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Identification of Seagrass Species and Density in Mibi Village, Makbon District, Sorong, Southwest Papua

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ABSTRACT

The study was conducted in Mibi Village, Makbon District, Sorong Regency, Southwest Papua, to identify seagrass species and assess their density. The study was conducted from May to June 2024 during low tide, using the line transect method at specific stations and with multiple repetitions. The results identified seven types of seagrasses, with Halodule uninervis and Syringodium isoetifilium having the highest density. Suggestions for further research include exploring the economic value of seagrass through tourism, fisheries, pharmaceutical, and other industrial sectors, potentially providing a positive impact on the Mibi Village community. This study can be a reference for thesis research or further studies on seagrass in Southwest Papua, Indonesia.

INTRODUCTION

Sorong Regency, Southwest Papua, is a region with a rich coastal resource biodiversity. This area, particularly Mibi Village, boasts a comprehensive coastal ecosystem encompassing mangroves, coral reefs, and seagrass beds. Seagrass is a flowering plant that lives in shallow marine waters and serves important ecological functions, such as providing habitat, protecting the coast from abrasion, and efficiently absorbing carbon. Seagrass ecosystems serve as a vital habitat for various marine organisms associated with them, including mollusks, crustaceans, echinoderms, and various fish species (Kuriandewa, (2009); Awom, et. al., 2023). Despite their significant role in supporting coastal ecosystem sustainability, seagrass ecosystems often receive less attention than other coastal ecosystems, such as mangroves and coral reefs (Unsworth et al., 2018). Globally, there are around 60 species of seagrass, and Indonesia has 12 types of seagrasses spread across various coastal areas (Hutomo & Nontji, 2014; Sjafrie et al., 2018).

The condition and potential of coastal ecosystems are crucial for managers of coastal areas, such as Mibi Village, to preserve and manage them sustainably, including seagrass ecosystems. Identifying seagrass species and density is a crucial first step in determining the health of the ecosystem and its role as a vital habitat for various marine biota. This information can serve as a basis for evaluating the condition of the aquatic environment, as a consideration in conservation planning, and as a reference for developing community-based coastal ecotourism. The results of the research are intended to increase community awareness, participation, and collective responsibility in preserving seagrass meadows in Mibi Village, Makbon District, Sorong Regency.

The seagrass beds in Mibi Village are crucial for supporting the livelihoods of the local community, most of whom are of the Moi ethnic group and depend on coastal resources for their livelihoods. However, the lack of scientific data on the condition of seagrass beds in this area hinders the sustainable management and conservation of this ecosystem. Given the importance of seagrass beds' ecological function and the potential pressures from human activities and environmental change, research on the types and densities of seagrass beds in Mibi Village is necessary. This research aims to obtain baseline information for coastal area management and development, while also contributing to the scientific development of seagrass biodiversity data in Sorong Regency.

METHOD

Sampling in this study was conducted through a field survey method with direct observation techniques (observation) using the quadrant transect method. This method aims to systematically identify the types and calculate the density of seagrass. Sampling was done by drawing a 100-meter transect line perpendicular from the coastline towards the sea, and then dividing it into several observation points (stations). Then, the 100-meter line transect method was divided into 5 parts with 4 stations using a 50 cm^2 plot, and a 25 cm subplot (Dahuri, et al., 2001; Rahmawati, et al., 2014; Dewi, Et.al., 2021). The species of seagrass were visually identified at each observation station by observing their morphological characteristics such as their leaves, stems, and rhizomes, referring to the identification guide by Kuriandewa, Hutomo (2006); Rahmawati, et al., (2014) and the calculation of the number of individuals per species to determine the density level expressed in individuals/m^3. Seagrass samples contained in each quadrat were recorded and calculated based on the number of shoots, then the results were converted to m^2 units. The results of this calculation provide a quantitative picture of the dominance and distribution of seagrass species at the research site (Nontji, 2005; Rahmawati et al., 2019).

This research was conducted from May to June 2024, located in Mibi Village, Makbon District, Sorong Regency, Southwest Papua Province (Figure 1).

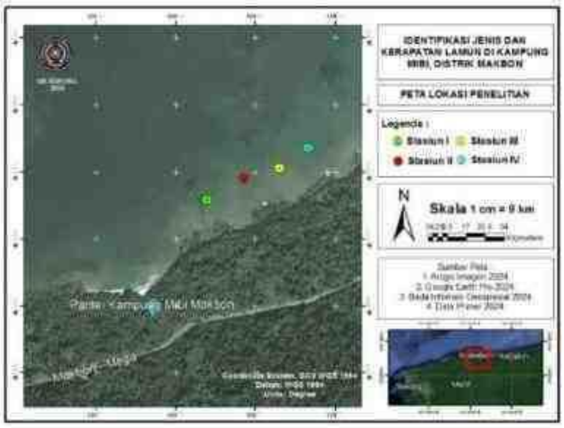

Figure 1. Research Location Map
(Sumber: ArcGis 10.4.1 2024)

Data Analysis Methods

Prior to data analysis, seagrass species were identified using the line transect method. The data analysis method used in this study was adapted to address the objectives formulated in this study, as follows:

1. Seagrass Density

Seagrass density is calculated using the formula Rahmawati, Et., al., (2019), namely:

$$D = Ni/A$$

Where:

D : Density of species (shoots/m^2)

N_i : Number of individuals (shoots) in quadrant transect

A : The area of the sampled area (m^2)

Following the seagrass density calculations, the conditions are determined using the seagrass density criteria in Table 1 regarding the seagrass density criteria.

Table 1. Seagrass Density Criteria

Density	Condition
>175	Very dense
125-175	Dense
75-125	Quite dense
25-75	Rare
<25	Very Rare

Source: Gosari and Haris (2012); Putri, Et., al., (2018)

2. Seagrass Cover

Seagrass cover is calculated by adding up the seagrass cover in each subplot in the quadrant by dividing it into 25 cm x 25 cm squares (small squares) which are divided into 4. The percentage of seagrass cover in small squares can be calculated using the formula of Rahmawati, et., al., (2019) as follows:

$$Seagrass\ Cover\ (\%) = \frac{Total\ of\ Seagrass\ Over\ (4\ Quadrat\ Transects)}{4}$$

3. Average Seagrass Cover

Calculate seagrass cover per transect or station by adding the seagrass cover for each quadrant, as a result of equation 1, to all transects within that station. Then, divide the sum by the number of quadrants within that transect or station. Calculate the average seagrass cover per transect or station using the formula of Rahmawati, *et., al.*, (2019) as follows :

$$Average\ Seagrass\ Coverage\ (\%) = \frac{Sum\ of\ Seagrass\ coverage\ percentages\ in\ all\ quadrats}{Total\ number\ of\ quadrats}$$

The average seagrass cover at each location is divided into categories in Table 2 (Rahmawati et al., 2014; Rahmawati, et al., 2019).

Table 2. Seagrass Cover Category

Cover Percentage (%)	Category
0-25	Rare
26-50	Medium
51-75	Dense
76-100	Very Dense

4. Seagrass Dominance Index

The seagrass cover per species is calculated to determine the most dominant seagrass species at a location by calculating the seagrass cover per seagrass species at one station by adding up the percentage value of each seagrass cover in each square of the entire transect and dividing it by the number of squares at that station. Calculating the seagrass cover value per species at one transect or station can be done using the formula of Rahmawati, et al., (2019) as follows:

$$Seagrass\ Dominane\ Index\ (\%) = \frac{The\ total\ value\ of\ each\ type\ of\ Seagrass\ cover\ in\ all\ quadrats}{Total\ number\ of\ quadrats}$$

RESULT AND DISCUSSION

Mibi Village is a coastal area established in 2013 and located in the northern part of Sorong Regency, Southwest Papua Province. This village is approximately 45 km from Sorong City, with a travel time of approximately two hours by land transportation. Based on geographic coordinates, Mibi Village is located at 0°45'58.7"S and 131°33'29.4" E. Administratively, this area is bordered by the Open Sea to the north, the Trans Sorong–Tambrauw Road to the south, Malaumkarta Village to the east, and Kwadas Village to the west (Sorong Regency Government, 2023). The community of Mibi Village is dominated by the Moi ethnic group, one of the indigenous tribes in the Bird's Head region of Papua Island (Voogel Kop). The Moi tribe originates from an area called Malamoi (Mala means vast land, Moi means smooth). The Moi tribe is known for its friendly character, upholding the value of togetherness, and resolving conflicts through traditional approaches. Religious values and clan kinship ties are strongly embedded in their social structure (Ayomi, 2020). Land and sea rights are determined by a system of customary rights passed down through clan lines. Not all clans have direct access to coastal and marine areas; only certain clans, such as Sapisa, Mubalen, Malasemuk, and Kalami, possess these areas, which, according to customary law, also means they have control over the sea directly adjacent to their land (Siburian, 2019; Ministry of Agrarian Affairs and Spatial Planning/National Land Agency, 2022).

Identification of Seagrass Species

This research was conducted at four stations with five repetitions at each station. Observations at the research location revealed seven seagrass species identified. Table 3 shows the number of stands at each station.

Table 3. Number of Shoots/Station

Seagrass Species	Shoots/Station			
	Station I	Station II	Station III	Station IV
Enhalus acoroides	-	8	24	26
Thalassodedron ciliatum	-	550	125	609
Cymodocea rotundata	-	209	253	-
Syringodium isoetifolium	235	312	238	261
Halodule uninervis	331	254	393	95
Halodule pinifolia	321	153	-	-
Halophila ovalis	88	184	83	-
Total	1019	1670	1116	991

Source: Primary Data, 2024

Notes: *Enhalus acoroides* = Ea, *Thalassodedron ciliatum* = Tc, *Cymodocea Rotundata* (Cr), *Syringodium isoetifilium* =Si, *Halodole pinifolia* = Hp, *Halodule uninervis* = Hu, and *Halophila ovalis* = Ho.

Seagrass Species Density

The results of the seagrass density analysis above (Figure 2) show that the density of seagrass species at each station found seven types of seagrass on the Mibi Coast, namely: *Enhalus acoroides* (Ea), *Thalassodedron ciliatum* (Tc), *Cymodocea Rotundata* (Cr), *Syringodium isoetifilium* (Si), *Halodole pinifolia* (Hp), *Halodule uninervis* (Hu), and *Halophila ovalis* (Ho). Among the seven types of seagrass found, station I found four types, namely Syringodium isoetifilium (400 stands/m^2), Halodole pinifolia (642 stands/m^2), Halodole uninervis (1950 stands/m^2), and Halophila ovalis (176 stands/m^2), with very dense conditions based on the seagrass density category according to the seagrass density criteria of the Minister of Environment Decree No. 51 of 2004.

Meanwhile, at station II, all species found during the study were present. Based on Figure 2, 6 of them have very dense conditions, except for the *Enhalus acoroides* species, which has very rare conditions with a density value of 16 (≤25). The density of species at the research location is influenced by the characteristics of the substrate, environmental conditions, and nutrients, which support the growth of seagrass, so that it has a high frequency of presence and cover (Gosari and Haris, 2012; Feryatum, 2012; Putri, Et. al., 2018).

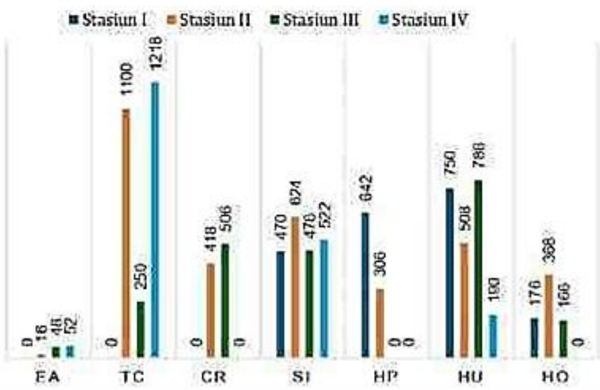

Figure 2. Seagrass Density Graph

The low density of the *Enhalus acoroides* species at the observation location is due to the rarity of this species found in the observation quadrant. Based on the results of measurements and calculations of current speed, it shows that at each station at point 0 of the transect, the current speed is very low, causing the seagrass to be affected by sediment attached to the seagrass, thus disrupting the seagrass growth process.

Furthermore, existing disturbances, such as human activity and trampling on seagrass, make it difficult for it to grow (Putri et. al., 2018). This location is a tourist destination and a fishing spot for the Mibi Village community. The lack of tolerance of a seagrass species to environmental factors can be a limiting factor in its growth and development (Eki, Et., al., 2013).

The highest density values were obtained for the seagrasses *Halodule uninervis* and *Syringodium isoetifilium*. According to the analysis of the current speed at all stations at the 100 m point, the average current speed value was 0.05. Therefore, this value strongly supports the growth of the seagrasses *Halodule uninervis* and *Syringodium isoetifilium*. Surabi et. al. (2018) stated that the high density of a species is due to the large number of species found in each observation quadrant, resulting in a high density.

Seagrass Cover

The percentage of seagrass cover describes the extent of seagrass cover in a body of water. According to Rahmawati et al. (2014), the seagrass species that falls into the very dense category (76-100%) is *Halodule uninervis* at station 1 with a coverage percentage of 81.25%. According to Surabi et al. (2018), this seagrass is usually found growing in a monospecific community that is dominant on sand, rubble (dead coral fragments), and hard substrates. Observations of the substrate type at all stations indicate a sandy substrate type that supports seagrass growth.

Conversely, the lowest seagrass cover value is *Enhalus acoroides* at all stations. The coverage of seagrass species at each station can be seen in Figure 3.

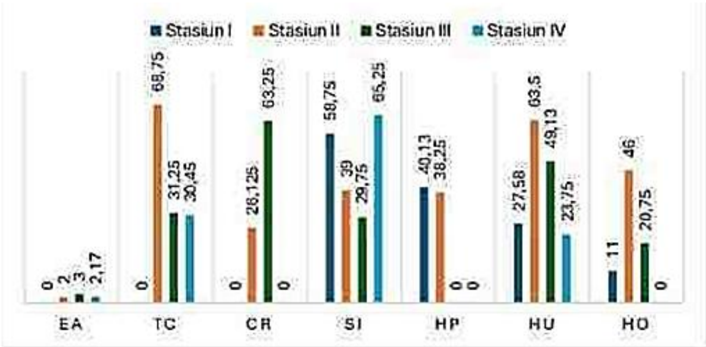

Figure 3. Seagrass Cover Graph

The highest overall seagrass cover was observed at station II, with a coverage value of 283.625%. The nutrient-rich muddy sand substrate is one of the reasons for the excellent seagrass cover at station II. Meanwhile, the lowest seagrass cover was at station IV, with a value of 121.617%.

Dominance Index

A low dominance index indicates that no species dominates over other species, and vice versa, a high dominance index indicates that a species dominates within a community (Ledheng and Yolanda, 2018). The dominance index is used to indicate the presence or absence of dominance of a particular species within a community. The dominance index in the waters of Mibi Village is shown in Figure 4.

The dominant seagrass species in the waters of Mibi Village can be seen in Figure 4, a graph of the Dominance Index. The most dominant species is Thalassodedron ciliatum (Tc), with 256 stands, followed by *Syringodium isoetifilium* (Si) and *Halodule uninervis* (Hu). Species with low dominance index values include *Enhalus acoroides* (Ea), *Cymodocea rotundata* (Cr), *Halodole pinifolia* (Hp), and *Halophila ovalis* (Ho). Low dominance indicates that the ecosystem is stable and unpressured (Ledheng dan Yolanda, 2018).

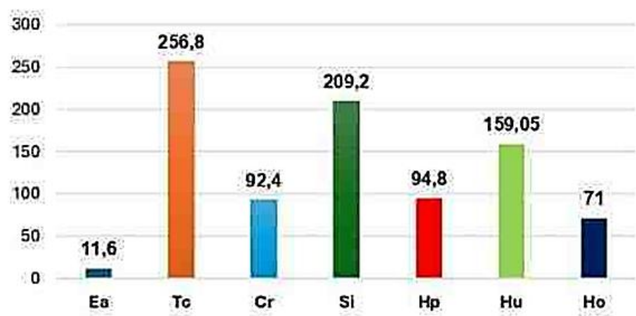

Figure 4. Dominance Index Graph

Water Parameters

Seagrass bioecology can be described from the characteristics of seagrass biodiversity conditions, associated biota, and ecological conditions from a physical and chemical perspective, including temperature, substrate, salinity, pH, currents, and waves (Angkotasan and Daud, 2016). This can be seen in Figure 5 regarding the measurement of water parameters at Mibi Beach at each station.

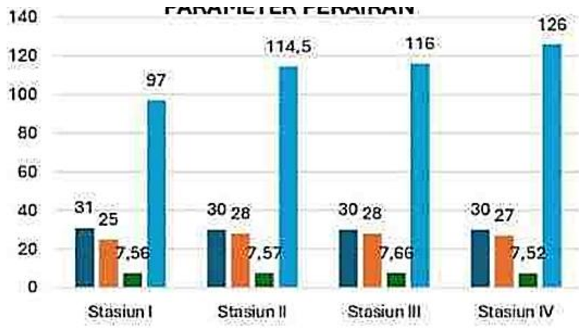

Figure 5. Water Parameter Graph

Temperature

The optimum temperature for seagrass growth is in the range of 28-30°C (Pelafu, Et., al., 2022). Seagrass is highly productive in surface light at temperatures of 40°C and above (Zurba, 2018). When the water temperature reaches 38°C, seagrass becomes stressed, and when it reaches an extreme temperature of 48°C, seagrass can experience death (Zurba, 2018), as well as a decrease in density (Collier and Waycott, 2014; Estafani, 2023). Measurements of water parameters at the research location obtained the results of temperature measurements at each station, namely 30°C, indicating that the water temperature at the research location follows the optimum temperature for seagrass growth. However, at station 1 at the 0-meter point, the temperature is different from the other stations, namely 31°C. This could be the cause of the low seagrass density at station 1.

Salinity

According to Minister of Environment Decree No. 51 of 2004 concerning seawater quality standards for seagrass growth, the standard is around 33–34‰. Meanwhile, the salinity range at the research location ranges from 25–30‰ (Simbolon, 2016). The measurement results indicate that salinity at the research location may be contributing to the low density and cover of seagrass at stations I and IV compared to stations II and III, which are categorized as good for seagrass growth.

pH

Referring to Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management, the optimum acidity range for seagrass growth is 7–8.5. Measurements using a pH meter revealed that the pH value at the research location was 7.6–7.66, which is the optimum pH for seagrass growth.

Current Speed

Current speed data collection was repeated twice at each station, namely at the first point where seagrass was seen or at 0 and 100 meters. The current kite in the form of a distilled water bottle was floated on the surface with a 2-meter rope and a stopwatch was activated simultaneously until the rope stretched straight, followed by time measurements.

At the 0 m point, or the first-time seagrass was seen from the transect at four stations, the current velocity was low, at 0.02-0.04 m/s. According to Dahuri (2003), Rangkuti et. al., (2022), a current with a speed of 0.05 m/s can support good seagrass growth. Current speed is a very important factor for seagrass meadows, which functions to clean various deposits or sand and mud particles that stick to the seagrass (Hidayat et al., 2018); Rahman. Et. al., 2022). According to Oktavianti et al. (2014), Yunita Et., al., (2020), current speed can affect the zoning of some seagrass species and their growth. This is in line with the results of the analysis of low-density and cover data at the 0 m point.

Depth

The water depth measured at the research location ranged from 71 to 156 cm. With a brightness of 100%, it means that the bottom of the water is still affected by sunlight. Water clarity is determined visually from the water surface perpendicular to the bottom using a secchi disk (Rahmawati et al., 2019). The brightness value is categorized as good for the growth of seagrass, which is a shallow-water plant, because it can help the process of photosynthesis. After all, the light intensity can still reach the bottom of the water where the seagrass grows, according to the quality standards for depth parameters for the growth and health of seagrass in shallow waters (Sutadi, Et al., 2021).

Substrat

According to Subur (2013); Leni, Et., al., (2024), seagrass is usually found growing well in tidal areas and coastal waters with a base of muddy sand, sand, coral sand, or dead coral fragments. The substrate is determined visually and by selecting the substrate using the fingers (Rahmawati et al., 2019). The results of visual observations of the substrate type at the research location were predominantly sandy and muddy sand, especially at station IV. The substrate at the research site supports seagrass growth well.

CONCLUSION

According to the results of a line transect study conducted in the waters of Mibi village, seven species of seagrass were identified: *Enhalus acoroides* (Ea), *Thalassodedron ciliatum* (Tc), *Cymodocea rotundata* (Cr), *Syringodium isoetifilium*

(Si), *Halodule pinifolia* (Hp), *Halodule uninervis* (Hu), and *Halophila ovalis* (Ho). The density of seagrass species found at each station is in the very dense category, except for the Enhalus acoroides type. The cover of seagrass species at the research location that has a very dense category is at station I, namely Haludule uninervis, with a cover value of 81.25%.

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