Jurnal Natur Indonesia
24(1), April 2026: 21-27

p-ISSN 1410-9379
e-ISSN 2503-0345

Condition of the Seagrass Ecosystem in the Waters of Jago-Jago Village, Central Tapanuli Regency, North Sumatra

Kondisi Ekosistem Rumput Laut di Perairan Desa Jago-Jago, Kabupaten Tapanuli Tengah, Sumatera Utara

Erika Endra Yanti[1], Joko Samiaji[1*], Zulkifli[1]
[1]Department of Marine Science, Faculty of Fisheries and Marine, Universitas Riau, Pekanbaru 28293 Indonesia
*Correspondent Author: joko.samiaji@lecturer.unri.ac.id

ABSTRACT

This research was conducted in February-March 2023 in the coastal waters of Jago-Jago Village, Central Tapanuli Regency, North Sumatra Province. The purpose of this research was to determine the state of the seagrass ecosystem, including the type, density, coverage, and frequency of seagrass. This research used a purposive sampling method in determine sampling stations. At each station, 3 transect lines were applied, each 30 m long, and the distance between transects was 50 m. The results showed that the seagrass species at the study site was *Enhalus acoroides*. The highest average seagrass density is found at Station III, i.e., 47.44 ind/m^2, included in a scale of 2, indicating it is classified as seagrass with rare conditions. Station I, with a density of 23.78 ind/m^2, and Station II, with a density of 28.67 ind/m^2, are included on the scale as seagrass with very rare conditions. The highest average coverage is at Station III (61.11%), and the lowest is at Station I (30.56%). Station III is in good condition, Station I and Station II are in damaged condition. The frequency of seagrass type 1, represented only by *E. acoroides*, is found at all research stations.

Keywords: Jago-Jago Village, Seagrass condition, Density, Cover, Frequency

ABSTRAK

Penelitian ini dilaksanakan pada bulan Februari-Maret 2023 di perairan Desa Jago-Jago, Kabupaten Tapanuli Tengah, Provinsi Sumatera Utara. Tujuan dari penelitian ini adalah untuk mengetahui kondisi ekosistem lamun yang meliputi jenis, kerapatan, tutupan dan frekuensi lamun di lokasi penelitian. Penelitian ini dilakukan dengan menggunakan metode survei dimana stasiun pengambilan sampel ditentukan secara *purposive sampling* pada 3 stasiun. Pada masing-masing stasiun menggunakan 3 garis transek dengan panjang 30 m dan jarak antar transek yaitu 50 m. Hasil penelitian menunjukkan bahwa jenis lamun yang ditemukan di lokasi penelitian yaitu *Enhalus acoroides*. Kerapatan rata-rata lamun tertinggi terdapat pada Stasiun III yaitu sebesar 47,44 ind/m^2 termasuk dalam skala dua yang berarti tergolong lamun dengan kondisi jarang. Stasiun I dengan nilai kerapatan sebesar 23,78 ind/m^2 dan Stasiun II dengan nilai kerapatan sebesar 28,67 ind/m^2 termasuk dalam skala satu yang berarti tergolong lamun dengan kondisi sangat jarang. Tutupan rata-rata tertinggi terdapat pada Stasiun III yaitu sebesar 61,11% dan terendah terdapat pada Stasiun I sebesar 30,56%. Stasiun III tergolong dalam kondisi baik, stasiun I dan stasiun II tergolong dalam kondisi rusak. Frekuensi jenis lamun 1 dimana hanya diwakili oleh *E. acoroides* yang dapat ditemukan pada semua stasiun penelitian.

Kata Kunci: Desa Jago-Jago, Kondisi lamun, Kerapatan, Tutupan, Frekuensi

INTRODUCTION

Central Tapanuli is one of the regencies in the province of North Sumatra, located on the west coast of Sumatra, with a coastline of 205 km (Samiaji et al., 2022). Central Tapanuli has a large coastal area and a diversity of marine resources that support human life. There are three major ecosystems in the coastal area: mangrove, seagrass, and coral reef ecosystems. Seagrass is the only flowering plant group found in the marine environment. Seagrass can adapt to high salinity and has structural vessels that perform a function almost identical to that of land plants. Seagrass has a lifestyle in the form of an expanse that covers a coastal area or shallow sea formed by one or more types of seagrass (Hutomo, 2009).

Seagrass ecosystems are among the most productive ecosystems in shallow seas. The seagrass ecosystem may support the sustainability and durability of the organisms that live on it. The importance of seagrass as an

Received: 10 February 2026
Accepted: 29 March 2026

ecosystem contributor and habitat provider, ensuring the sustainability of aquatic biota, is evident in its condition from time to time. Assessment of seagrass conditions is necessary to provide data on changes and developments in activities in coastal areas.

The condition of seagrass ecosystems can be analyzed by assessing seagrass type composition, seagrass density, seagrass coverage, and seagrass frequency (Supriyadi, 2010). Seagrass density and coverage are scored to determine the seagrass ecosystem conditions category. The condition of seagrass ecosystems may vary across regions and under different environmental conditions. Seagrass coverage, density, and frequency can affect one another. Thus, research on the state of seagrass ecosystems in the waters of the village of Jago-Jago, Tapanuli Tengah, North Sumatra, is very important. It can serve as a basis for future management of the area. The purpose of this research is to find out the state of the seagrass ecosystem, including the type, density, coverage, and frequency of seagrass in the waters of Jago-Jago Village, Central Tapanuli Regency, North Sumatra Province.

MATERIALS AND METHODS

Time and place

This research was conducted in February-March 2023 in the coastal waters of Jago-Jago Village, Central Tapanuli Regency, North Sumatra Province. Sample analysis was performed at the Marine Biology Laboratory, the Marine Chemistry Laboratory, and the Physical Oceanography Laboratory, all in the Department of Marine Science, Faculty of Fisheries and Marine Sciences, Universitas Riau.

Methods

The method used in this research is a survey method, which involves conducting observations and sampling directly at the research site. The samples taken are in the form of seagrass, sediment, and water quality parameters, i.e., substrate, temperature, pH, salinity, brightness, depth, flow rate, and DO.

Procedures

Sampling stations are determined by purposive sampling. Sampling was carried out at 3 stations. Station I is in an area near residential areas; Station II is about 200 m from Station I toward the west of the bay; and Station III is in an area with no human activity, about 500 m from Station II. The determination of the sampling site is deemed to represent the research site, where the determination of the station is based on human activity. Seagrass data were retrieved in this study using line transect and plot-quadrant methods. Seagrass data collection is carried out during the low tide. The transect line at each station is placed perpendicular to the coastline, with a length of 30 m, and the distance between transects is 50 m. The quadrant plot used is 1 x 1 m^2.

Sediment sampling is conducted at each station to determine the substrate type. Sediment sampling is performed using a 10 cm-diameter PVC pipe. Sediment samples are taken by inserting the pipe into the substrate to a depth of 10 cm. Sediment sampling is performed in three replicates at each station, with ±500 g of sediment collected at each station. The samples are placed in plastic bags, labeled, and then placed in an ice box for transport to the laboratory. Analysis of sediment type in the laboratory was performed according to Rifardi (2008), an analysis of the size of sediment grains for sand and gravel fractions was conducted by wet screening, and mud fractions were analyzed by the pipette method. The health and growth of seagrass fields cannot be separated from the state of water quality parameters that can affect seagrass life. The measurement of water quality parameters is considered supporting data in analyzing the results. The measured water quality parameters are temperature, pH, brightness, depth, flow rate, DO, and sediment type.

Composition of the seagrass type

The composition of the seagrass type is the number of stands in each type of seagrass found in one observation area (plot quadrant). Observations are carried out directly, followed by identification and registration of seagrass based on the morphology of the seagrass type, in accordance with the guidelines for seagrass identification (McKenzie, 2003).

Seagrass density

Seagrass density was calculated based on the calculations of Snedecor & Cochran as follows (Fachrul, 2007): $\mathrm{Ki} = \frac{\mathrm{ni}}{\mathrm{A}}$

where: Ki = density of type (ind/m²); Ni = number of individuals or stands for i in squares; A = area of quadrant (m²)

The state of the seagrass field was determined in calculating seagrass density, and the results are shown in Table 1.

Table 1. The scale of seagrass conditions based on density (Gosari & Haris, 2012)

Scale	Condition	Density (ind/m²)
5	Very Densed	>175
4	Densed	125-175
3	Slightly Densed	75-124
2	Sparse	25-74
1	Very Sparse	<25

Seagrass cover

Seagrass cover is the area covered by seagrass plants in one observation area. The method used to calculate seagrass cover is the square transect method, adapted from the Seagrass Watch method. The seagrass watch method was developed by the Northern Fisheries Center in Australia and is intended for the general public or volunteers who want to monitor seagrass fields (Rahmawati et al., 2017). The quadrant plot used is a 1 x 1 m^2 plot consisting of 4 subplots. The percentage of seagrass coverage for each subplot in the quadrant plot is shown in Table 2.

Table 2. Assessment of seagrass cover

Category	Seagrass Coverage Value
Full Covered	100
Three quarterly Covered	75
Halfly Covered	50
One quarterly Covered	25
No Coverage	0

Seagrass cover in one quadrant plot can be calculated using the formula: Seagrass cover (%)=$\frac{\text{Total seagrass cover value 4 subplot}}{4}$. The average seagrass cover in one station can be calculated using the formula: Seagrass cover (%)=$\frac{\text{Total seagrass cover in all transects}}{\text{Total plot}}$

The condition of the seagrass field is determined by examining the coverage value. The determination of seagrass field conditions is based on seagrass coverage, presented in Table 3.

Table 3. The scale of the seagrass field condition based on cover

Status	Condition	Coverage (%)
Good	Rich/Healthy	$\geq$ 60
Damaged	Less Rich/Less Healthy	30-59.9
Damaged	Poor	$\leq$ 29.9

Seagrass frequency

Type frequency is the probability that a type will be found in the observed example point. The type frequency is calculated with the formula as follows (Fachrul, 2007): $F = \frac{Pi}{\Sigma P}$; where: F = frequency type; Pi = number of square plots where species i is found; ΣP = total number of square tiles observed

Data Analysis

Data on seagrass type, density, coverage, and frequency were descriptively analyzed and presented in tables and graphs, following guidelines and literature.

RESULT AND DISCUSSION

Water quality parameters

The water quality parameters measured in this study were temperature, pH, salinity, brightness, depth, flow rate, and DO. The results for the Jago-Jago Village water quality parameters are shown in Table 4. Temperature measurements carried out in the waters of Jago-Jago-Jago Village obtained different values between stations, ranging from 28.7-29.7 ^{o}C. This result showed that the water temperature at the research site was still included in the optimal temperature for seagrass growth. The pH of the waters in Jago-Jago Village ranges from 7 to 8, indicating that the waters are still suitable for seagrass life. The optimal pH range determined by PP RI No.22

(2021) is in the range of 7-8.5. The salinity of the waters of Jago-Jago Village is in the range of 30-33‰. The salinity state is still good for the life of seagrass, and the results were in parallel with a study conducted by Supriharyono (2007), in which the salinity that is good for the life of seagrass ranges from 25-35‰. The brightness in the waters of Jago-Jago Village ranges from 2.6 to 3.7 m.

Table 4. Water quality parameters Jago-Jago Village

Parameter	Quality Standard*	Station		
		I	II	III
Temperature (°C)	28 - 30	29.7	29.3	28.7
pH	7 – 8.5	8	7	7
Salinity (‰)	33 - 34	33	31	30
Brightness (m)	>3	2.6	3.7	3.1
Depth (cm)	-	45	81	70
Flow Rate (m/s)	-	0.41	0.46	0.44
Dissolved oxygen (mg/l)	>5	5.2	6.4	6.8

According to PP RI No. 22 (2021), the standard for good brightness quality is >3 m, so the brightness condition is quite good for photosynthetic seagrass. The water depth in Jago-Jago Village ranges from 45-81 cm, where light can still penetrate to the bottom, and is classified as shallow. Jago-Jago Village water currents range from 0.41-0.46 m/s. Dahuri (2003) states that the current conditions supporting seagrass photosynthesis are 0.5 m/s. Thus, the results of the flow rate measurement in the waters of Jago-Jago Village are classified as weak flow conditions, so it is not good for seagrass life. The results of the measurement of dissolved oxygen were obtained with a range of 5.6-2.8 mg/L. According to PP RI No.22 (2021), the value of dissolved oxygen good for aquatic organisms is >5 mg/L. Given the measurement results, the state of dissolved oxygen in the waters is still good for the life of seagrass.

Sediment fraction

Sediment samples from each transect at the study site were analyzed to determine the type of aquatic substrate using the Sheppard triangle. Based on the results of the sediment fraction analysis, a comparison of the fraction weight percentage and sediment type is presented in Table 5.

Table 5. Percentage of fraction weight and water sediment type in Jago-Jago Village

Station	Zone	Sediment Fraction (%)			Sediment Type
		Gravel	Sand	Mud	
I	Upper	7.13	73.51	19.36	Muddy Sand
	Middle	4.40	76.36	19.24	Sand
	Lower	6.22	73.62	20.16	Muddy Sand
Average		5.92	74.50	19.59	Sand
II	Upper	8.89	59.17	31.94	Muddy Sand
	Middle	5.80	62.08	32.13	Muddy Sand
	Lower	4.80	46.50	48.70	Sandy Mud
Average		6.50	55.92	37.59	Muddy Sand
III	Upper	5.38	36.77	57.85	Sandy Mud
	Middle	4.49	33.81	61.70	Sandy Mud
	Lower	4.76	35.97	59.28	Sandy Mud
Average		4.88	35.52	59.61	Sandy Mud

It was determined that Station I had the type sand substrate, Station II had the muddy sand substrate, and Station III had the sandy mud substrate. The type of substrate is the main factor influencing seagrass growth, as it also affects water quality. Different types of sediment can be overgrown with seagrass, different types of sediment can cause differences in the composition of seagrass species, and affect nutrition for seagrass growth.

Seagrass type and density

Based on morphological observations of seagrass, the leaves are quite long, up to 120 cm, and form a band. There is a leaf cover; the leaf surface is smooth; and the edges of the leaves are flat. The ends of the leaves are bone, and there are fibers on the stem, measuring 6-7 cm. Based on morphological characteristics, this seagrass is identified in *E. acoroides*. This is in line with what has been explained by Kepmenlh No. 200 (2004), which states that seagrass type *E. acoroides* has rhizomes with a diameter of more than 10 mm and rigid fibers; leaf length ranges from 300-1500 mm and width 13-17 mm.

Seagrass Density

Seagrass density describes the condition of an aquatic environment. The density of seagrass is higher if the condition of the waters where the seagrass grows is in good. Seagrass density can range from waters with very tight seagrass fields to waters with rare seagrass fields. Several factors affecting seagrass density include seagrass species, environmental conditions, and human disturbances. The results of the calculation of seagrass density between stations in the waters of Jago-Jago Village are presented in Table 6.

Table 6. Calculation of seagrass density in the waters of Jago-Jago Village

Station	Transect	Density (ind/m^2)
	1	18.00
I	2	28.33
	3	25.00
Amount Average		23.78 ± 5.27
	1	28.00
II	2	32.33
	3	25.67
Amount Average		28.67 ± 3.38
	1	47.00
III	2	49.67
	3	45.67
Amount Average		47.44 ± 2.04

The highest average density is at Station III, at 47.44 ind/m^2, followed by Station II at 28.67 ind/m^2, and then the lowest density at Station I at 23.78 ind/m^2. The high density of seagrass at Station III is believed to be due to environmental factors that promote its growth and to a substrate suitable for its habitat, namely, sandy mud. The location of Station III with minimal human activity can also cause a higher density compared to Station II and Station I. The seagrass density condition at Station III is included in the scale of two with a density value of 25-75 ind/m^2, meaning it is classified as seagrass with rare conditions. Station II, with an average density, is suspected to be caused by the location of the station in the tourist area. Although it is a tourist area, this station has minimal human activity. People are coming to enjoy the view from the beach. The type of substrate at this station is muddy sand. The seagrass density condition on Station II is included in the scale of one with a density value of <25 ind/m^2, meaning it is classified as seagrass with very rare conditions.

The lowest seagrass density of *E. acoroides* is at Station I, which is 23.78 ind/m^2. The low seagrass density is caused by activities in and around the water and on land. The condition of the station near residential areas makes the location highly influenced by anthropogenic sources, such as household and ship waste, reducing the number of species obtained. The location of this station is also used as a nearby seaside resort for young people, which puts pressure on the seagrass ecosystem at Station I. The type of substrate at this station is sand. Rosari (2019) reported that the waters of Jago-Jago Village have a sandy substrate, so seagrass roots cannot penetrate too deeply and escape the substrate. The seagrass density condition at Station I is included in the scale of 1, with a density value of <25 ind/m^2, meaning it is classified as seagrass with very rare conditions.

Seagrass cover

Seagrass cover describes the degree of space closure within each seagrass type or community. Coverage information is important for understanding the general state of the ecosystem and the extent to which the seagrass community can benefit from the existing area (Andriani, 2014). The results of the calculation of seagrass cover between stations in the waters of Jago-Jago Village are presented in Table 7.

the highest average coverage rate at Station III is 61.11% and followed by Station II at 36.81%, then the lowest coverage at Station I is 30.56%. Based on Kepmen LH Number 200 of 2004, Station III is classified as in good condition, namely the rich/healthy seagrass field (coverage percentage value >60%), station I and station II are classified as damaged condition, namely the seagrass field is less rich/unhealthy (the value of the coverage percentage is 30-50.9%). Simon et al. (2013) states that seagrass coverage is closely related to the habitat or morphological shape and size of a seagrass species. High density and tidal conditions during observation may also affect the estimated value of seagrass coverage.

The location of waters disturbed by human activity may affect the percentage of seagrass than pristine water (Feryatun, 2012). The height of the seagrass cover at Station III is supposed to be caused by the aquatic environment that has a suitable depth for seagrass that lives with open water conditions and the presence of breakwater that calms the water, so the currents and tides are fairly good. While Station I is close to settlements and human activities. Human activities here can create the debris of the waters around the station difficult to avoid. This is supported by the statement Rustam et al. (2014), which suggests that turbidity can inhibit the occurrence of photosynthesis, where impaired photosynthesis means that seagrass growth is reduced.

Table 7. Calculation of seagrass cover in the waters of Jago-Jago Village

Station	Transect	Coverage (%)
I	1	81.25
	2	93.75
	3	100
Amount Average		30.56±9.55
II	1	112.50
	2	137.50
	3	81.25
Amount Average		36.81 ± 28.18
III	1	187.50
	2	187.50
	3	175
Amount Average		61.11 ± 7.22

Station II, with less rich/unhealthy seagrass coverage, is suspected because it has a smaller seagrass morphology. Argadi (2003) states that the small seagrass morphology itself can cause the low percentage of seagrass cover. Rifai et al. (2013) state that seagrass closure is closely related to the habitat or morphological shape and size of a seagrass species. High density and tide conditions during observation may also affect the estimated value of seagrass closure. The seagrass frequency describes the probability of a type being found in an observed quadrant. Based on the results of observations at each station, the frequency of the probability of finding seagrass type *E. acoroides* is 1. The seagrass type is represented only by *E. acoroides* at all research stations. However, species of *E. acoroides* can adapt to different substrates and are spread evenly enough to have the same frequency in all stations.

CONCLUSION

The conclusions of the research results are: (1) The type of seagrass found in the waters of Jago-Jago Village is only one species of seagrass, namely *E. acoroides*; (2) Seagrass density in Jago-Jago Village Waters has been included in very rare conditions and rare conditions; (3) Seagrass cover in the waters of Jago-Jago Village is in good condition in areas without human activity and is classified as damaged in areas in residential areas and areas around mangroves; (4) The highest frequency of the seagrass type is only represented by *E. acoroides*, which can be found at all research stations. Further research is needed on the nutrient and organic matter content in the waters of Jago-Jago Village to determine their effects on density and seagrass cover. The awareness of activities that can damage seagrass and the continuous maintenance of the sustainability of the seagrass ecosystem as a reserve of aquatic resources with ecological benefits.

REFERENCES

[KLH] Kementerian Lingkungan Hidup., 2004. Keputusan Menteri Lingkungan Hidup No.200 Tahun 2004 tentang Kriteria Baku Kerusakan dan Pedoman Penentuan Status Padang Lamun. Kementerian Lingkungan Hidup. Jakarta.

Andriani, N., 2014. *Analisis kelompok dan tutupan lamun di wilayah Trismades Desa Malang Rapat Kecamatan Gunung Kijang Kabupaten Bintan Provinsi Kepulauan Riau*. Universitas Maritim Raja Ali Haji.

Argadi, G., 2003. *Struktur komunitas lamun di Perairan Pangerungan, Jawa Timur*. Program Studi Manajemen Sumberdaya Perairan. IPB.

Dahuri, R., 2003. *Keanekaragaman hayati laut aset pembangunan berkelanjutan Indonesia*. Gramedia Pustaka Utama. Jakarta.

Fachrul, M.F., 2007. *Metode sampling bioekologi*. PT Bumi Aksara. Jakarta.

Feryatun, F., Hendrarto, B., 2012. Kerapatan dan Distribusi lamun (*seagrass*) berdasarkan zona kegiatan yang berbeda di Perairan Pulau Pramuka, Kepulauan Seribu. *Journal of Management of Aquatic Resource*,1-7.

Gosari, B.A.J., Haris, A., 2012. Studi kerapatan dan penutupan spesies lamun di Kepulauan Spermonde. *Jurnal Ilmu Kelautan dan Perikanan*, 22 (3): 156-162.

Hutomo, M., 2009. *Prosiding Lokakarya Nasional I Pengelolaan Ekosistem Lamun*. Pusat Kajian Sumberdaya Pesisir dan Lautan. Institut Pertanian Bogor. Bogor

McKenzie, L.J., 2003. *Guidelines for the rapid assessment and mapping of tropical seagrass habitats*. The State of Queensland. Department of Primary Industries.

Pemerintah Republik Indonesia., 2021. Peraturan Pemerintah Republik Indonesia No. 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup. Jakarta.

Rahmawati, S., Irawan, A., Supriyadi, I.H., Azkab, M.H., 2017. *Panduan pemantauan penilaian kondisi padang lamun. Edisi 2.* Coral Reef Information and Training Center (CRITC), Coral Reef Rehabilitation and Management Program (COREMAP). Puslit Oseanografi.

Rifai, N., Patty, S.I., 2013. Struktur komunitas padang lamun di Perairan Pulau Mantehage, Sulawesi Utara. *Jurnal Ilmiah Platax*, 1(4): 55-64

Rifardi, R., 2008. *Ekologi sedimen laut modern*. UR Press. Pekanbaru

Rosari, W.S., 2019. *Pengaruh ukuran partikel sedimen terhadap kerapatan dan morfometrik daun lamun (Enhalus acoroides) di Perairan Desa Jago-Jago Tapanuli Tengah Provinsi Sumatera Utara.* Fakultas Perikanan dan Kelautan. Pekanbaru.

Rustam, A., Kepel, T.L., Afiati, R.N., Salim, H.L., Astrid, M., Daulat, A., Mangindaan, P., Sudirman, N., Puspitaningsih, Y., Dwiyanti, D., Hutahaean, A., 2014. Peran ekosistem lamun sebagai *blue carbon* dalam mitigasi perubahan iklim, Studi Kasus Tanjung Lesung, Banten. *Jurnal Segara*, 10 (2): 107-117.

Samiaji, J., Harahap, H.Y., Adiprayoga, S.N., Sipahutar, H., Harahap, S.V., 2022. *Kajian potensi ekowisata pantai Kabupaten Tapanuli Tengah.* BAPPEDA Tapteng.

Simon, I.P., Rifai, H., 2013. Struktur komunitas padang lamun di Perairan Pulau Mantehage, Sulawesi Utara. *Jurnal Ilmiah Platax*, 1(4): 177-186.

Supriharyono, S., 2007. *Konservasi ekosistem sumberdaya hayati di wilayah pesisir tropis*. Pustaka Pelajar. Yogyakarta.