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Species Composition and Abundance of Seagrass in Sibuguey Bay, Tungawan, Zamboanga Sibugay

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ABSTRACT

This study evaluated the species composition, abundance, and ecological condition of seagrass beds in Linguisan and Tigbucay, Tungawan, Zamboanga Sibugay along Sibuguey Bay. Using the transect-quadrat method, two species were recorded: *Enhalus acoroides* and *Halodule pinifolia*, with *E. acoroides* dominant. Linguisan exhibited moderate seagrass cover (44.34%), whereas Tigbucay showed poor condition (20.2%). Degradation was associated with anthropogenic stressors, siltation, and a red tide outbreak in August 2024. Conservation measures, including the Bangaan Island Marine Sanctuary established in 2004 and community-based management programs, have provided localized protection, but environmental pressures persist. The findings highlight the vulnerability of Tungawan's seagrass ecosystems and the need for strengthened conservation actions, including pollution control, habitat restoration, and expansion of marine protected areas. Future research should incorporate physicochemical parameters, conduct seasonal monitoring, and expand surveys to additional barangays to capture temporal and spatial variability, thereby supporting adaptive management and long-term sustainability of seagrass habitats.

Keywords : Species Composition, *Enhalus acoroides*, *Halodule pinifolia*, Seagrass Cover, Environmental Management, Marine Sanctuary.

1 INTRODUCTION

Seagrasses are flowering marine plants that thrive in shallow, sandy to muddy coastal sediments where light penetration is sufficient, tolerating salinity ranges from 5 to 60 practical salinity units (PSU). They reproduce underwater through pollination, producing fruits and seeds that sustain marine habitats. Globally, seagrass ecosystems have been declining due to human-induced pressures such as direct habitat destruction, climate change, sedimentation, and nutrient pollution that reduce light availability (Green & Short, 2003). Despite these threats, seagrasses play vital ecological roles: they provide nursery grounds for fish and invertebrates, support commercial, recreational, and subsistence fisheries, and act as effective carbon sinks through their extensive rhizome systems and dense canopies, thereby contributing to climate change mitigation and adaptation (Duarte et al., 2013).

Seagrass habitats in Southeast Asia, including the Philippines and Mindanao are subject to escalating anthropogenic pressures such as coastal development, pollution, and overexploitation, contributing to significant declines in their health and biodiversity (Fortes et al., 2018). Despite their ecological and socioeconomic importance, seagrass ecosystems in many areas remain poorly studied, particularly in Sibuguey Bay. Limited localized data hinders the development of targeted management interventions and evidence-based conservation strategies. This gap underscores the need for site-specific assessments that can serve as a basis for understanding seagrass status and associated anthropogenic threats.

To address this gap, the present study assesses the composition, abundance, and condition of seagrass species in two representative sites in Sibuguey Bay, focusing on the municipality of Tungawan, Zamboanga Sibugay. It also examines key human-induced threats affecting these ecosystems. By generating site-specific information, the research aims to provide a stronger scientific basis for conservation planning and ecosystem-based management at the local level, particularly within Sibuguey Bay.

Furthermore, the protection and restoration of seagrass habitats directly contribute to several United Nations Sustainable Development Goals (SDGs). These include SDG 14 (Life Below

Water), which emphasizes marine conservation; SDG 1 (No Poverty), by sustaining small-scale fisheries and supporting local livelihoods; SDG 8 (Decent Work and Economic Growth), by fostering sustainable economic opportunities in coastal communities; and SDG 13 (Climate Action), due to the role of seagrass meadows in carbon sequestration and coastal resilience. Thus, this study not only provides ecological insights but also highlights the broader socioeconomic and climate-related benefits of seagrass conservation, ensuring that management strategies align with both biodiversity preservation and human well-being.

2 METHODOLOGY

2.1 Study Area

The assessment of seagrass beds was conducted in June 2024 under fair weather conditions along the coastal waters of Tungawan, a municipality in Zamboanga Sibugay facing Sibuguey Bay. Sampling was carried out in two coastal barangays: Linguisan (7°30'03.18" N, 122°26'04.86" E) and Tigbucay (7°30'23.20" N, 122°25'00.80" E) (Fig. 1). A preliminary survey was conducted to identify suitable areas, after which two sites were selected to represent the local seagrass community. Site selection was guided by observed seagrass presence, accessibility during low tide, and practical considerations of logistics and resources, ensuring consistent and reliable sampling.

Prior to the study, a letter requesting site access was submitted to the Local Government Unit (LGU) of Tungawan, Zamboanga Sibugay, through the Municipal Environment and Natural Resources Office (MENRO). Following approval, the assessment was conducted in accordance with local environmental protocols.

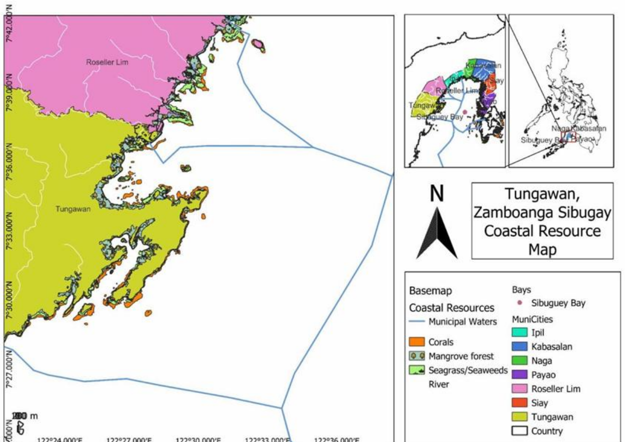


Figure 1. Coastal map of study site in Tungawan, Zamboanga Sibugay

2.2 Sampling and Data Collection

Seagrass assessment was conducted using the transect-quadrat method (English et al., 1997). Three 50-meter transects were laid perpendicular to the shoreline and spaced 100 meters apart in the two selected sampling sites in Tungawan to ensure spatial representation across the intertidal zone. Along each transect, 1 m × 1 m quadrats were systematically placed at 10-meter intervals. Within each quadrat, data on seagrass percent cover, species composition, and abundance were recorded. This method provided consistent, repeatable, and representative sampling of seagrass cover across the study area.

The identification of seagrass species was based on the identification keys compiled by FishCORAL Project Field Guide (Region V). Seagrass species were identified within each replicate quadrat, ensuring accurate classification.

2.3 Data Analysis

Seagrass percent cover was determined through direct visual estimation within quadrats placed systematically along transects. Each quadrat represented a sample unit, with percent cover values visually assessed and recorded. The data collection followed the Standard Criteria for Damage and Guidelines for Determining the Status of Seagrass (Table 1), derived from the Decree of the Indonesian Minister of Environment No. 200/2004 which classifies ecological condition based on percent cover.

Table 1. The Standard Criteria for Damage and Guidelines for Determining the Status of Seagrass

Description	Condition	Coverage
Good	Healthy	>60%
Moderate	Less Healthy	30 - 59.9%
Bad	Poor	<29.9%

Two parameters were used in assessing the species abundance: percent cover and species present. The number of subquadrats occupied by seagrasses was counted, divided by the total number of subquadrats, and the result was expressed as the percentage of cover. This method provided a quantitative estimate of seagrass abundance and distribution across the study area. The total seagrass cover across all transects for the study site were averaged using the formula:

$$\text{Total Average \% cover} = \frac{\text{Sum of average percentage cover from all transects}}{\text{Total number of transects}}$$

The relative densities of seagrass species were also assessed to understand species composition and dominance within the study area. The relative density was calculated using the following formula:

$$\text{Relative density} = \frac{\text{Density of a species}}{\text{Total density of all species}} \times 100$$

This approach provided an evaluation of seagrass abundance and its condition essential for informing conservation and management strategies.

3 RESULTS AND DISCUSSION

3.1 Species Composition

Two seagrass species, *Enhalus acoroides* (Figure 2A) and *Halodule pinifolia* (Figure 2B), were identified at the selected sampling sites in Tungawan, Zamboanga Sibugay. *E. acoroides* was observed to be a more dominant and widely distributed species on both sites, while *H. pinifolia* appeared in more fragmented patches. In comparison, Dagalea (2024) documented higher diversity in Bangaan Island in Tungawan, with five seagrass species recorded with an average cover of 11.5%. It also shows that greater species richness was found in deeper quadrats, suggesting that more stable underwater conditions may support healthier seagrass ecosystems.

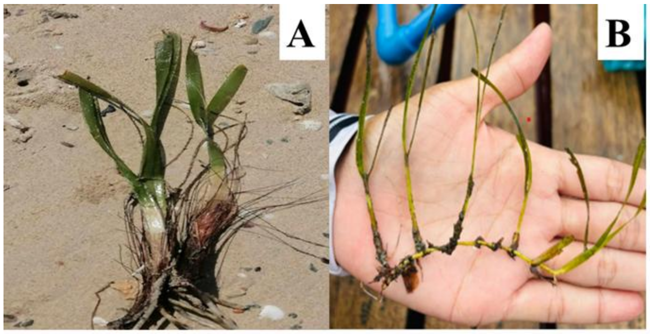


Figure 2. Seagrass species found in Tungawan, Zamboanga Sibugay (A. *Enhalus acoroides*; B. *Halodule pinifolia*)

The disparity between the two studies highlights the site-specific nature of seagrass ecosystems. While the Bangaan Island sites, located within a marine sanctuary, exhibited higher seagrass diversity and slightly greater percent cover, the assessed coastal sites reflected a simpler community structure with fewer species and potentially lower ecological resilience. The protected status of Bangaan may have contributed to its comparatively healthier seagrass meadows, as reduced anthropogenic pressures within sanctuaries often promote greater recovery and persistence of species. Previous studies have demonstrated that environmental factors, including light availability, sediment quality, and human disturbance, significantly influence seagrass occurrence and distribution (Short & Wyllie-Echeverria, 2020; Rodemann et al., 2021). Depth as noted in Dagalea's study, may mitigate certain stressors by providing more stable conditions conducive to species richness.

3.2 Seagrass Condition, Average % Cover, and Relative Density

The study assessed seagrass condition based on average percent cover in Linguisan and Tigbucay (Table 2; Fig. 3). Seagrass in Linguisan was classified as "moderate," with an average percent cover of 44.34%, indicating a relatively healthier condition compared to Tigbucay, which recorded a lower average cover of 20.2% classified as "poor" condition. Linguisan also supported two seagrass species, *Enhalus acoroides* and *Halodule pinifolia*, which may reflect more favorable environmental conditions, potentially related to the site's distance from residential areas and reduced anthropogenic pressures. In contrast, Tigbucay exhibited lower percent cover and reduced relative density (10.4%) of *E. acoroides,* suggesting possible environmental stress. These results highlight spatial differences in seagrass condition between the two sites and suggest that local human activities may influence seagrass health.

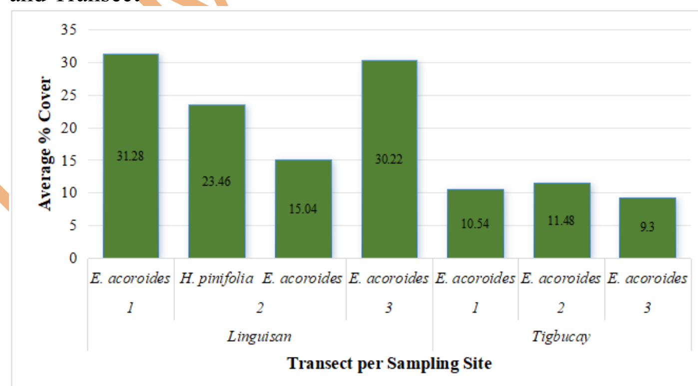
Table 2. Seagrass condition at sampling sites in Tungawan, Zamboanga Sibugay

Sampling Site	Average % Cover	Condition	Identified Species	Relative Density (%)
Linguisan	44.34	Moderate	*Enhalus acoroides*	41.9
			Halodule pinifolia	16.1
Tigbucay	20.2	Poor	*Enhalus acoroides*	10.4

Analysis per transect further highlights spatial heterogeneity (Table 3). In Linguisan, *E. acoroides* attained higher cover in Transects 1 (31.28%) and 3 (30.22%), with *H. pinifolia* contributing substantially in Transect 1 (23.46%). However, cover was notably lower in Transect 2 (15.04%), indicating patchiness likely influenced by substrate variability or localized disturbance. Field observations revealed that *E. acoroides* occurred across sandy–muddy substrates, whereas *H. pinifolia* was confined to sandy areas. This substrate-dependent distribution aligns with regional findings in Siargao Island, Surigao del Sur showing that substrate grain size strongly influences seagrass density and species composition (Baranggan et al., 2023). By contrast, Tigbucay exhibited uniformly low cover across transects (9.3–11.48%), suggesting widespread habitat degradation and limited substrate suitability.

Overall, the findings demonstrate that Linguisan retains a structurally diverse and spatially variable seagrass community, while Tigbucay exhibits reduced cover and species limitation. These patterns emphasize the site-specific nature of seagrass resilience and highlight the role of localized environmental factors, such as substrate type and disturbance pressures, in shaping meadow condition.

Table 3. Average Percent Cover of Seagrass Species per Sampling Site and Transect



The predominance of *E. acoroides* across both sites can be attributed to its hardy nature. Its robust morphology and physiological tolerance allow it to persist in low-light conditions and variable salinity, making it more adaptable to disturbed environments. These observations align with the findings of Reyes et al. (2023), who reported high biomass and density of *E. acoroides* in both relatively undisturbed and stressed habitats, underscoring the species' broad ecological amplitude. On the other hand, *Hadoldule pinifolia* was present in lower proportions, likely due to its sensitivity to turbidity and substrate instability. Similar patterns were observed by Abubakar and Echem (2018), who reported limited coverage of *H. pinifolia* in Tawi-Tawi, attributing its scarcity to disturbances in oceanic conditions and substrate dynamics.

The overall species composition in Tungawan revealed a clear dominance of *E. acoroides*, which comprised 83.88% of the total seagrass population, while *H. pinifolia* accounted for only 16.12%. This dominance pattern further reinforces *E. acoroides*' role as a resilient species and potential bioindicator for habitat conditions. However, the reduced species richness and lower percent cover observed in Tigbucay raise concerns about localized stressors.

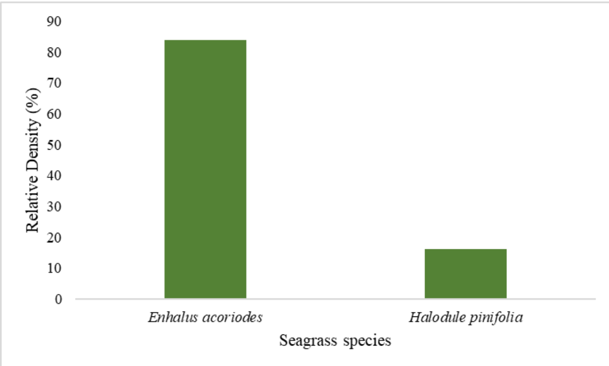


Figure 3. Relative density of seagrass species in Tungawan, Zamboanga Sibugay

These findings reflect similar patterns reported in other Philippine coastal areas. For instance, Atencio et al. (2024) observed that seagrass sites in Panguil Bay with low average cover were also marked by poor ecological conditions, often linked to local development and sedimentation.

3.3 Other Observation

The presence of *Halimeda* spp algae., invertebrates such as starfish, sea urchins, sponges, scallops and crabs indicate a biologically active but environmentally stressed habitat. Silt and anthropogenic pollutants, mainly plastics, were commonly observed, particularly in Tigbucay, suggesting the effects of runoff and insufficient waste management.

3.4 Identified Disturbances and Management Intervention

In recent years, the coastal barangays of Tungawan, Zamboanga Sibugay have faced a series of environmental challenges that have tested both ecological stability and community resilience. Among the most impactful was the red tide outbreak recorded in August 2024. The Bureau of Fisheries and Aquatic Resources (BFAR) confirmed the presence of toxic algal blooms in the coastal waters of Tungawan, with the municipality repeatedly listed in the Shellfish Bulletins throughout the year. This incident not only disrupted shellfish harvesting and local livelihoods but also underscored the sensitivity of local marine systems to abrupt ecological changes. Beyond episodic events like red tides, several chronic stressors were directly observed during the present study, including continuous siltation, high turbidity, and the frequent accumulation of marine debris in the surrounding waters. These conditions appear to be gradually degrading the health of local seagrass beds, diminishing both their ecological function and resilience.

The patterns observed in Tungawan are not isolated. Similar findings have been documented elsewhere in the Philippines. Reyes et al. (2023) and Payo et al. (2018) have both underscored how coastal degradation often stems from urban development, pollution, unsustainable fishing practices, and lax regulation all contribute to the weakening of seagrass ecosystems nationwide. For example, Payo et al. (2018) reported that anthropogenic pressures such as fish pen operations and untreated wastewater discharge were key threats to seagrass health. Meanwhile, studies from Bongao, Tawi-Tawi and Cape Bolinao revealed a more diverse species composition, but similar vulnerabilities to sedimentation and water quality decline.

At the local level, conservation interventions have been established to address these pressures. The Bangaan Island Marine Sanctuary, created in 2004, was intended to protect coral reefs, mangroves, and seagrass meadows. Dagalea (2024) reported five seagrass species within the sanctuary, suggesting that protection has helped maintain higher species richness compared to unprotected areas. Nevertheless, field observations and local accounts indicate that long-term ecological stress persists, partly due to gaps in enforcement and compliance. For instance, recreational activities and the operation of passenger boats transporting tourists to Bangaan Island may be contributing to seagrass damage. In contrast, the present study documented only two species in the two assessed barangays outside the sanctuary. This discrepancy underscores both the relative buffering capacity of marine protected areas and the heightened vulnerability of unprotected coastal sites.

These findings reinforce the argument of Ame and Ayson (2009) that community-based approaches, when paired with robust policies and effective enforcement, are vital for the sustainability of marine protected areas. Strengthening and expanding conservation initiatives in Tungawan is therefore urgent. Integrated strategies should prioritize site-specific threats observed in this study—particularly siltation, turbidity, and marine debris—while also considering the broader anthropogenic pressures documented in the literature. Key actions include controlling land-based sources of pollution, restoring degraded habitats, and promoting sustainable resource use across fisheries and tourism sectors. Equally critical is the need to build local capacity, invest in environmental education, and ensure active community participation in coastal resource governance. Together, these measures will be essential to reverse degradation trends and secure the long-term ecological integrity of Tungawan's coastal ecosystems.

4 Conclusion

The assessment of seagrass beds in Linguisan and Tigbucay, Tungawan, Zamboanga Sibugay revealed a low-species seagrass community composed of *Enhalus acoroides* and *Halodule pinifolia*. *E. acoroides* was clearly dominant, accounting for the majority of relative density across both sites, highlighting its adaptive advantage in disturbed coastal habitats and potential as a bioindicator of seagrass bed condition. In contrast, the limited distribution of *H. pinifolia*, found only in Linguisan, reflects its sensitivity to environmental stressors.

Linguisan exhibited a higher average percent cover and greater species composition, indicating a moderately healthy seagrass ecosystem, potentially influenced by reduced anthropogenic pressure and favorable substrate conditions. Tigbucay, on the other hand, showed signs of environmental stress, as reflected in its lower percent cover, single-species composition, and the presence of silt and marine debris. These results suggest ongoing ecological pressures, likely associated with nearby human activities, runoff, and inadequate waste management. While the observed diversity of invertebrates and algae indicates some level of biological productivity, the overall ecosystem remains fragile and vulnerable.

Local management initiatives, such as the establishment of marine sanctuaries in Bangaan and community-led resource governance, provide a foundation for conservation. Nonetheless, the findings underscore the need for more comprehensive and sustained action, including habitat restoration, strengthened regulatory enforcement, and community engagement through environmental education and participatory decision-making.

For future research, it is recommended to incorporate physicochemical parameters, such as water quality, sediment characteristics, and light availability, to better understand factors influencing seagrass distribution and condition. Seasonal monitoring is also advised to capture temporal variation, particularly in relation to monsoonal changes and resource use patterns. Expanding sampling to additional barangays within Tungawan and neighboring municipalities would allow for a more robust comparative assessment, enhancing the scientific basis for seagrass management and conservation planning in Zamboanga Sibugay.

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