|---|
| Seedlings | *Rhizophora styllosa* | 18.60 | 7.41 | 26.00 |
| | *Rhizophora mucronata* | 9.09 | 18.52 | 27.61 |
| | *Rhizophora apiculata* | 7.85 | 11.11 | 18.96 |
| | *Brugueira cilindrica* | 14.46 | 18.52 | 32.98 |
| | *Ceriops decandra* | 6.20 | 11.11 | 17.31 |
| | *Ceriops tagal* | 34.30 | 18.52 | 52.82 |
| | *Scyphiphora hydrophyllacea* | 9.50 | 14.81 | 24.32 |
| Saplings | *Rhizophora styllosa* | 1.95 | 8.00 | 9.95 |
| | *Rhizophora mucronata* | 11.72 | 12.00 | 23.72 |
| | *Rhizophora apiculata* | 19.14 | 20.00 | 39.14 |
| | *Brugueira cilindrica* | 5.86 | 16.00 | 21.86 |
| | *Ceriops decandra* | 7.03 | 8.00 | 15.03 |
| | *Ceriops tagal* | 50.39 | 28.00 | 78.39 |
| | *Scyphiphora hydrophyllacea* | 3.91 | 8.00 | 11.91 |
| Tree | *Rhizophora styllosa* | 15.96 | 11.54 | 41.41 |
| | *Rhizophora mucronata* | 19.15 | 19.23 | 70.26 |
| | *Rhizophora apiculata* | 40.43 | 30.77 | 109.96 |
| | *Brugueira cilindrica* | 9.57 | 15.38 | 33.64 |
| | *Ceriops decandra* | 1.06 | 3.85 | 5.25 |
| | *Ceriops tagal* | 13.83 | 19.23 | 39.49 |

The seedling category at station 3 for the same highest relative frequency value is owned by 3 species namely *Rhizophora mucronata*, *Brugueira cilindrica* and *Ceriops tagal*. In addition, *Ceriops tagal* also has the highest value for relative density and importance index.

*Ceriops tagal* dominates the sapling category by having the highest values for relative density, relative frequency, and important value index at station 3. Meanwhile, the tree category is dominated by *Rhizophora apiculata* which has the highest values for relative density, relative frequency, and important value index.

**Station 4**

Mangrove species found at station 4 are 5 species with different values of relative density, relative frequency, and importance value index (Table 6).

**Table 6:** Mangrove vegetation of station 4

| Categories | Name of species | RD (%) | RF (%) | IVI (%) |
|---|---|---|---|---|
| Seedlings | *Rhizophora styllosa* | 8.93 | 10.00 | 18.93 |
| | *Rhizophora mucronata* | 0.89 | 10.00 | 10.89 |
| | *Rhizophora apiculata* | 22.32 | 20.00 | 42.32 |
| | *Bruguiera gymnorhiza* | 6.25 | 20.00 | 26.25 |
| | *Ceriops decandra* | 61.61 | 40.00 | 101.61 |
| Saplings | *Rhizophora styllosa* | 16.67 | 26.09 | 42.75 |
| | *Rhizophora apiculata* | 16.67 | 17.39 | 34.06 |
| | *Bruguiera gymnorhiza* | 7.87 | 21.74 | 29.61 |
| | *Ceriops decandra* | 58.80 | 34.78 | 93.58 |
| Tree | *Rhizophora styllosa* | 14.50 | 17.14 | 39.18 |
| | *Rhizophora mucronata* | 7.63 | 17.14 | 41.76 |
| | *Rhizophora apiculata* | 43.51 | 25.71 | 112.37 |
| | *Bruguiera gymnorhiza* | 12.98 | 20.00 | 58.17 |
| | *Ceriops decandra* | 21.37 | 20.00 | 48.51 |

*Ceriops decandra* dominates for seedling and sapling categories at station 4, which has the highest relative density, relative frequency, and importance index values among other species. As for the tree category, it is dominated by *Rhizophora apiculata* with the highest relative density, relative frequency, and importance index among other species.

*Rzhizophora* sp. is the most dominating species among other species, this type is most often found in all research stations ranging from seedling, sapling, to tree categories. This is in *accordance* with the statement of Usman *et al* (2013), that Rzhizophora sp. is one of the mangrove species that is tolerant of environmental conditions (substrate, salinity, depth and nutrient sources) and can spread and grow in various places (Serosero *et al*, 2020) [14]. The type of substrate in Dulangeya Village is mud so it is very suitable for the habitat of Rzhizophora sp. Muddy substrates in Indonesia are very suitable for the life of Rzhizophora mangrove species (Rusila *et al*, 1999; Susanto *et al* 2018) [16].

## Mangrove Damage

The standard criteria for mangrove damage determined through mangrove density values based on the Decree of the Minister of Environment No. 201 Year 2004 has been presented in Table 7.

**Table 7:** Result Mangrove damage standard criteria

| Categories | Number of individuals (ind/ha) | | | | Average | Criteria |
|---|---|---|---|---|---|---|
| | St. 1 | St. 2 | St. 3 | St. 4 | | |
| Tree | 1258.824 | 958.333 | 940 | 1091.667 | 1062.206 | Moderate |
| Saplings | 2823.529 | 2358.333 | 2560 | 1800 | 2385.466 | Good |
| Seedlings | 1629.412 | 2733.333 | 2420 | 933.333 | 1929.02 | Good |

The results showed that the mangrove ecosystem in Dulangeya Village was included in the moderate to good criteria. This is due to mangrove planting activities organized by the government and involving the village community so that the condition of the mangrove ecosystem in Dulangeya Village is still well maintained.

## Discussion

Based on the results of the study, 8 species of mangroves were found in four research locations in Dulangeya Village. They were *Rhizophora styllosa*, *Rhizophora mucronata*, *Rhizophora apiculata*, *Ceriops tagal*, *Ceriops decandra*, *Brugueira cylindrical*, *Bruguiera gymnorhiza*, and *Scyphiphora hydrophyllacea*. Species distribution of mangrove has been influenced by many factors such as salinity, substrate type, and habitat geomorphology (Dharmawan and Pramudji, 2019) [3].

The most common mangrove species with the highest importance index is *Rhizophora apiculata*. This shows that *Rhizophora apiculata* is a species that has the highest value of influence on the lives of coastal communities in Dulangeya Village. The large number of *Rhizophora apiculata* species found in a location is due to its high tolerance to extreme environmental conditions (Susanto *et al* 2018; Rahim *et al*, 2023) [16, 11]. In addition, *Rhizophora apiculata* is also supported by a root system called aerial roots (pneumatophore), which can keep it stable (Hariyanto *et al.*, 2019) [5].

Based on the Decree of the Minister of Environment No. 201 Year 2004, mangrove ecosystem in Dulangeya Village is in good condition. This is due to the awareness of the surrounding community about the rules prohibiting mangrove logging.

## Conclusion

Based on the results of the study, there are 7 types of mangroves found in Dulangeya Village. Tree level density is classified as moderate and for sapling and seedling levels is classified as good. The highest species frequency for tree level is *Rhyzopora apiculata*, while for sapling and seedling level is *Ceriops decandra*. The Index of Importance (INP) for the tree level obtained values ranging from 5.247 - 127.159. Mangrove ecosystems in Dulangeya Village are included in moderate to good criteria based on the standard criteria for mangrove damage determined by the Minister of Environment Decree No. 201 of 2004.

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