MANGROVE COMMUNITY STRUCTURE IN TELUK BELUKAR VILLAGE NORTH GUNUNGSITOLI DISTRICT GUNUNGSITOLI CITY NORTH SUMATRA

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Abstract

Mangrove forests are ecosystems that have ecological and economic functions. The ecological functions of mangrove forests include protecting coastlines, preventing sea water intrusion, habitat, feeding ground, nursery ground, spawning ground for aquatic biota and as a climate regulator. micro. This research aims to determine the structure of the mangrove community and mangrove density. This research was conducted in Teluk Belukar Village, North Gunungsitoli District, North Gunungsitoli City, North Sumatra in August 2023. Research activities were carried out by creating a plot measuring 10x10 m2. Each plot contains the size categories of tree (10x10 m2), sapling (5x5 m2) and seedling (1x1 m2). There are 24 types of mangroves found at the research location. The highest value of mangrove species density (Di) obtained at the research location was at the seedling level of 160,000 ind/ha.

Keywords : ***Mangrove, Mangrove density, Mangrove community, Mangrove type, Village Thicket Bay***

1. INTRODUCTION

Mangroves or mangrove forests are ecosystems that have ecological and economic functions. The ecological functions of mangrove forests include protecting coastlines, preventing sea water intrusion, habitat, feeding ground, nursery ground, spawning ground for aquatic biota and as a climate regulator. micro. The economic functions of mangrove forests include producing household needs, producing industrial needs and producing seeds (Asyiawati & Akliyah, 2017). Mangrove forests are the main ecosystem supporting coastal life and have a big role in the balance of nature. Mangroves grow optimally in coastal areas that have large river estuaries and mud substrates, mangroves in coastal areas that do not have river estuaries, mangrove forests grow abnormally. Mangroves can also grow well in muddy substrates and tidal waters which cause anaerobic conditions, this is because mangroves have special roots that function as buffers and directly absorb oxygen from the air on the water surface (Rangkutiet al., 2017).

Nias Island is one of the islands located to the west of Sumatra Island which consists of 4 (four) districts and 1 (one) Municipality based on the results of the expansion of Nias Regency on November 26 2008 based on Law no. 47 of 2008, namely: Nias Regency, North Nias Regency, West Nias Regency, South Nias Regency and Gunungsitoli City. Gunungsitoli Utara District, Gunungsitoli City has quite extensive mangrove ecosystem potential compared to other sub-districts, especially in Teluk Belukar Village, and the location of mangroves in the Teluk Belukar Village area is very close to residential areas (BPS Gunungsitoli City, 2020). Mangroves in Teluk Belukar Village, North Gunungsitoli District, Gunungsitoli City, North Sumatra are still natural and have a very important role because they are close to villages. The mangrove community in this village surrounds the unique Luaha Talu lagoon shaped like a stingray as a container for the mouths of the Lawu-lawu and Boe rivers.

The existence of the mangrove community is considered very important because its functions are very diverse, including protecting the coast from crashing waves, preventing abrasion, collecting rainwater so that it can prevent flooding, and absorbing waste that pollutes the

waters. The mangrove ecosystem has high decomposition of organic material, making it an ecological chain that is very important for the life of living creatures in the surrounding waters. Organic matter makes mangrove forests a food source and nurturing place for various biota such as fish, shrimp and crabs. On this basis, it is necessary to carry out research on the structure of mangrove communities in the context of area management, especially since this area is a natural tourism area.

2. RESEARCH METHODS

Research on Mangrove Community Structure was carried out using the vegetation analysis method, namely by taking direct measurements of the structure of the stand community at various levels (mature trees, juveniles and seedlings) of the species found. dominant in the community with the estimated basal area of the stand. Measurements are carried out in a sampling area (plot) with a certain area which is generally square in shape. The tools used in this research are raffia rope as a transect line, camera for documentation, stationery to record the results obtained in the field, roller meter to measure the length of the transect line, laptop to assist in processing and displaying the data obtained, introductory guide book mangroves in Indonesia (Giessen at al., 2012) to help identify mangrove types (FAO, 1998). The material used is mangroves around the lagoon in Teluk Belukar Village, North Gunungsitoli District, Gunungsitoli City, North Sumatra. Research activities were carried out by creating a plot measuring 10x10 meters2. Each plot contains the size categories of trees (10x10 meters2), saplings (5x5 meters2) and seedlings (1x1 meters2). In each plot, the number of individuals of each type was counted and the diameter of the mangrove trees was measured. Data analysis refers to commonly used mangrove community structure formulas.

2.1. Mangrove Thickness

Mangrove thickness and width measurements were carried out manually by measuring using a rope and a roll meter. Mangrove thickness is measured from the first mangrove vegetation discovered from the sea direction perpendicular to land until the last mangrove vegetation is discovered.

2.2. Type Density (Di)

Species density (Di) is the number of stands of type i in a unit area (Bengen, 2000).Analysis of mangrove species density was carried out based on growth categories, namely seedlings, saplings and trees. Determination of specific density using the formula:

$$\mathbf{At} = \frac{ni}{A}$$

Where:

In :I-th type density
Ni :Total number of i-th individuals
A : Total areasampling (m2)

2.3. Relative Density (RDi)

Relative density (RDi) is the comparison between the number of stands of type 1 and the total stands of all types (Bengen, 2000). Determination of Relative Density (RDi) using the formula:

$$\mathbf{RDi} = \frac{Fi}{\sum n} \; x \; \mathbf{100}$$

Where:
RDi : Relative density
here :Total number
$\sum n$: Total stands of all species

2.4. Frequency Type (Fi)

Species frequency (Fi) is the probability of finding the i-th species in all sample plots compared to the total number of sample plots created (Bengen, 2000). To calculate the species frequency (Fi) the formula is used:

$$\mathbf{Fi} = \frac{Pi}{\sum F}$$

Where:
Fi :Frequency of type i
Pi : Amountsample plot where type i is found
$\sum F$: Total number of sample plots created (3 plots).

2.5. Relative Frequency (RFi)

Relative frequency (RFi) is the comparison between the frequency of type i and the total frequency of all types (Bengen, 2000). To calculate relative frequency use the formula:

$$\mathbf{RFi} = \frac{Fi}{\sum F}\ x\ 100$$

Where:
RFi :Relative frequency of types
Fi :Frequency of type i
$\sum F$: Total number of sample plots created (3 plots).

2.6. Closure Type (Ci)

Type closure (Ci) is the area of type i closure in a certain unit area (Bengen, 2000). To calculate type closure use the formula:

$$\mathbf{Ci} = \frac{\sum BA}{A}$$

Where:
Ci : Closure type
∑BA :πd2/4 (d = trunk diameter at chest height (d = circumference/π), π = 3.14)

2.7. Relative Closure (RCi)

Relative closure (RCi) is the comparison between the closure of type i and the total area of closure for all types (Bengen, 2000). To calculate RCi, the formula is used:

$$\mathbf{RCi} = \left(\frac{Ci}{\sum C}\right)\ x\ C$$

Where:
RCi : Relative closure
Ci : Closure type
C : Total closure for all types

2.8. Important Value Index (INP)

According to (Bengen, 2000), to calculate the mangrove importance index, use the following formula:

1. For tree level use the formula:

$$INP = RDi + RFi + RCi$$

2. For seedling and sapling levels, use the formula:

$$INP = RDi + RFi$$

3. RESULTS AND DISCUSSION

3.1. Mangrove Thickness

The highest mangrove thickness measurement results in Teluk Belukar Village, North Gunungsitoli District, Gunungsitoli City are at station 2 with a thickness of 365 m, with a category suitable for mangrove tourism (Figure 1). At station 2 the mangrove ecosystem is directly facing the sea so that some of the mangrove ecosystem conditions at this station are always flooded by water during normal tides. When compared with the condition of the mangroves in Central Tapanuli Regency, the thickness of the mangroves in Teluk Belukar Village, North Gunungsitoli District is in balance with the thickness of the mangroves on Mursala Island, Central Tapanuli Regency, namely 75-360 m (Rangkutiet al., 2020), and much lower than the condition mangroves on Sembilan Island, Langkat Regency, namely 134-1683 m (Rangkuti et al., 2016).

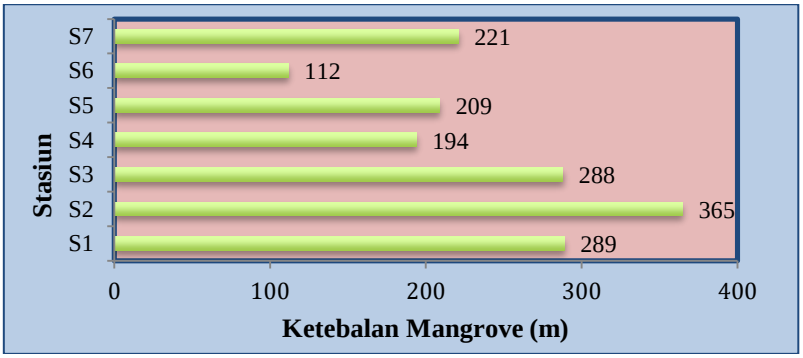

Figure 1.Mangrove thickness at the research location

3.2. Types of Mangrove Vegetation

There are 24 types of mangroves found in locations in Teluk Belukar Village, North Gunungsitoli District. The types of mangroves found can be seen in table 1 below.

Table 1. Types of mangrove vegetation in Teluk Belukar Village, North Gunungsitoli District

No	Family	Species	Station						
			1	2	3	4	5	6	7
1	*Achanthaceae*	*Achanthus ebracteatus*	-	✓	✓	✓	✓	-	-
		Achanthus ilicifolius	-	✓	✓	✓	✓	✓	-
2	*Apocynaceae*	*Cerbera manghas*	-	-	✓	✓	✓	-	-
3	*Arecaceae*	*Nypa fruticans*	-	-	-	✓	✓	✓	-
4	*Combretaceae*	*Lumnitzera littorea*	-	-	✓	✓	✓	-	-
5	*Malvaceae*	*Hibiscus tiliaceus*	-	-	✓	✓	✓	-	-
6	*Melastomataceae*	*Melastoma candidum*	-	-	-	-	✓	✓	-
7	*Meliaceae*	*Xylocarpus granatum*	✓	✓	✓	✓	✓	✓	✓
8	*Myrsinaceae*	*Aegiceras corniculatum*	✓	-	-	-	-	-	-
9	*Passifloraceae*	*Passiflora foetida*	-	-	✓	✓	✓	-	-
10	*Pteridaceae*	*Acrostichum aureum*	-	-	✓	✓	✓	-	-
		Acrostichum speciosum	-	✓	✓	✓	✓	✓	✓
11	*Rhizophoraceae*	*Bruguiera cylindrical*	-	✓	✓	✓	-	-	-
		Bruguiera gymnorrhiza	✓	✓	✓	✓	✓	✓	✓
		Ceriops decandra	-	-	-	✓	-	✓	✓
		Rhizophora apiculata	✓	✓	✓	✓	✓	✓	✓
		Rhizophora mucronata	-	✓	✓	✓	-	-	-
12	*Rubiaceae*	*Morinda citrifolia*	-	✓	✓	✓	-	-	-
		Scyphiphora hydrophyllaceae	✓	-	-	✓	-	-	-
13	*Sonneratiaceae*	*Sonneratia alba*	✓	✓	✓	✓	✓	✓	✓
		Sonneratia caseolaris	✓	✓	✓	✓	-	-	-
14	*Sterculiaceae*	*Herittiera littoralis*	-	✓	-	-	-	-	-
15	*Verbenaceae*	*Avicennia marina*	✓	-	-	-	-	-	-
		Clerodendrum inerme	✓	✓	✓	✓	✓	✓	✓

Information : (✓) : found; (-) : not found

3.3. Type Density and Relative Density of Mangroves

The research results showed that the density of mangrove species found in Teluk Belukar Village, North Gunungsitoli District, at tree level, contained 12 types of mangroves. The tree level density value of mangrove species at station 1 is 6500 ind/ha, at station 2 is 9467 ind/ha, at station 3 is 10200 ind/ha, at station 4 is 9200 ind/ha, at station 5 is 7467 ind/ha , at station 6 it is 7100 ind/ha and at station 7 it is 7900 ind/ha. Density of mangrove species at tree level obtained in Teluk Belukar Village, North Gunungsitoli District. The density of mangrove types found in Teluk Belukar Village, North Gunungsitoli District, at the sapling level, contained 11 types of mangroves. The density value of mangrove species at seedling level at station 1 is 27467 ind/ha, at station 2 is 29067 ind/ha, at station 3 is 27733 ind/ha, at station 4 is 26933 ind/ha, at station 5 is 33467 ind/ha , at station 6 it is 23200 ind/ha and at station 7 it is 26000. The density of mangrove species at the sapling level was obtained in Teluk Belukar Village, North Gunungsitoli District.

The density of mangrove types found in Teluk Belukar Village, North Gunungsitoli District, at the seedling level, contained 8 types of mangroves. The density value of mangrove species at seedling level at station 1 is 150000 ind/ha, at station 2 is 80000 ind/ha, at station 3 is 83333 ind/ha, at station 4 is 160000 ind/ha, at station 5 is 40000, at station 6, namely 190,000 ind/ha and at station 7, namely 90,000 ind/ha. Density of mangrove species at seedling level obtained in Teluk Belukar Village, North Gunungsitoli District. Based on the research results, it is known that the highest density of mangrove species at tree level is at stations 1 and 5, namely 2600 ind/ha of the R. apiculata species, with a relative density of 40%. At the sapling level, there were 11333 ind/ha of R. apiculata at station 6, with a relative density of 48.85%. At the seedling level, there were

133333 ind/ha of R. apiculata at station 6, with a relative density of 70.18%. Mangrove density is determined by the number of individual mangroves. This is in accordance with Babo et al (2020) who state that the high density value is determined by the large number of individuals, and vice versa if the number of individuals is small then the density value is low. The highest species density is due to a suitable substrate, and the ability to adapt to environmental conditions. The density of mangrove species in Teluk Belukar Village, North Gunungsitoli District is much higher than the mangrove density on Mursala Island, Central Tapanuli Regency, namely 1,367-3,233 (Rangkutiet al., 2020), still lower than the mangrove density on Sembilan Island, Langkat Regency, namely 333- 4601 ind/ha (Rangkuti et al., 2016).

3.4. Type Frequency and Relative Frequency of Mangroves

The research results showed that the highest frequency of mangrove species in Teluk Belukar Village, North Gunungsitoli District was found at all observation stations with a value of 1 ind/m2 and the lowest with a value of 0.3 ind/m2. The relative frequency values obtained at the research location can be seen in table 2 below. Based on the results obtained, the highest type frequency value at all levels is 1 ind/ha and the lowest is. Meanwhile, the highest relative frequency at tree level was at station 1, namely 33% of the species S. alba, R. apiculata, and X. granatum. At the sapling level, 33% of B. gymnorriza, R. apiculata and S. alba were found at station 6. At the seedling level, there were 60% R. mucronata species at station 2. Overall, the type of R. apiculata was found at every station.

This shows that this type has a high distribution compared to other types. This is in accordance with Mangindaan et al (2012) who stated that the frequency value of mangroves is influenced by the number of species found in each quadrant, the more the number of quadrants in which mangrove species are found, the higher the frequency value of mangrove presence. The relative frequency of mangroves in Teluk Belukar Village, North Gunungsitoli District is shown in table 3 below. This relative frequency is higher than the relative frequency of mangroves in Tapian Nauli I Village, Tapian Nauli District, Central Tapanuli Regency. At the seedling and sapling growth level it is Avicennia marina (28.47% and 27.27%) for the tree level it is Rhizophora apiculata (28, 46%) (Simamora et al., 2014), while it is balanced or the same as the relative frequency in the Bagan Asahan Village Area, Tanjung Balai District, namely the types Avecennia marina and Rhizophora apiculata 33% (Siahaan et al., 2022).

Table 2.Frequency of mangrove types in Teluk Belukar Village, North Gunungsitoli District

Species	Frequency of Types at Tree Level						
	S1	S2	S3	S4	S5	S6	S7
S. alba	1	1	1	1	1	1	1
R. apiculata	1	1	1	1	1	1	1
X. granatum	1	1	1	1	1	1	1
R. mucronata	0	1	1	1	0	0	0
B. cylindrica	0	0.7	0	0.3	0	0	0
B. gymnorriza	0	1	1	1	0	1	1
H. littoralis	0	0.3	0	0	0	0	0
C. manghas	0	0	1	1	1	0	0
H. tilliaceus	0	0	1	0	0	0	0
S. caseolaris	0	0	0	0.7	0	0	0
C. decandra	0	0	0	1	0	1	1
L. littorea	0	0	0	0	1	0	0
Amount	3	6	7	8	5	5	5

Species	Species Frequency at Sapling Level						
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
B. gymnorriza	1	1	1	1	1	1	1
C. decandra	1	0	0	0	0	0	1
R. apiculata	1	1	1	1	1	1	1
A. corniculatum	1	0	0	0	0	0	0
S. alba	1	0	0	1	0	1	1
X. granatum	1	1	0	0	0	0	0
R. mucronata	0	1	1	1	1	0	0
M. citrifolia	0	1	0	0	0	0	0
B. cylindrica	0	0	1	0	1	0	0
S. caseolaris	0	0	0	1	0	0	0
L. littorea	0	0	0	0	1	0	0
Amount	6	5	4	5	5	3	4
Species	**Frequency of Species at Seedling Level**						
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
R. apiculata	1	0	1	0	1	1	1
R. mucronata	0	1	0.7	1	0	0	0
B. gymnorriza	1	0	0	0.7	0	0.7	1
A. ilicifolius	0	0.3	0	0	0	0	0
A. speciosum	0	0	0.3	0	0.3	0.3	0
A. ebracteatus	0	0	0.3	0	0.3	0	0
A. aureum	0	0	0	0.3	0	0	0
C. inerme	0	0.3	0.3	0	0.7	0	0
Amount	2	1.6	2.6	2	2,3	2	2

Table 3.Relative Frequency of Mangroves in Teluk Belukar Village, North Gunungsitoli District

Species	Tree Level Relative Frequency						
	S1	S2	S3	S4	S5	S6	S7
S. alba	33	17	14	13	20	20	20
R. apiculata	34	17	16	13	20	20	20
X. granatum	33	17	14	13	20	20	20
R. mucronata	0	17	14	13	0	0	0
B. cylindrica	0	11	0	0	0	0	0
B. gymnorriza	0	17	14	13	0	20	20
H. littoralis	0	4	0	0	0	0	0
C. manghas	0	0	14	13	20	0	0
H. tilliaceus	0	0	14	0	0	0	0
S. caseolaris	0	0	0	9	0	0	0
C. decandra	0	0	0	13	0	20	20
L. littorea	0	0	0	0	20	0	0
Amount	100	100	100	100	100	100	100
Species	**Sapling Level Relative Frequency**						
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
B. gymnorriza	17	20	25	20	20	33	25
C. decandra	15	0	0	0	0	0	25
R. apiculata	17	20	25	20	20	33	25
A. corniculatum	17	0	0	0	0	0	0
S. alba	17	0	0	20	0	33	25
X. granatum	17	20	0	0	0	0	0
R. mucronata	0	20	25	20	20	1	0

M. citrifolia	0	20	0	0	0	0	0
B. cylindrica	0	0	25	0	20	0	0
S. caseolaris	0	0	0	20	0	0	0
L. littorea	0	0	0	0	20	0	0
Amount	100	100	100	100	100	100	100

Species	**Relative Frequency of Seedling Rate**						
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**
R. apiculata	50	0	37.5	0	42.85	50	50
R. mucronata	0	60	25	50	0	0	0
B. gymnorriza	50	0	0	33.33	0	33.33	50
A. ilicifolius	0	20	0	0	0	0	0
A. speciosum	0	0	12.5	0	14.29	16.7	0
A. ebracteaus	0	0	12.5	0	14.29	0	0
A. aureum	0	0	0	16.67	0	0	0
C. inerme	0	20	12.5	0	28.57	0	0
Amount	100	100	100	100	100	100	100

3.5. Species Coverage and Relative Species Coverage of Mangroves

The research results showed that the highest cover of mangrove species in Teluk Belukar Village, North Gunungsitoli District was at station 1 of the R. apiculata type with a value of 9320 ind/m2 and the lowest was at station 2 with a value of 888 ind/m2, as shown in figure 2 below. Based on the results obtained, the highest species cover value was at station 1, namely 9320 ha of the R. apiculata type with a relative cover of 38%. The lowest type of closure was at station 2, namely 888 ha of the H. littoralis type with a relative closure of 3% as seen in Figure 3 below. High and low mangrove cover is caused by the condition of the mangroves. This is in accordance with Anthoni et al (2017) who stated that the factors that influence the low value of species cover are the heterogeneous conditions of mangroves, in addition to the exploitation of natural resources which is carried out without taking into account the condition of environmental balance. The mangrove cover in Teluk Belukar Village, North Gunungsitoli District is higher than the mangrove cover in Sembilan Island, Langkat Regency, reaching 2522-5810 cm2/ha (Rangkuti et al., 2016), higher than the mangrove cover in Tepian Nauli Bay, namely ranges from 1.39 - 3.07 m2/ha and on Mursala Island it ranges from 0.25-3.32 m2/ha (Rangkuti et al., 2020).

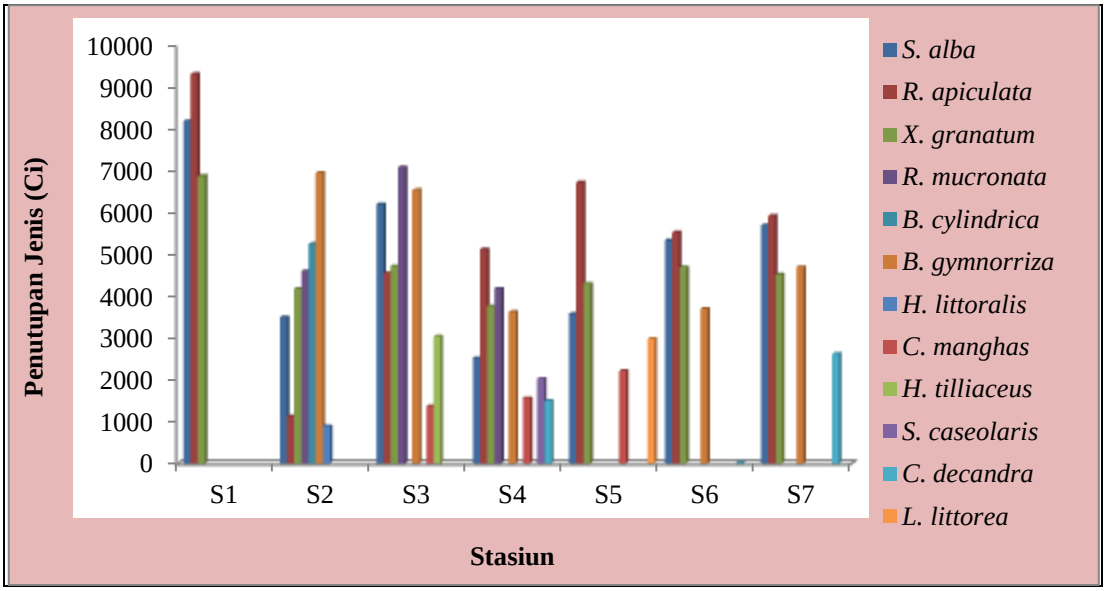

Figure 2.Closure of Mangrove Types in Teluk Belukar Village, District North Gunungsitoli

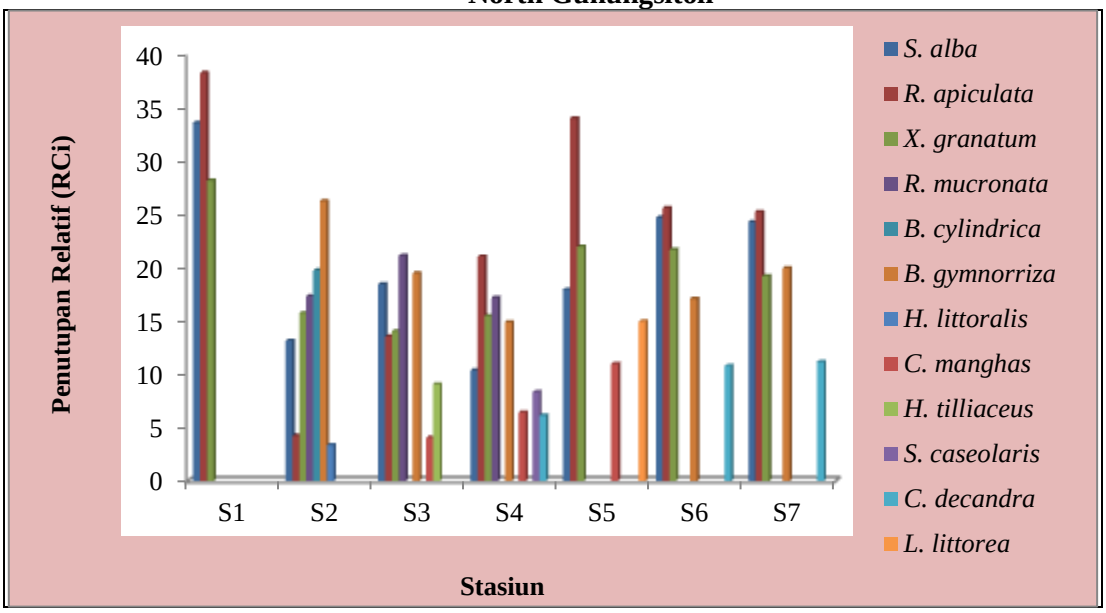

Figure 3.Relative Closure of Mangroves in Teluk Belukar Village, District North Gunungsitoli

3.6. Importance Value Index

The research results showed that the highest mangrove importance index in Teluk Belukar Village, North Gunungsitoli District was at the station 2 seedling level for the R. mucronata type with a value of 148 ind/m2 and the lowest was at the station 3 seedling level with a value of 17. The importance value index provides an overview of the influence or role of a type of mangrove plant in the mangrove community. The highest important value index at tree level was at station 1, namely 112% of the R. apiculata species, and the lowest was at station 2, namely 18% of the H. littoralis species. The highest sapling level was at station 6, namely 82% of the R. apiculata type and the lowest was at station 1, namely 25% of the C. decandra and A. corniculatum types. The highest seedling rate was at station 2, namely 148% of the R. mucronata species and the lowest was at station 3, namely `17% of the A. speciosum, A. ebracteaus and C. inerme species. Based on the entire station, only the R. mucronata species at the sapling level has the highest INP value. This is in accordance with Agustini et al (2016) who stated that the dominant species in a plant community

have a high important value index, so that the most dominant species has the largest important value index. The Importance Value Index of mangroves in Teluk Belukar Village, North Gunungsitoli District has the same value as the INP in Sembilan Island, Langkat Regency, namely 300 (Rangkuti et al., 2016), and is higher than the INP value in the Tepian Nauli mangrove ecosystem, Tapian Nauli District, Tapanuli Regency The middle is 100 (Simamora et al., 2014).

4. CONCLUSION

4.1. Conclusion

There are 24 types of mangroves found at the research location in Teluk Belukar Village, North Gunungsitoli District, consisting of 15 families.The value of mangrove species density (Di) obtained at the research location in Teluk Belukar Village, Gunungsitoli Utara District was the highest, namely at the seedling level of 160,000 ind/ha. The highest Fi value was found at all observation stations with a value of 1 ind/ha. The highest Ci value was found at station 1 for the R. apiculata type with a value of 9320 ind/ha. The highest important value index was found at the station 2 seedling level for the R. mucronata type with a value of 148 ind/ha.

4.2. Suggestion

The suggestion for this research is that there is further researchrelated to the management of the mangrove ecosystem in Teluk Belukar Village, North Gunungsitoli District, Gunungsitoli City, North Sumatra in anticipating development developments that could damage the existing ecosystem so that environmental conditions and the mangrove ecosystem are maintained.

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