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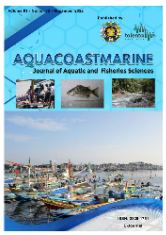

Distribution and ecological status of mangroves in the Nias Islands-North Sumatra Province

Sebaran dan status ekologis mangrove di Kepulauan Nias-Provinsi Sumatera Utara

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ABSTRACT

The Nias Islands are a group of islands located on the west coast of Sumatra. Nias Island is the main and largest island on the West Coast of Sumatra. Information on the distribution and potential status of mangroves in the Nias Islands has been reported, but it is limited to a narrow area and not yet comprehensive throughout the Nias Islands. This study aims to determine the distribution and ecological status of mangroves in the Nias Islands. The research location was divided into two observation areas, namely 15 points on Nias Island and 23 points on the southern part of Nias. The research was carried out in June 2019 and June 2021. Mangrove sampling was carried out using the "spot check" method which refers to Bengen (2004). The results showed that the mangroves found in the Nias Islands consisted of 22 primary mangrove species and 9 secondary mangrove species. *Rhizophora apiculata, Rhizophora mucronata*, and *Xylocarpus granatum* are the most abundant mangrove species and are commonly found in the Nias Islands. The thickness of mangroves in the Nias Islands ranges from 15 – 880 m. The density of mangroves found reached 350-4,360 ind/ha. Mangrove cover reaches 0.08-31.62 m2/ha. The results of the analysis of the significant value of mangrove species show that *Rhizophora mucronata* and *Rhizophora apiculata* have a large influence and role in the mangrove vegetation community on Nias Island. Mangroves in the Nias Islands are categorized as damaged–good. The good category was found in South Nias, Belukar Bay, and Bengkuang Bay, while the damaged category was found in Lahewa Bay and Dalam Bay.

Keyword: Mangrove, Nias, small island

ABSTRAK

Kepulauan Nias merupakan gugusan kepulauan yang terdapat di Pantai barat Sumatera. Pulau Nias merupakan pulau utama dan yang terbesar di Pantai Barat Sumatra. Informasi tentang sebaran dan status potensi mangrove di kepulauan Nias sudah ada dilaporkan, namun terbatas pada areal yang sempit dan belum menyeluruh di seluruh kepualuan Nias. Penelitian ini bertujuan untuk mengetahui sebaran dan status ekologis mangrove di Kepulauan Nias. Lokasi penelitian dibagi menjadi dua area pengamatan, yaitu 15 titik di Pulau Nias dan 23 titik di Nias bagian selatan. Penelitian dilaksanakan pada Juni 2019 dan Juni 2021. Pengambilan contoh mangrove, dilakukan dengan menggunakan metode "spot chek" yang mengacu pada Bengen (2004). Hasil penelitian didapatkan bahwa Mangrove yang terdapat di Kepulauan Nias terdiri dari 22 spesies mangrove primer dan 9 spesies mangrove sekunder. *Rhizophora apiculata, Rhizophora mucronata*, dan *Xylocarpus granatum* merupakan jenis mangrove yang paling melimpah dan banyak ditemukan di Kepulauan Nias. Ketebalan mangrove di Kepulauan Nias berkisar antara 15 – 880 m. Kerapatan mangrove yang ditemukan mencapai 350-4.360 ind/ha. Tutupan mangrove mencapai 0,08-31,62 m2/ha. Hasil analisis nilai penting jenis mangrove menunjukkan bahwa *Rhizophora mucronata* dan *Rhizophora apiculata* memiliki pengaruh dan peran yang besar dalam komunitas vegetasi mangrove di Pulau Nias. Mangrove di Kepulauan Nias dikategorikan rusak – baik. Kategori baik ditemukan di Nias Selatan, Teluk Belukar, dan Teluk Bengkuang, sedangkan kategori rusak ditemukan di Teluk Lahewa dan Teluk Dalam.

Keyword: Mangrove, Nias, Pulau kecil

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1. Pendahuluan

Mangroves are important ecosystems in coastal areas (Nybakken and Bertness, 2005; Bengen, 2004). Mangroves an important role in the life support system for various aquatic organisms (Nybakken and Bertness, 2005; Rangkuti et al., 2017), both as a feeding ground, nursery ground, and spawning ground. Therefore, a damaged mangrove ecosystem will affect habitat which can further cause the loss of various species associated with the mangrove ecosystem (Giesen et al., 2012). Mangroves also contribute to controlling the global climate through carbon sequestration (Rangkuti et al., 2017). Mangroves are an important element for determining the criteria for conservation areas and zoning in conservation areas. It is necessary to study the status and distribution of mangroves in conservation areas to determine the extent of the role and function of mangroves in conservation areas.

Mangroves are one of the essential ecosystems in Indonesia's coastal areas. These mangroves are scattered on the main island (mainland) and small islands (Rangkuti et al., 2017). In 2017 KLH reported that the area of mangroves in Indonesia reached 3.4 million ha or 23% of the world's mangrove area (KLH, 2017). Based on the latest report from the Control of River Basin Areas and Protection Forests, the Minister of Environment and Forestry, the existing area of mangroves in Indonesia is 3.3 million ha and the area of potential mangrove habitat is 0.75 ha so the total area of mangrove ecosystems reaches 4.1 million ha (KLH, 2021). The latest mangrove area in North Sumatra in 2021 was reported at 57,490 Ha (KLH, 2021), whereas the mangrove area in 2015 was reported at 74,417.80 ha (KLH, 2012; MFA North Sumatra, 2015). Thus, there has been a reduction in the area of mangroves in North Sumatra in the last 7 years. The mangroves damage on the east coast of North Sumatra is caused by land clearing or forest conversion for aquaculture, settlements, industry, oil palm plantations, and sea sand mining along the coast of the front of the mangrove forest area (MoE, 2012; Rangkuti et al., 2017). In general, mangroves in North Sumatra are found on the East Coast, parts of the west coast of Sumatra, and small islands on the west coast of North Sumatra (Muhtadi et al., 2020a,b; KLH, 2021).

The mangrove condition and status on the east and west coasts of North Sumatra have been widely reported. Mangroves on the east coast of North Sumatra spread from the southern part of Labuhan Batu Selatan to the Labuhan Batu Utara in Langkat Regency (MFA North Sumatra, 2015; Muhtadi et al., 2020a; MoE, 2021). Mangrove on the west coast of North Sumatra is found in Tapian Nauli Bay on the Nias Islands and the Mandailing Natal district coast (Muhtadi et al., 2020b; MoE, 2021). The mangrove status on the east coast of

North Sumatra is in bad condition, namely damaged to moderate status (Rangkuti et al., 2017; Muhtadi et al., 2020a; MoE, 2021), mangrove on Pulau Sembilan is the slightly better condition (Muhtadi et al., 2016). The mangrove condition in Tapian Nauli Bay is slightly better than the mangroves on the East Coast of North Sumatra (Muhtadi et al., 2020b). Mangrove studies on small islands in North Sumatra, especially Nias Island have never been reported. For this research was conducted to determine the distribution and ecological status of mangroves in the Nias Islands-North Sumatra Province.

2. Metode Penelitian

2.1 Place and time

The location for collecting mangrove data is in the Nias archipelago, both in Main Nias and small islands in South Nias. Data collection was carried out in June 2019 and June 2021. Data collection was carried out at 38 observation points (**Fig. 1**). The tools used were writing instruments, mangrove identification books (Giesen et al., 2012), digital cameras, Garmin GPS, and cloth tape measure for trunk circumference and tape measure for transects.

2.2 Mangrove data collection

Determination of observation transects was carried out using the "spot check" method (Bengen, 2004). The observation point consists of 3 points parallel to the shoreline. At each point, the transect is pulled perpendicular from the sea to the land along 50 meters as much as 3 tracks with a distance between the tracks of 50-100 meters. At each transect, tree vegetation data was sampled on a 10 m x 10 m transect. After that, the tree trunk circumference on the transect was measured. Identification of mangrove plants based on the guidelines of Giesen et al. (2012). Mangrove thickness was measured by a straight transect from sea to land to the end of the mangrove tree.

2.3 Data Analysis

The data analysis was used to determine the condition of the mangrove ecosystem using species density, species frequency, area of coverage, and species importance value (Bengen 2004). Mangrove status refers to Regulation of the Minister of the Environment No. 201 of 2004 concerning Standard Criteria and Guidelines for Determining Mangrove Damage. The mangrove community index refers to Odum and Bernet (2005) which consists of: diversity, uniformity and dominance

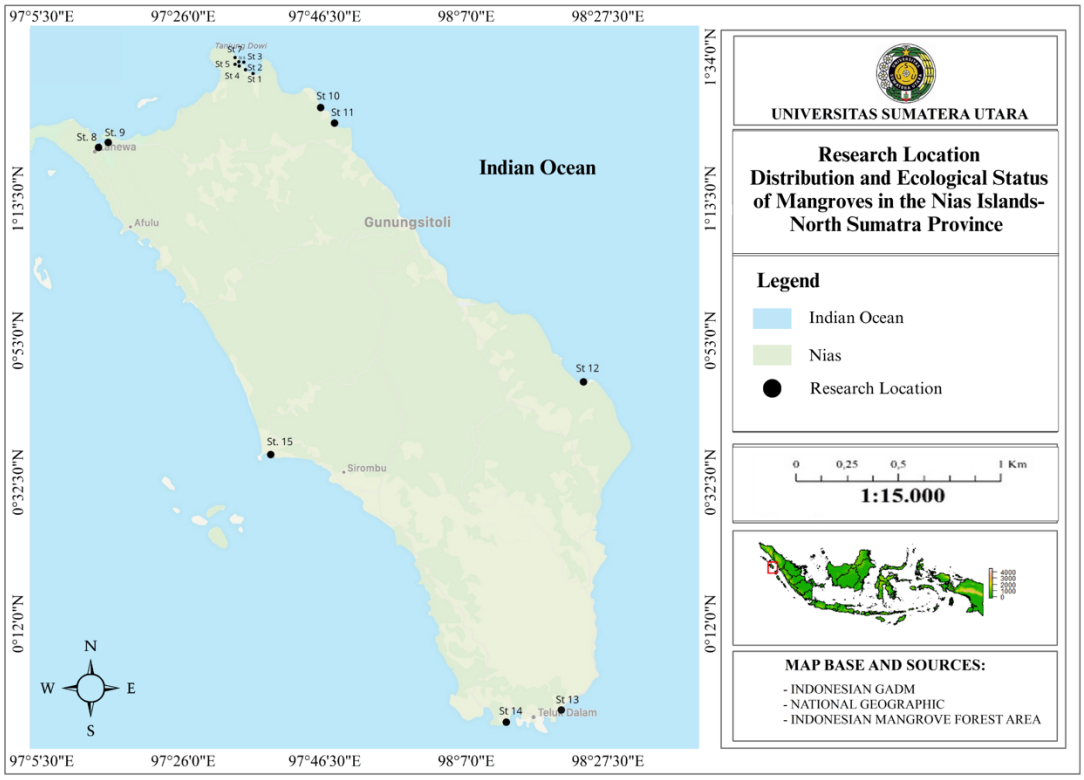

Fig 1a. Research Location in Nias Island

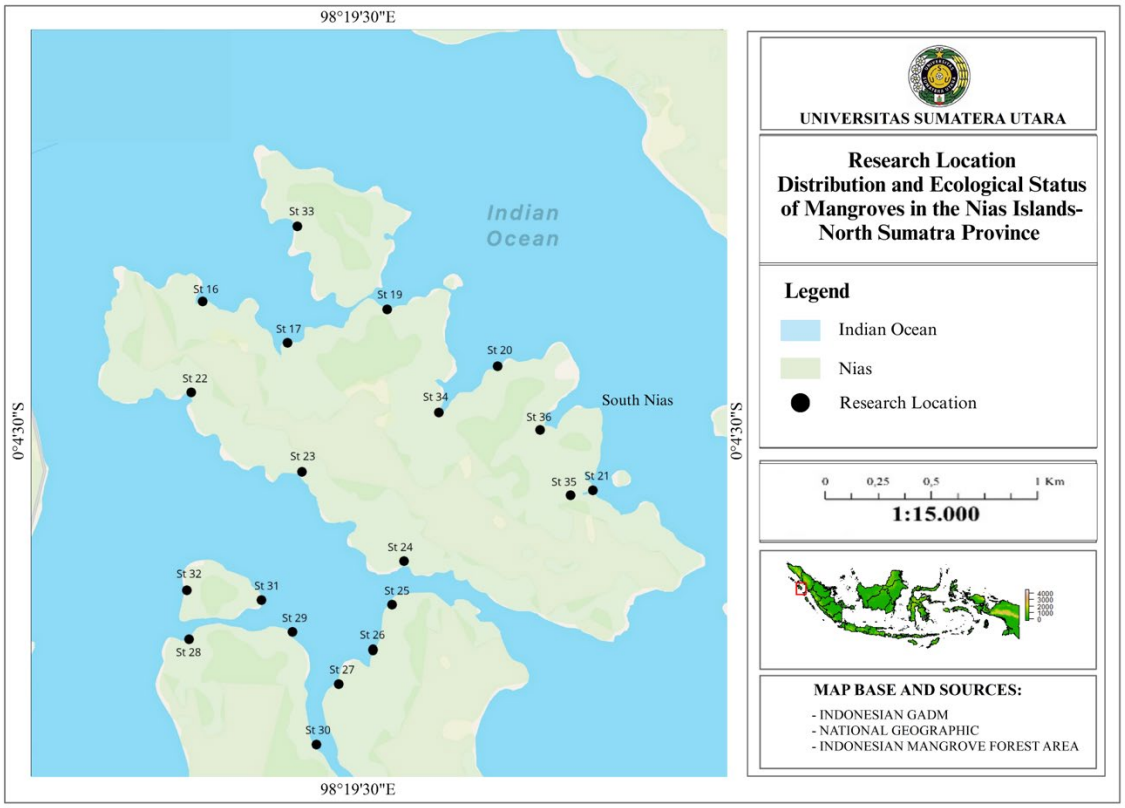

Fig 1b. Research Location in South Nias

3. Result and Discussions

3.1. Composition of mangrove species

Based on observations of mangroves in the Nias Islands, 24 mangrove primer species (11 families) and 9 associated mangroves (8 families) were found (**Table 2-3**). Most of the mangrove communities are in South Nias and on Nias Island they can be found in Belukar Bay, Lahewa Bay, and Bengkoang Bay, and a few in Sirombu on the west coast of Nias Island. Spatially, the richness of mangrove species is generally greater in the southern part of Nias. However, around Belukar Bay at the same location (Nias Mainland), the highest was found compared to other locations (**Fig. 2-3**). The high richness of mangrove species in South Nias is due to the good and natural conditions of mangroves which grow and develop well in protected bays.

Rhizophora apiculata, Rhizophora mucronata, and *Xylocarpus granatum* are the most abundant mangrove species and are commonly found in the Nias Islands. The Rhizophoraceae family is the family with the most common mangrove species. Observations of mangroves in the Nias Islands showed that the Rhizophoraceae family had more species, namely 9 species. In the research results of Akbar et al. (2015) on Manomadeha Island and Domretu Island, North Maluku, 6 species were found from the Rhizophoraceae family. Muhtadi et al. (2016; 2020b) found 7 species from the Rhizophoraceae family on Pulau Sembilan, Mursala Island, and Tapian Nauli Bay in North Sumatra Province.

A large number of species from the Rhizophoraceae family were found because of the opportunity to find more species from this family at each point, and the substrate conditions at the study sites strongly support the growth of this family (Muhtadi et al., 2016; 2020b). The substrate found at the research site is sandy mud as a growing medium for this family. The Rhizophora mangrove species will live on a mud substrate and grow side by side with Avicennia marina, then the Rhizophora stylosa species live on sandy soil or broken coral reefs and are usually associated with the Sonneratia alba species (Bengen, 2004; Giesen et al., 2012; Muhtadi et al. ., 2016). Muhtadi et al further said. (2016; 2020b) that in areas with muddy substrates, *Rhizophora* sp. is the dominant vegetation. The sandy substrate is dominated by the Avicenniaceae family (Muhtadi et al., 2016; 2020b).

Based on several existing reports, the type of mangrove found in the Nias Islands (24 species) is a type mangrove that is quite common compared to other areas. Mangroves in the Nias Islands have a high mangrove species richness compared to other places. The species richness of mangroves on the east coast of North Sumatra ranges from 5-18 species (Sitompul et al., 2014; Hutabarat et al., 2015; Muhtadi et al., 2020a; 2020c) and on the west coast of North Sumatra, to be precise in Taman Pulau Kecil Central Tapanuli as many as 17 species (Muhtadi et al., 2020b). There are 28 species richness of mangroves in Pulau Sembilan (Muhtadi et

al., 2016). Mangrove wealth elsewhere is only found in four species in Liquisa Timor-Leste (De Jesus, 2012), 8 species in Waisai City, Raja Ampat (Mirino et al., 2014), 17 species in Umbele, Morowali (Samsumarlin et al., 2015), 5-11 species on Manomadeha Island, Domretu Island, and Mare Island, North Maluku (Akbar et al. 2016), and only 6 species on the coast of Pidie, Aceh Province (Karnanda et al. 2016).

Table 2. Mangroves primer found in Nias Islands

No	Family	Species	Indonesian name	Local name	Distribution
1	Acanthaceae	*Acanthus ebracteaus*			Low
2		*Acanthus ilicifolius*			Low
3	Arecaceae	*Nypa fruticans*	Nipah	Nipah	Low
4	Avicenniaceae	*Avicennia marina*			Medium
5	Combretaceae	*Lumnitzera littorea*	Api-api uding		Hight
6		*Lumnitzera racemosa*	Teruntum	Teruntum	Hight
7	Euphorbiaceae	*Excoecaria agallocha*	Mata buta/ Garu	Buta-buta	Low
8	Meliaceae	*Xylocarpus granatum*	Nyirih		Hight
9	Myrsinaceae	*Aegiceras corniculatum*			Low
10	Pteridaceae	*Acrostichum aureum*	Paku laut		Low
11		*Acrostichum speciosum*			Low
12	Rhizophoraceae	*Bruguiera cylindrica*	Tancang		Medium
13		*Bruguiera gymnorriza*			Medium
14		*Bruguiera sexangula*	Tancang	Tanjang	Medium
15		*Ceriops decandra*	Tengar		Medium
16		*Ceriops tagal*	Tengar		Medium
17		*Rhizophora apiculata*	Bakau	Bako	Hight
18		*Rhizophora mucronata*	Bakau besar	Bako	Hight
19		*Rhizophora stylose*	Bakau merah	Bako kurap	Hight
20		*Rhizphora lamarchii*			Low
21	Rubiaceae	*Scyphiphora Hydrophyllacea*	Cingam		Low
22	Sonneratiaceae	*Sonneratia alba*	Pedada	Pedada	Hight
23		*Sonneratia caesolaris*	Pidada	Pidada	Hight
24	Sterculiaceae	*Heritiera littoralis*		Jambu laut	Low

Tabel 3. Associated Mangrove species found on Nias Island

No	Family	Species	Indonesian name	Local name	Distribution
1	Convolvulaceae	*Ipomea pescaprae*			Low
2	Combretaceae	*Terminalia catappa*	ketapang		Hight
3	Cyperaceae	*Cyperus malaccensis*			Low
4		*Cyperus scariosus*			Low
5	Fabaceae	*Canavalia maritima*			Low
6	Goodeniaceae	*Scaevola taccada*			Low
7	Malvaceae	*Hibiscus tiliaceus*	Waru laut		Hight
		Thespesia populnea	Waru laut		Hight
8	Rubiaceae	*Morinda citrifolia*	Mengkudu		Low
9	Pandanaceae	*Pandanus tectorius*	Pandan	Pandan	Low

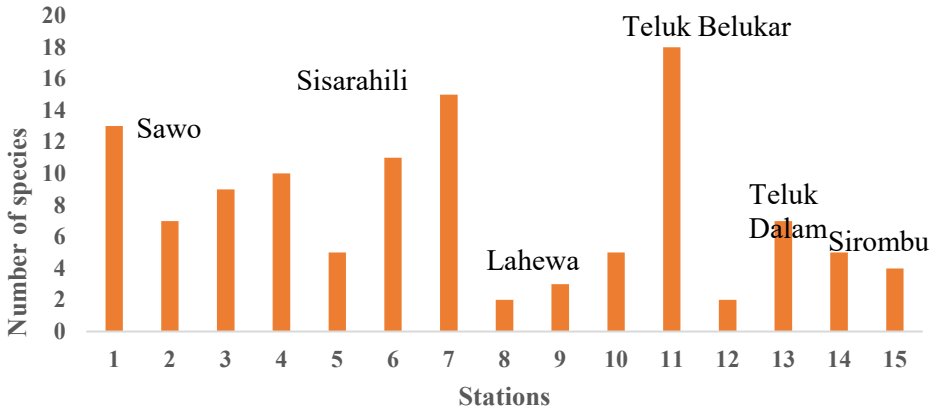

Figure 2. Mangrove species richness on Nias Island (mainland)

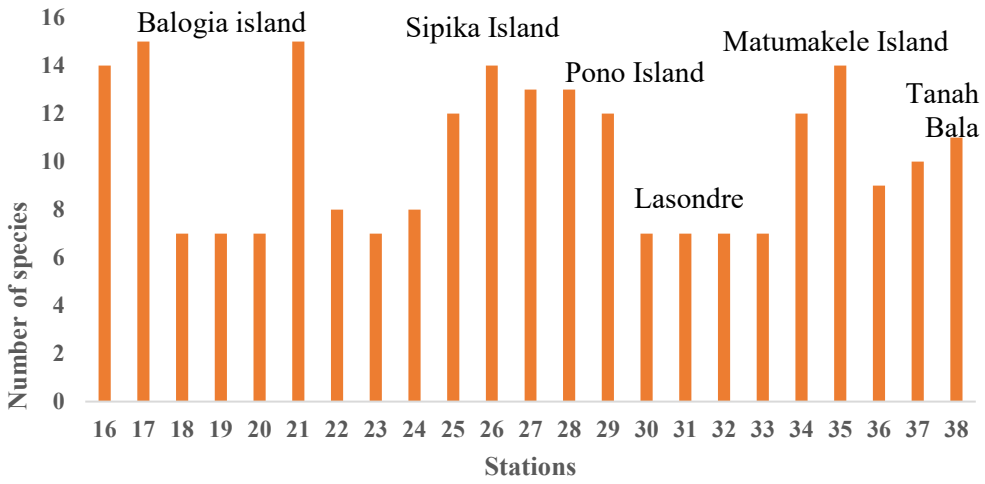

Figure 3. Mangrove species richness in southern Nias

3.2. Mangrove thickness

In the protected area in the form of a bay or protective island in front of it, there are mangroves with varying thicknesses, especially on Balogia Island, north to east of Pono Island, and north and west of Sipika Island. This shows that mangroves can grow well in calm and protected water conditions. The thickest mangroves on Nias Island are in protected areas, namely in Teluk Belukar which reaches 440 m, and in Bengkoang Bay in Sisarahili with a thickness of up to 325 m (Figure 4). In general, mangroves on Nias Island are quite low, especially in Lahewa Bay with a thickness of only about 15-30 m. In the southern part of Nias with protected areas around islands, thick mangrove are found in the northern part of Balogia Island in the form of a bay that can reach 590 m and on Matumakele Island with a thickness of up to 880 m (Figure 5). Low-thickness mangroves are found in southern Nias, namely in Lasondre which only reaches 70 m (Figure 5). The difference in mangrove thickness is caused by the type of substrate found at different observation locations. The substrate on the more open part of the beach (other than the bay) is generally dominated by muddy sand, while the part of the bay is dominated by mud substrate. Mangroves grow well on muddy soils, especially in areas covered with silt (Rangkuti et al., 2017; Muhtadi et al., 2016; 2020ab). Rangkuti et al. (2017) stated that apart from soil conditions, salinity and frequency of inundation are factors that influence the dominance of mangrove species.

The condition of the mangroves on the east coast of North Sumatra and the thickness of the mangroves on the Nias Islands (west coast) is no different. The thickness of mangroves on the east coast of North Sumatra as reported from several studies on Bali Beach, Batubara Regency with a thickness of 150-550 m (Sitompul et al., 2014), on the Sei Nagalawan Beach, Serdang Bedagai with a thickness of 45-75 m (Siagian et al., 2014) in Labu Beach, Deli Serdang Regency with mangrove thickness of 325-450 m (Hutabarat et al., 2015). The thickness of the mangroves on the eastern coastal island of North Sumatra is much lower, namely 107-1684 m (Muhtadi et al., 2016). The thickness of mangroves on the West Coast of North Sumatra is 70-571 and on Mursala Island is 75-360 (Muhtadi et al., 2020b). The results of research on mangroves on other islands showed slightly higher, namely on Saparua Island, Central Maluku, the thickness of mangroves was in the range of 30-940 m (Waas and Nababan (2010), on Manomadeha Island and Domretu Island with a thickness of 145-600 m (Akbar et al. (2015).

3.3. Distribution and zoning of mangroves

Rhizophora apiculata, Rhizophora mucronata, and *Xylocarpus granatum* are mangrove species that are always found at every station. Mangroves *Rhizophora lamarchii* and *Scyphiphora Hydrophyllacea* are only found in Bengkoang bay in Sisarahili and Teluk Belukar bay. The Rhizophoraceae family is a mangrove that is always found in every observation. Based on the station, found 18 species in the Bay of Grove. Based on the zoning, the vegetation on the front (sea) is *Rhizophora apiculata* and *Rhizophora mucronata*. The last zone is *Nypa Frutican*, *Bruguiera cylindrica*, *Lumnitzera racemosa*, and *Excoecaria agallocha*. Ferns (*Acrostichum aureum*) are located in the middle of rare tides (Muhtadi et al., 2016; Rangkuti et al., 2017).

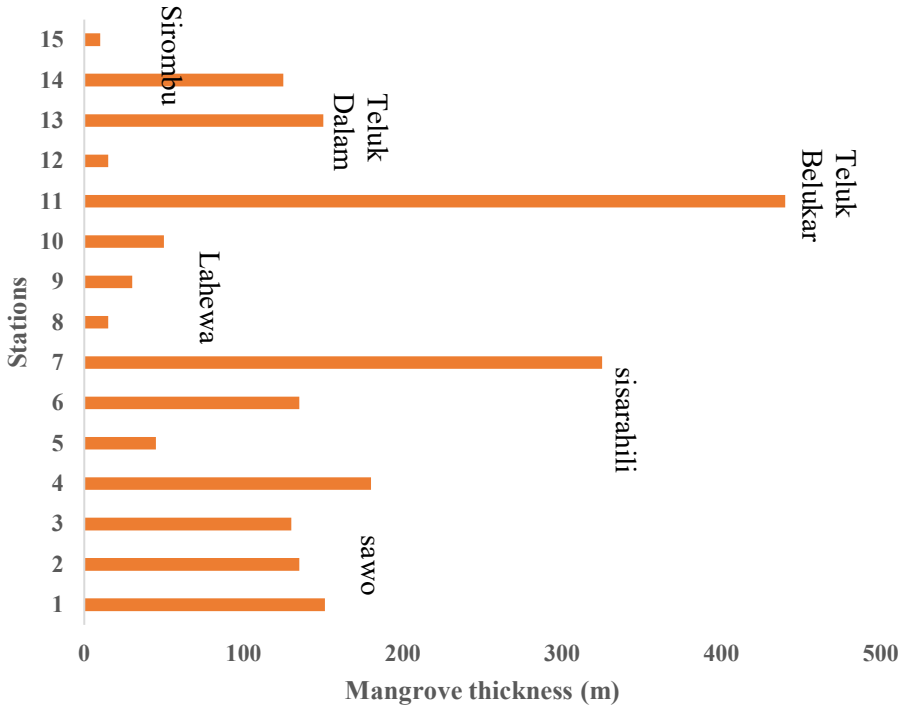

Figure 4. Mangrove thickness in Nias Islands (Main lands)

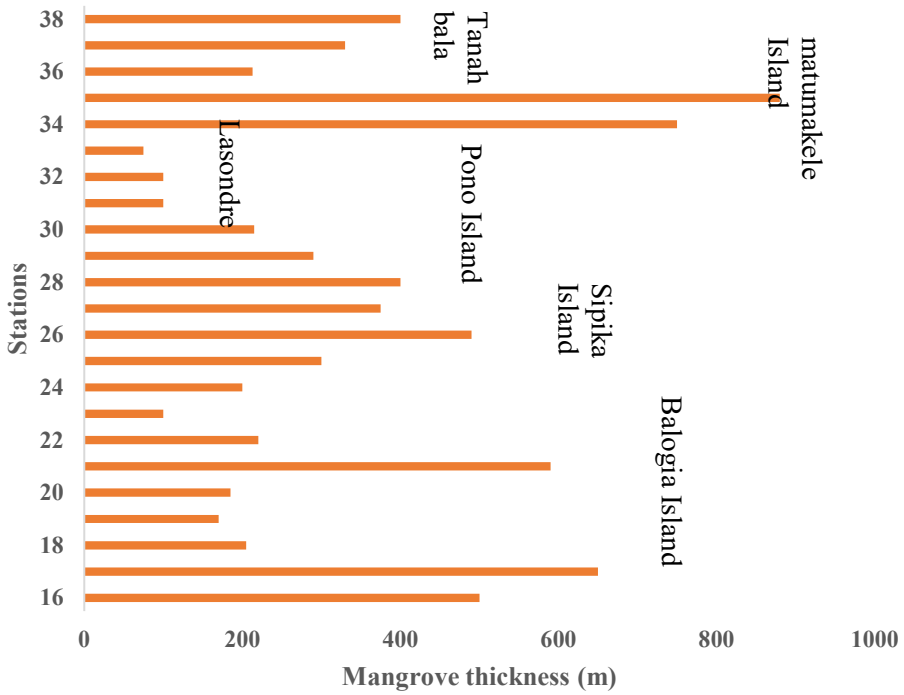

Figure 5. Mangrove thickness in southern Nias

Areas that are always flooded even at low tide are generally dominated by *Rhizophora apiculata* and *Rhizophora mucronata*. Although *Avicenni*a sp. is a type of mangrove that can tolerate a wide range of salinity compared to other types, the mangroves in Nias Small Island Park that are the most tolerant and species-positive are *Rhizophora apiculata* and *Rhizophora mucronata*. Rangkuti et al. (2017) stated that *Rhizophora* spp. is a species that can grow over a wide range of salinities and from silty sand or silty substrates. Some can even grow in the crevices of coral reefs. Areas that are inundated only during high tide (more inland) are generally dominated by *Bruguiera* sp. and *Xylocarpus granatum*. Areas that are only inundated by high tide (only a few days a month) are generally dominated by Bruguiera sexangula, and *Lumnitzera littorea*, including *Excoecaria agallocha*.

3.4. Mangrove density

The density of mangroves in the Nias Islands ranges from 350-4,360 ind/ha. The highest densities were found in the northern bays of Balogia Island and Bengkoang Bay in Sisarahili with densities reaching 4,360 ind/ha. The lowest density is found in Lahewa Bay with a density of only 350 ind/ha. In general, the highest density is found on the coast of the bay on Balogia Island (Figure 3) and the lowest is on Lahewa Bay. Prior to the 2005 Nias Earthquake, the mangroves in Lahewa were the best mangroves in Nias, but the uplift of the land caused by the earthquake caused the death of mangroves in Lahewa Bay and its surroundings (north coast of Nias Island) (Suyarso et al., 2018).

The high density in Bengkoang Bay and around Balogia Island is due to the fact that the mud substrate is a suitable mangrove habitat. In addition, there is a kind of river that stretches from south to north in the west causing high tides to enter all parts of the coast so that various types of mangroves can grow well. This is in sharp contrast to the generally sandy east coast, where only a few species grow on the substrate. The Mangrove National Strategy (2003), states that under optimal tidal conditions, mangroves can grow on land. The main environmental factors affecting mangroves are tidal fluctuations and mean sea level. Based on the type of mangrove, the highest density is found in *Avicennia marina*. This type of mangrove is always found in every observation location.

The density of mangroves in the Nias Islands is still higher than in other locations. Sitompul et al. (2014), found the density of mangroves in Bali Beach, Batubara Regency, ranged from 1,233-1,400 ind/ha. Hutabarat et al. (2015) found mangrove density at Labu Beach, Deli Serdang with a value of 400-3,294 ind/ha. The density of mangroves in Tapian Nauli Bay ranges from 2,425-3,820 ind/ha with an average of 3,120 ind/ha. The density of mangroves on Mursala Island ranges from 1,367-3,233 ind/ha with an average of 2,356 ind/ha (Muhtadi et al., 2020b). The density of mangroves in the Nias Islands is slightly lower than in Pulau Sembilan, which reaches 5,935 ind/ha (Muhtadi et al. 2016).

The position of the Nias Islands in the middle of the Indian Ocean allows the beaches to be hit by waves and big waves. Therefore, there are not many mangroves on Nias Island (the main island), except in the large bays of Teluk Belukar Lake and Bengkoang Bay. On the West Coast of Nias Island, almost no mangroves are found except at river estuaries, and even then in small numbers and distribution in Sirombu, West Nias Regency (**Fig.6**). In general, good mangrove communities are found on the Nias Islands in protected areas, in the form of bays and straits. Because of this, good mangroves can be found south of Nias in the Batu Islands, including on the islands of Balogia, Pono, and Sipika Island. Balogia Island which is protected by the surrounding islands is also protected by the island and Tanamasa Bay, dense mangroves are found (**Fig.7**).

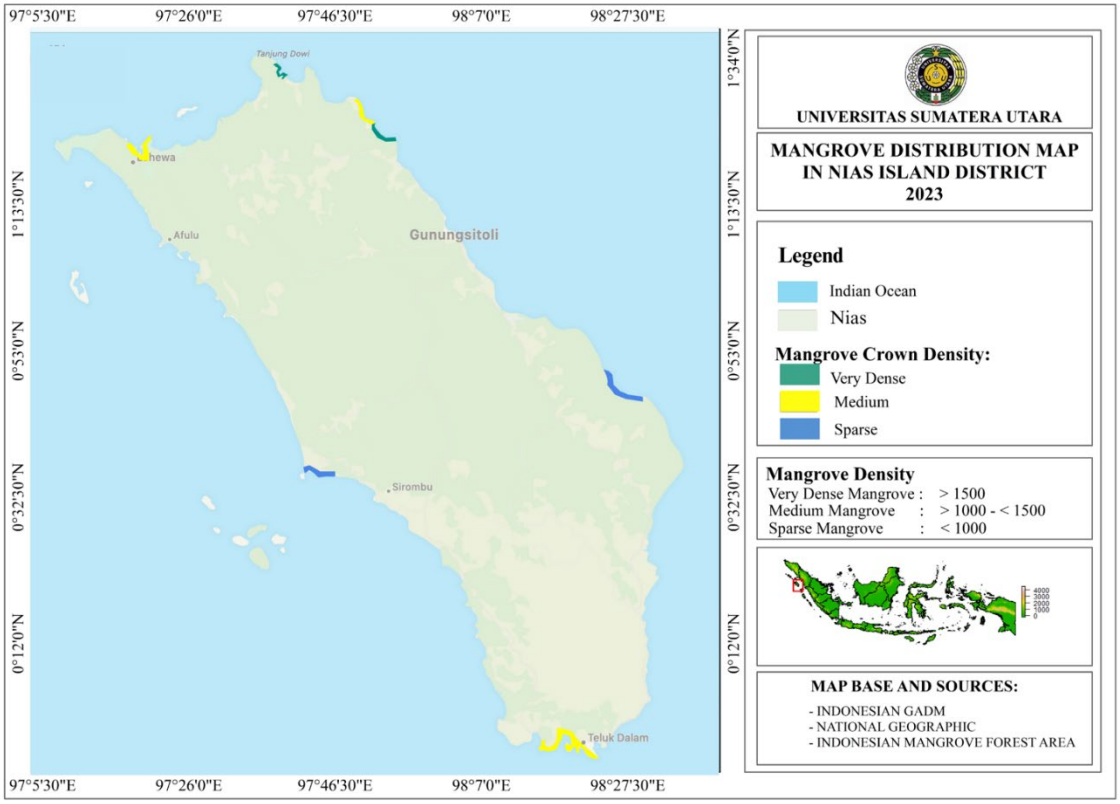

Figure 6. Density map of mangroves on Nias Island

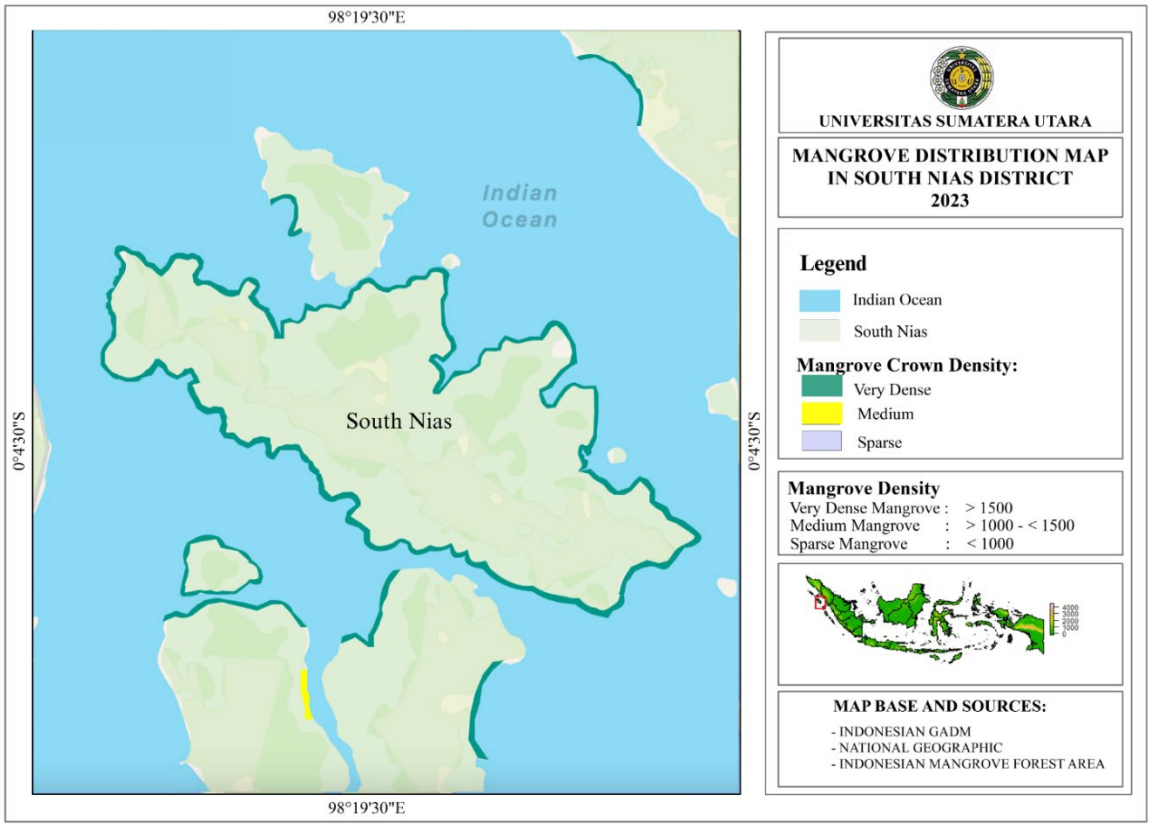

Figure 7. Density map of mangroves in Southern Nias

3.5. Mangrove cover

Mangrove cover on the Nias Islands in the bay is higher than on the open coast. This is directly proportional to the density of mangroves where this bay is higher than other beaches. Mangrove cover in the Nias Islands reaches 0.08-31.62 m^2/ha (**Fig.8-9**). In the bay section, the mangrove cover reached 25.57-31.16 m^2/ha, except in Lahewa Bay with a low trough cover of only 0.09-0.13 m^2/ha. On open beaches, it is only 0.08-0.9 m2/ha in Onlimbu and Siormbu. High mangrove cover in the bay as found by Muhtadi et al. (2020b), that mangrove cover in Tapian Nauli Bay ranges from 1.39-3.07 m^2/ha with an average of 2.26 m^2/ha. Mangrove cover on Mursala Island ranges from 0.25-3.32 m^2/ha with an average of 1.96 m^2/ha. The high value of mangrove cover in this bay is related to the high-density value where the trees found are generally large (Muhtadi et al., 2016; 2020b).

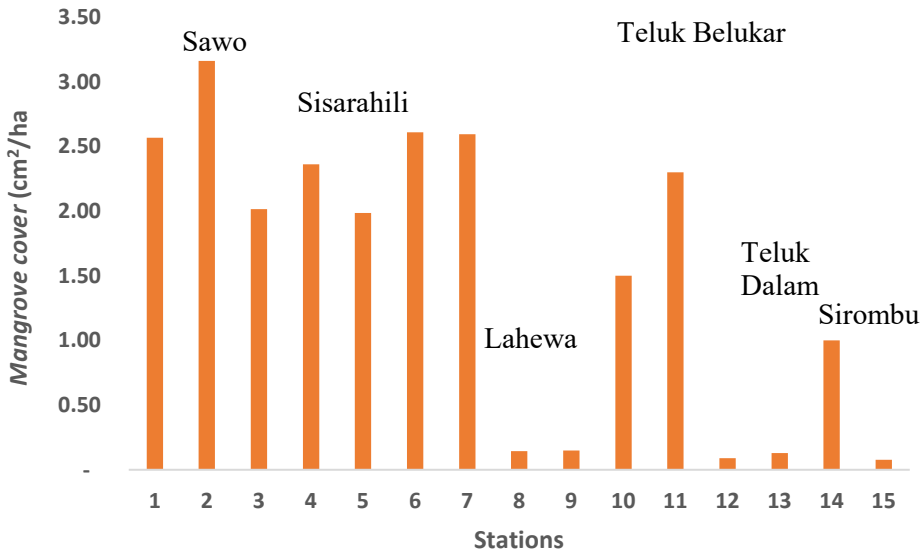

Figure 8 . Mangrove cover in Nias Islands

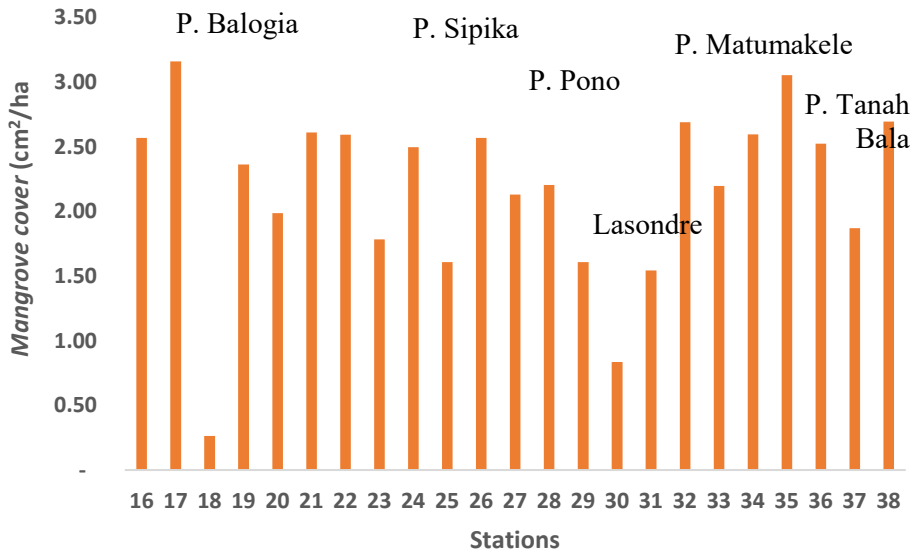

Figure 8 . Mangrove cover in Southern Nias Islands

3.6. Diversity and Importance Value Index

Mangrove diversity in Nias Islands is moderate with 1.33-3.12. The highest diversity is found at station 6 (**Fig.9-10**). The high value of mangrove diversity at the station is related to the number of species and the high density at the two locations. This moderate diversity value affects the high uniformity value (> 0.64) and with low dominance (< 0.33). Thus, even though *Rhizophora* has a large role in the community (highest Importance Value Index), it is not so dominant in the mangrove community in Nias Islands. This is because the *Rhizophora* species is only dominant on the front (near the sea), but on the back (near the mainland) no one dominates. This is related to the existence of zoning in the mangrove community where certain types will grow according to the substrate and the frequency of inundation.

The analysis of the mangroves' important value shows that *Rhizophora Mucronata* and *Rhizophora apiculata* have an important influence and role in the mangrove community in Nias Islands. *Rhizophora mucronata* and *Rhizophora apiculata* have an important role because these two species are the main species of mangroves that are always found and have a high density compared to other mangrove species. *Xylocarpus granatum* although always found, lower density and cover caused the importance index to be lower. *Bruguiera cylindrica* although less found, in addition to being evenly distributed, is also a tree species that is always found in large diameters, so the level of cover is greater and influences the community. Ceriops decandra and *Excoecaria agallocha* have less influence in the community. This is related to the lack of trees and uneven distribution.

Based on the Importance Value Index, it can be seen that the Rhizophora species is a mangrove with an Importance Value Index that is always high at every point of observation. This shows that it can be said that this species has a major role and influence on the mangrove community and ecosystem in Nias Islands. Mangrove exploitation, suitable habitat, and stable water conditions are factors that can affect the magnitude of the importance value (Akbar et al., 2015). Importance values are based on the determination results of several parameters, namely the Relative Species Density, Species Relative Frequency, and Relative Species Coverage (Bengen, 2004).

3.7. Mangrove status

Based on the standard criteria for mangrove damage according to Minister of Environment Decree No. 201 of 2004, shows that mangroves in the Nias Islands are generally classified as good and have high density. Good categories, even high densities, are found mainly in the southern part of Nias, Bengkoang Bay, and Belukar Bay with density values > 1500 ind/ha. Damaged mangrove conditions were found in Lahewa and Dalam Bay. The low level of mangroves is generally caused by the uplift of the coast due to the 2005 Nias Earthquake. Based on various studies in Indonesia, it was found that the condition of mangroves was in the moderately damaged category, good category, and very little species abundance. Results Sitompul et al. (2014) in Bali Beach, Batu Bara Regency with good category, Akbar et al. (2015) on the coast of Sidangoli, West Halmahera Regency, North Maluku, the condition of mangroves was the damaged category, on Mare Island, Tidore Islands, mangroves were found in moderate conditions (Akbar et al., 2016). Mangrove conditions that

are still good are found on Pulau Sembilan with a density of 5935 ind/ha (Muhtadi et al., 2016) and Central Tapanuli Small Island Park which reaches 2,425-3,820 ind/ha in Tapian Nauli Bay and 1,367-3,233 ind/ha on Pulau Mursala (Muhtadi et al. 2020b).

In 2012 the Ministry of Environment reported that only 56% of mangroves in Indonesia were still good and the rest were moderate and damaged mangroves in North Sumatra, 55.77% were damaged and only 8.16% were in a good category (KLH, 2012). However, based on the latest report from the Ministry of Environment in 2021, mangroves in Indonesia are declared good, reaching 92.78%. Mangroves in North Sumatra alone are reported to be in good condition reaching 73.93%. Thus, there was an increase in mangroves both in North Sumatra and in Indonesia. This is a good thing and should be maintained and increased for the preservation of coastal ecosystems.

Even though the mangroves in the Nias Islands are classified as good and natural, the threat of damage due to human activities still occurs. The main threat to mangrove damage is logging, even in small amounts. This is because there are crocodiles found in the southern part of Nias, precisely in the Small Island Park of the Nias Islands, so people are still afraid to do logging. However, in some places, there is a small amount of logging. Another threat is taking coral reefs for building houses. Taking coral reefs will indirectly change the tidal waves on the beach it affects the growth of mangroves. Therefore, socialization, assistance, and efforts to improve the local community's economy are needed so that these activities can continue to be reduced.

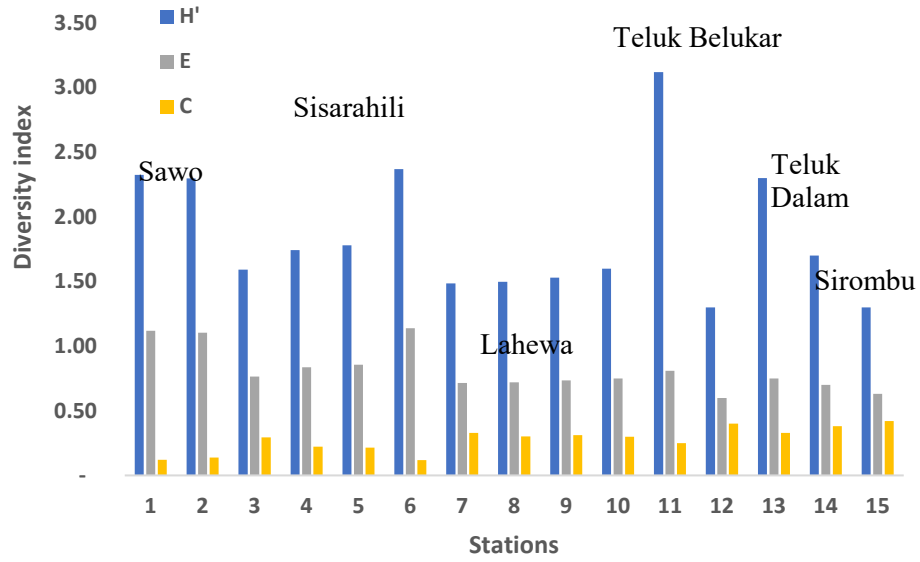

Figure 9. Diversity index in Nias Islands

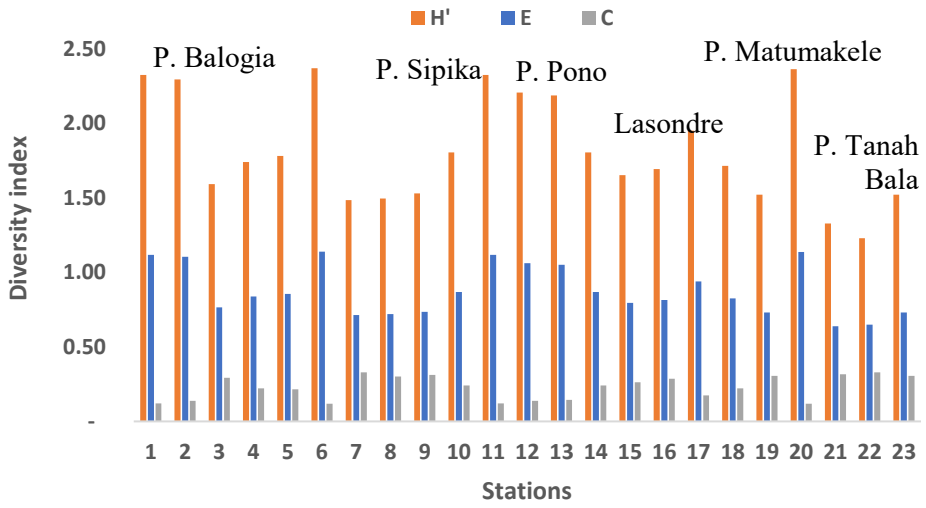

Figure 10. Diversity index in Southern Nias Islands
(H'=Diversity index; E=Evenness index; C=Dominance index)

4. Conclusion

The mangroves found in the Nias Islands consist of 22 species of primary mangroves and 9 species of secondary mangroves. Rhizophora apiculata, Rhizophora mucronata, and Xylocarpus granatum are the most abundant mangrove species and are commonly found in the Nias Islands. The thickness of mangroves in the Nias Islands ranges from 15 - 880 m. The density of mangroves found reached 350-4,360 ind/ha. Mangrove cover reached 0.08-31.62 m2/ha. The results of the analysis of the importance value of mangrove species show that Rhizophora Mucronata and Rhizophora apiculata have a large influence and role in the mangrove vegetation community in Nias Island. Mangroves in the Nias Islands are categorized as damaged - good. The good category was found in Southern Nias, Belukar Bay, and Bengkuang Bay, while the damaged category was found in Lahewa Bay and Dalam Bay.

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