Seagrass spatial distribution based on density in the waters of Tunda Island, Banten

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Abstract. One of the coastal ecosystems on Tunda island is the seagrass ecosystem, which functions as a primary producer, breakwater, spawning ground, nursery ground, and feeding ground for fish. Mining of sea sand around this island can potentially result in environmental degradation. The purpose of this study was to determine the type, density and percentage of seagrass cover as well as the influence of environmental factors on seagrass species and their spatial distribution. The research was conducted in July 2019 at 14 stations around the island. The results showed that the species composition of seagrass from the stations on Tunda Island consisted of 6 species with a similarity index of more than 75% except at stations 6, 7, 10 and 13. Correspondence analysis shows that the spatial distribution of stations is different and is influenced by habitat characteristics. *Thalassia hemprichii* dominates the entire station, followed by *Enhalus acoroides* 6 stations, *Halophila ovalis* 4 stations, while *Cymodocea rotundata* is only found at 2 stations, and *Cymodocea serrulata* at 1 station. The distribution and species composition also shows that the seagrass beds in Tunda Island are in a healthy category.

1. Introduction

Seagrass beds are one of the ecosystems in coastal areas that have high primary productivity [1]. Seagrass communities thrive in shallow waters and called as the seagrass field. This habitat is home to various types of marine organisms. So the seagrass community plays an important role both ecologically and biologically in coastal areas and estuaries [2]. Seagrass beds are used as habitat for marine biota such as fish as a feeding ground, nursery ground, spawning ground, as stability and sedimentation barrier, as well as reducing and slowing the movement of waves from the sea [3].

Tunda Island is one of the islands surrounded by the Java Sea, located in the waters of Banten Bay with an area of ± 300 hectares. Its existence is very far from the mainland so that it gives its own privileges for its natural resources, namely the coastal ecosystem. One of the important ecosystems on the Tunda Island coastal is the seagrass ecosystem. Research Satrya *et al.* [4] and Azizah *et al.* [5] stated that the seagrass ecosystem in Tunda Island is still in good condition. There were 5 types of seagrass found, namely, *Thalassia hemprichii, Enhalus acoroides, Cymodocea rotundata, Cymodocea serrulata* and *Halophila ovalis*. However, the high potential of sea sand in Serang Regency makes Tunda Island a sea sand mining area. Sea sand mining in the waters of Tunda Island on the one hand can be a source of regional income, but on the other hand it can also cause environmental damage [6].
This has the potential to threaten the preservation of biological resources, one of which is the seagrass ecosystem.

Monitoring the development of seagrass beds is one of the basics of coastal environmental management activities. Research on the structure of seagrass communities on this island has been widely carried out, but the interactions between seagrass species in their communities are not widely known. Based on this, it is necessary to research the spatial distribution of seagrass communities based on their density on Tunda Island, Banten. This study aims to examine the characteristics of the habitat and environmental factors on the spatial distribution and species composition of seagrass in Tunda Island, Banten.

2. Material and methods

2.1. Time and place

This research was conducted in the seagrass ecosystem of Tunda Island, Banten in July 2019. The data collection method used was a line transect that is perpendicular to the coastline by dividing the research location into 14 stations 'Figure 1'. Taking plots/points is carried out at each observation station from the shore to the edge of the edge. Station determination and transect placement were adapted from the Seagrass Net monitoring method [7], namely that the location has a seagrass bed community with homogeneous or almost the same percentage of cover, that is a community with relatively even seagrass cover, away from human disturbance or sources of destruction such as ports, and the location is easy to reach.

2.2. Tools and materials

Apart from observing the seagrass, the measurement of oceanographic parameters that affect the growth and life of seagrass was also carried out in situ. The equipment and materials used during the research can be seen in full in Table 1.

![Figure 1. Map of the location of the research station](image)

| No. | Parameter               | Tools and Materials                                                                 | Method |
|-----|-------------------------|-------------------------------------------------------------------------------------|--------|
| 1.  | Seagrass position       | GPS (Global Positioning System)                                                    | Insitu |
| 2.  | Seagrass community     | Underwater paper, roll meter, quadratic frame (50 cm x 50 cm), digital camera, and seagrass identification book | Insitu |
| 3.  | Temperature            | WQC (Water Quality Checker)                                                        | Insitu |
| 4.  | Salinity               | WQC (Water Quality Checker)                                                        | Insitu |
2.3. Data analysis

Seagrass data analysis includes species identification, calculating density, and percent cover of seagrass [8]. From these results, it can be seen that the level of condition of the seagrass beds at a certain location in a certain time is assessed based on the standard criteria for damage to the seagrass beds by using a percentage of the area of cover based on the Decree of the State Minister for the Environment Number 200 of 2004.

The level of damage to the seagrass beds will determine the condition of the ecosystem. To determine the level of damage, standard criteria were required that apply in all regions in Indonesia. This study uses criteria from the Minister of Environment Decree No. 200/2004 as in Table 2. Meanwhile, to determine the status of seagrass beds using the criteria in Table 3.

| No. | Parameter             | Tools and Materials          | Method |
|-----|-----------------------|------------------------------|--------|
| 5.  | pH                    | WQC (Water Quality Checker)  | Insitu |
| 6.  | Dissolved oxygen (DO) | WQC (Water Quality Checker)  | Insitu |
| 7.  | Brightness            | Sechi Disk                   | Insitu |

**Tabel 2. Standard criteria for seagrass beds damage**

| Damage Rate | The Area of Damage (%) |
|-------------|------------------------|
| High        | ≥50                    |
| Moderate    | 30-49.9                |
| Low         | ≤29.9                  |

Source: The Minister of Environment Decree No. 200/2004

**Tabel 3. Seagrass status**

| Condition            | The Area of Damage (%) |
|----------------------|------------------------|
| Good                 | ≥60                    |
| Rich/healthy         |                         |
| Less rich/not healthy| 30-59.9                |
| Damage               | ≤29.9                  |
| Poor                 |                         |

Source: The Minister of Environment Decree No. 200/2004

The grouping of research stations uses MINITAB software and the results of the grouping are described in a dendogram to see the similarities between research stations based on the density of seagrass species.

3. Result and discussion

3.1. Seagrass community

Based on the research results, there were 5 types of seagrass composition, namely *E. acoroides, T. hemprichii, H. ovalis, C. rotundata* dan *C. serrulata* Figure 2. Each type of seagrass was found to have different area and density between research stations. These results are following previous studies of seagrass in Tunda Island by Satrya et al. [4] and Azizah et al. [5] During the research, the type of seagrass with the largest composition was *T. hemprichii* and *E. acoroides*. 
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Figure 2. Types of seagrass found in Tunda Island, Banten. [a] Cymodocea rotundata, [b] Cymodocea serrulata, [c] Halophilla ovalis’ [d] Enhalus acoroides, [e] Thalassia hemprichii

The density of seagrass in Tunda Island, Banten is different at each research station Figure 3. The density value can indicate the number of individuals found in units of the area at a research location. The results of the collection of density data showed that the T. hemprichii species dominated at each station, this type of seagrass is found near mangrove ecosystems, because the high nutrient supply from the mangrove ecosystem can be utilized by seagrass for growth and reproduction [4]. This type is found at all stations although the density varies. The highest density of T. hemprichii is at station 1 with 13 ind/m². The stations that have the least density are stations 10 and 12 as much as 1 ind/m² because these stations have a muddy sand substrate. T. hemprichii species can grow either on sandy substrates or rocky sand [9]

The type of seagrass that dominates the second is the type E. acoroides, this type of seagrass is found in waters with a muddy sand substrate. E. acoroides was found at stations 9 and 14 which had
the lowest density of 1 ind/m$^2$, station 10 has a density of 3 ind/m$^2$, stations 11 and 12 have a density of 4 ind/m$^2$, station 13 has a density 2 ind/m$^2$.

C. rotundata were found at stations 6 and 7 which have the same density 2 ind/m$^2$, this seagrass grows on a substrate of muddy sand or sand with rubble at low tide. Sometimes mixed with other types of seagrass [10]. Meanwhile, C. serrulata seagrass was only found at station 9 with density 1 ind/m$^2$. The last type found at the time of the research was the type H. ovalis, this type of seagrass is found at station 4, station 5, station 6, and station 13. The highest density is at station 13 as much as 4 ind/m$^2$, while the lowest density is at station 5 with a density of 1 ind/m$^2$.

At station 4 it has a density of 2 ind/m$^2$ and 6 has a density of 3 ind/m$^2$.

The percentage of seagrass cover during the research in Tunda Island, Banten can be seen in Figure 4. T. hemprichii is found in all research stations, at station 5 this type of seagrass has the highest value of 38%, contrast to station 10 which has a low cover of 4%.

E. acoroides is only found at station 9, station 10, station 11, station 12, and station 14. Each station has a different area, at station 9 this seagrass has the lowest area value with a percentage of 1% because the substrate at this station is dominated by sand with coral fragments, while the substrate is only partially muddy, at station 10 it has a high percentage value of seagrass of 27%. According to Rahman et al. [11], E. acoroides grows scattered in small groups consisting of several very tight individuals.

The next seagrass type found on the coast of Tunda Island is C. rotundata. This type is found at stations 6 and 7 with a percentage value of 9% and 8%. H. ovalis which is included in the pioneer species was found at station 4 with a percentage value of 4%, at station 5 the percentage of this species is very low with a percentage value of 2%, at station 6 H. ovalis has a cover with a percentage value of 14%, station 13 is 11%.

The distribution and species composition also shows that the seagrass beds in Tunda Island, Banten are in the healthy category. The highest percentage of seagrass cover was (49.98%), medium (31.24%), and the lowest (21.59%).
3.2. Oceanographic conditions in seagrass ecosystem

The results of the analysis of oceanographic parameters in the seagrass ecosystem show the values presented in Table 4. From the measurement results, it can be seen that the differences in each research station, the lowest temperature is at station 14 with 29°C. While the highest temperature is at station 9, which is 33°C, other stations have a temperature range of 30-32°C. Water temperature values between 29-32°C are optimal for seagrass growth [12]. High water temperature conditions affect metabolism, nutrient absorption and seagrass survival. The effect of temperature on seagrass is very high for photosynthesis, respiration rate, growth and reproduction [13].

The value of pH on the coast of Tunda Island, Banten during the research had a value range of 8.4-8.5. According to Supriadi et al. [14], the optimum water pH for seagrass growth ranges from 7.5 to 8.0. For the range of salinity values from 28 to 33 ‰, this shows that the salinity in the waters of Tunda Island is quite high and very good for seagrass growth. Because of the acceptable salinity range of seagrass is 10-40 ‰ [15].

The greatest value of dissolved oxygen (DO) during the study was at station 9 with a value of 10.35 mg/l and the lowest value was at station 14 with a value of 8.23 mg/l, this shows that the DO levels in the waters of Tunda Island are still good. Because if the DO concentration is low in the waters, it can cause disturbances in the biota of the respiratory process.

Table 4. Oceanographic parameters in Tunda Island, Banten

| Station | pH (unit) | Temperature (°C) | Salinity (%) | Dissolved Oxygen (mg/l) | Brightness (m) |
|---------|-----------|------------------|--------------|--------------------------|----------------|
| 1       | 8.4       | 30               | 28           | 9.7                      | 1              |
| 2       | 8.3       | 30               | 34           | 9.6                      | 0.80           |
| 3       | 8.5       | 31               | 32           | 10.4                     | 0.40           |
| 4       | 8.5       | 30               | 32           | 10.18                    | 0.30           |
| 5       | 8.5       | 31               | 32           | 8.96                     | 0.42           |
| 6       | 8.5       | 30               | 33           | 8.56                     | 0.52           |
| 7       | 8.5       | 30               | 34           | 10.15                    | 0.70           |
| 8       | 8.5       | 31               | 34           | 10.23                    | 0.40           |
### 3.3. Spatial distribution of seagrass communities

The results of the similarity analysis of the spatial distribution of seagrass communities based on their density show that each species has a different distribution pattern. Stations 1, 2, 3, 4, 7, 8, 9, 11 and 12 have a similarity level >80% characterized by *C. serrulata*, *H. ovalis*, *E. acoroides*, and *T. hemprichii*. While stations 4, 7, 11 and 14 have a similarity level of >75% characterized by *H. ovalis*, *C. rotundata*, *E. acoroides*, and *T. hemprichii*. The rest have a similarity level <70%, namely at stations 5, 6, 10 and 13 Figure 5.

![Dendrogram](image.png)

**Figure 5.** Similarity of habitat based on seagrass density in Tunda Island, Banten

According to Goodsell and Connell [16] the spatial distribution and species composition of seagrass are also influenced by the age of the seagrass beds. The types of *E. acoroides* and *T. hemprichii* generally characterize mature and stable seagrass beds [17]. The spatial distribution of seagrass in tropical areas is generally clustered (patchy) interspersed with areas where seagrass is not grown [16].

### 4. Conclusion

The existence of seagrass communities in the waters of Tunda Island, Banten is evenly distributed. The concentration of the existence of the seagrass ecosystem is in the north of Tunda Island. However, each station is dominated by different types of seagrass. This shows that the spatial distribution of...
seagrass is different because it is influenced by the characteristics of the habitat and associated marine biota.

5. References
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