Density and Biomass of Seagrass Beds and its Threats on Lamongan Regency

Citra Satrya Utama Dewi1,4, Defri Yona1,3, Pratama Diffi Samuel2,5, Rizqi Aimmatul Maulidiyah3, Ahdiya Syahrir3, Yandini Eka Putri3, Hilal Rakhmawan3, and Maulana Fikri3

1Department of Aquatic Resource Management, Faculty of Fisheries And Marine Science, University of Brawijaya
2Aquatic Biofloc Research Group, Faculty of Fisheries And Marine Science, University of Brawijaya
3Department of Marine Science, Faculty of Fisheries And Marine Science, University of Brawijaya
4Coastal and Marine Research Center, Research and Empowering Society Institution, University of Brawijaya
5Fisheries Diving School, Faculty of Fisheries And Marine Science, University of Brawijaya

E-mail Address: satryacitra@ub.ac.id

Abstract This study aimed to determine the density of seagrass species, seagrass biomass, and threats faced by seagrass communities in the Coastal District of Lamongan. The study was conducted from August to November 2019 in three coastal villages of Lamongan Regency, namely Tunggul Village (Station 1), Kranji Village (Station 2), and Banjarwati Village (Station 3). Furthermore, the stages of the study consisted of preparation, data collection on density, threat data, seagrass stand samples, sample processing, and data analysis. The results showed that the total density of seagrass species at Stations 1, 2, and 3 was 160 stands/m², 172 stands/m², and 185 stands/m², respectively. Moreover, the total biomass of seagrass at Stations 1, 2, and 3 was 4633 g/m², 2136 g/m², and 9234 g/m², respectively. In addition to seagrass species, seagrass density values also affected seagrass biomass. As development progresses in Lamongan Regency, it is known that the biggest threat of seagrass communities in the study site is human activity (anthropogenic), especially the anchor ships when anchored and the use of coastal areas as tourist areas. This occasion often cleans up seagrass communities because they are deemed unfit to be enjoyed tourism sector.

Introduction

Climate change is becoming an increasingly engaging and discussed issue because its impact has been felt directly by humans. It is caused by increasing greenhouse gases which can be formed due to human activities (anthropogenic) or naturally (Wahyudi, 2019). Gases included in GHG include carbon dioxide (CO₂), nitrogen oxides (N₂O), methane (CH₄), fluorinated gases (HFCs, PFCs, and SF₆), aldehyde groups, ozone (O₃), and water vapor (H₂O) (Uyigue et al., 2010). One of the greenhouse gases that has a considerable effect on global warming is CO₂. This problem causes the earth to get hotter and get more extreme weather (Angrelina et al., 2019). The increase in CO₂ greatly affects the ecological function of the waters. Specifically, an increase in acidity since CO₂ easily binds to seawater and turns into acid compounds (Wahyudi, 2018).

Many climate change mitigation efforts to reduce gas have been carried out by optimizing the utilization of resources on land and sea. The marine coastal area is known to be able to absorb CO₂ and store it in the form of carbon, both as biomass and stored in the substrate, especially in the three main ecosystems, namely mangrove forests, seagrass beds, and salt marsh (Howard et al., 2014). This stored carbon is called Blue Carbon. Coastal ecosystems can
transfer and store carbon from the atmosphere and oceans four times greater than tropical forests (Lawrence, 2012). However, coastal and marine environmental services as blue carbon are very dependent on the health of the ecosystem in them.

Seagrass beds are vital contributors to prime global ocean production. They only exist at 0.15% of sea level and account for 1% of the net primary production of global oceans (Charpy-Roubaud & Sournia, 1990). Seagrass can absorb CO₂ and convert it into energy, which is stored in the form of organic carbon contributing to the accumulation and storage of organic carbon in the oceans, up to 15% of the total carbon stored in the oceans (Laffoley & Grimsditch, 2009). The mean biomass standing in the seagrass beds was 223.9 ± 17.5 and 237.4 ± 28 gDWm⁻², indicating a general trend for a balanced distribution of biomass between leaves, rhizomes, and roots. Annual seagrass production has averaged 1012 gDWm⁻²y⁻¹, exceeding the previous estimate of 25% (Duarte & Chiscano, 1999). With its extraordinary ability to store carbon in the long term in biomass. Seagrass habitat can contribute significantly to climate change mitigation.

Lamongan Regency is part of the "Gerbangkertosusila National Strategic Area," which undoubtedly having enormous human and industrial activities and resulting in the production of more CO₂ gas compared to other regions. From another perspective, this district is also known to have seagrass community structures in its coastal areas and is thought to have the potential to absorb carbon from the atmosphere. Therefore, it can be one of the solutions to climate change mitigation. The objectives of this study were (1) to identify and know the density of seagrass species; (2) to know the value of seagrass biomass; (3) to know the threats faced by seagrass communities on the Coast of Lamongan Regency.

**Materials and Methods**

**Sample**

This study was conducted from July to November 2019 in the Coastal District of Lamongan and LSIH-UB. The study was conducted in three coastal villages, namely Tunggul (Station 1), Kranji (Station 2), and Banjarwati (Station 3). The research ran with the theme of seagrass consisted of several stages, namely preparation, data and seagrass collection, processing of seagrass samples in LSIH-UB, and data analysis.

Data collected from the field include water quality, substrate type, and density of seagrass species, as well as hazard data faced by seagrass communities in the study site. Water quality data was obtained using a water quality checker, while substrate type data was obtained by visual survey. Furthermore, seagrass density data were obtained using the line transect method combined with quadratic transects (Azkab, 1999; Dewi et al., 2012, 2017, 2018). Finally, the threat data faced by seagrass communities was obtained by interview and visual observation methods.

Samples collected from this study are the stand of seagrass species found in the field. First, the samples of the seagrass stand obtained were separated by the upper side of the substrate (above ground-abg) and the lower side of the substrate (below ground-blg). Last, the biomass value was calculated by measuring the fresh weight and dry weight of each type of seagrass (Duarte, 1990).

**Data analysis**

Data analysis conducted in this study included analysis of species density data using Formula 1, analysis of seagrass biomass with Formula 2, and analysis of the relationship of seagrass density with seagrass biomass using linear regression analysis. Meanwhile, the analysis of threats faced by seagrass communities was carried out descriptively.
according to the results of interviews and visual surveys during the study.

Seagrass Density = Amount of Stand/Area of Research Area --- Formula 1
Seagrass Biomass = Dry Weight/Area of Research Area --- Formula 2

Results and Discussion

Water quality measured in this study includes temperature, salinity, dissolved oxygen (DO), acidity (pH), and turbidity. The results of the measurement of the five water quality parameters at three stations (Table 1) show a value that is still within reasonable limits for seagrass growth. Furthermore, the third type of substrate is sand dominant with little mud or coral fragments. It is relevant with the literature, which stated that seagrasses would grow in habitats with a substrate of the majority of the sand, both muddy sand and sand with coral fragments (Waycott et al., 2004).

### Table 1. Water Quality Parameters at Three Stations.

| No | District | Village  | Seagrass Communities | Temperature (°C) | Salinity (ppt) | pH   | DO (ppm)  | Turbidity | Substrate       |
|----|----------|----------|----------------------|------------------|----------------|------|----------|-----------|----------------|
| 1  | Paciran  | Tunggul  | Present              | 31.37 ± 0.12     | 30.00 ± 0.00   | 8.37 ± 0.15 | 7.40 ± 0.26 | 35.00 ± 0.00 | Coral Rubble   |
| 2  | Paciran  | Kranji   | Present              | 28.73 ± 0.21     | 29.00 ± 0.00   | 8.10 ± 0.00 | 6.73 ± 0.21 | 24.00 ± 0.00 | Sand and Clay |
| 3  | Paciran  | Banjarwati| Present             | 30.70 ± 0.20     | 32.00 ± 0.00   | 8.23 ± 0.15 | 7.23 ± 0.23 | 27.00 ± 0.00 | Coral Rubble   |

Seagrass density gives an estimate of the number of seagrass stands in one square meter. Seagrass density at the study site was 33 - 160 stands per square meter (Figure 1). The highest total seagrass density was observed at Station 1 and consisted of only one type, specifically _E. acoroides_. Moreover, two species were found at Station 3, namely _E. acoroides_ and _T. hemprichii_. Furthermore, the lowest total seagrass density, discovered at Station 2, consisted of two types of seagrass with a composition of _T. hemprichii_ species that was greater than _E. acoroides_.

![Figure 1. Seagrass Density](image-url)
The composition of seagrass species at Stations 2 and 3, which are heterospecies, are different from those at Station 1, which are monospecies of *E. acoroides*. It is thought to be caused by the type of substrate. *E. acoroides* prefers habitats with muddy sand substrates like at Station 1, while *T. hemprichii* will be more easily found on sand substrates with coral fragments, such as at Stations 2 and 3 (Den Hartog et al., 2006).

Seagrass biomass explains the amount of body mass of each seagrass at every square meter. The total biomass of seagrass at the study site was 2136.06 - 9234.10 grams dry weight per square meter (g/m²). The lowest seagrass biomass values were obtained from Station 2, while the highest was at Station 3 (Figure 2).

Seagrass biomass is strongly influenced by seagrass species and densities. Seagrass species affect the amount of biomass because each type of seagrass has different morphology and morphometry, for example, *E. acoroides*, whose leaf size and rhizomes are much larger than *T. hemprichii*. The density of seagrass species affects biomass because a large number of stands will unquestionably provide a large value of biomass.

Seagrass communities at the study site showed healthy conditions at Station 1 but lacking at Stations 2 and 3. It was allegedly due to threats at Stations 2 and 3. Threats experienced by seagrass communities at this study site were local threats caused by human activity (anthropogenic). One of the activities that pose a threat to the Coastal District of Lamongan is dredging marine sediments for reclamation activities, both for port construction and tourism.

**Conclusions and Suggestion**

The total density of seagrass in Lamongan Regency was around 160 to 185 stands/m², and it appertains to be high density. Furthermore, the total biomass of seagrass in the study area was about 2136 to 9234 g/m². Hereinafter, this study represents that biomass of the seagrass grade was affected by the species and density of the seagrass. Moreover, the seagrass community in Lamongan Regency had to grapple with the local threat caused by humans (reclamation for harbor).

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