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Species Composition and Abundance of Mangroves in the Coastal Areas of Roseller T. Lim, Zamboanga Sibugay

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ABSTRACT

Mangrove forests in the Philippines have lost nearly half of their original cover due to aquaculture expansion, logging, coastal development, and increasing climate-related pressures. Along Sibuguey Bay—including the municipality of Roseller T. Lim—mangroves face similar threats, yet baseline ecological assessments remain limited. The absence of such data constrains the development of targeted conservation and rehabilitation strategies. This study evaluated the species composition, abundance, diversity, vegetation structure, and habitat condition of mangroves in R.T. Lim using line transects established across three stations, each with five 10 × 10 m quadrats. A total of twelve species belonging to six families were recorded, with the Rhizophoraceae family contributing the largest share (55.03%). Rhizophora apiculata was identified as the most dominant species, exhibiting the highest relative abundance (22.1%) and importance value index. The Shannon–Wiener Diversity Index (H′ = 2.20) indicated moderate diversity, while habitat assessments revealed a mean crown cover of 59.51%, an average tree height of 3.80 m, and a regeneration rate of 2.16 seedlings per m²—attributes that classify the forest as being in "good" ecological condition. Overall, the findings suggest that the mangrove forest in R.T. Lim is structurally stable but ecologically skewed toward a few dominant species, reflecting both historical disturbances and previous reforestation efforts. These baseline data provide a critical foundation for biodiversity-oriented rehabilitation and adaptive management interventions aimed at strengthening mangrove resilience in the municipality.

Keywords : Species richness, Relative Abundance, Species diversity Index, Mangrove assessment, Sibuguey Bay.

1 INTRODUCTION

Mangrove forests are recognized as one of the most productive ecosystems globally, widely recognized not only for their ecological role as habitats for diverse species but also for their capacity to trap sediments, recycle nutrients, and protect shorelines from erosion (Ribeiro et al., 2019 and FAO, 2007). Beyond their ecological role, mangrove forests provide significant economic and environmental benefits to coastal populations. One of their key functions is carbon sequestration. Studies by Aksornkoae et al. (2011) show that mature mangrove stands around 40 years old can store up to 370.7 tons of carbon per hectare, while younger stands of about 15 years can hold approximately 208.5 tons per hectare.

Mangrove ecosystems are among the most threatened tropical habitats globally, with 11 true mangrove species currently listed on the IUCN Red List of Threatened Species (Polidoro et al., 2010). Global mangrove cover has experienced a significant decline from 18.8 million hectares in 1980 to 15.2 million hectares in 2005—despite Asia holding the largest share of these forests; the region also faces the highest rates of mangrove deforestation (Giri et al., 2010; FAO, 2015). In the Philippines, mangrove deforestation has reached alarming levels, with an estimated loss of up to 50% in which the IUCN identifies coastal expansion, climate change, logging, industrialization, human settlements, and agriculture as major threats to mangrove species in the country (Maritime Review, 2017). This decline has placed many mangrove forests on the brink of collapse (Gevaña et al., 2019). Additionally, anthropogenic activities, such as the use of mangrove trees for construction, fuelwood, fencing, and animal fodder, have significantly contributed to their decline, as observed in Cebu Island (Lillo and Fernando, 2017).

Mangrove forests in Roseller T. Lim, Zamboanga Sibugay, play a crucial role in supporting local fisheries, enhancing coastal resilience, and sustaining the livelihoods of coastal communities. However, these biologically rich habitats, composed of diverse tree, shrub, and plant species, face growing threats such as tidal influences, and human activities, all which impact species composition and biodiversity. This study aims to assess the species composition and abundance of mangroves in RT Lim, contributing to data-driven strategies for conservation and sustainable management. This will provide valuable insights into how ecological health can be integrated with socioeconomic development, in alignment with global environmental goals. Understanding the current state of mangrove ecosystems is vital for conservation and management efforts. Mangroves significantly contribute to various United Nations Sustainable Development Goals (SDGs), including: SDG 1 (No Poverty), where mangroves provide a habitat for fish and shellfish, supporting the livelihoods of coastal communities; SDG 6 (Clean Water and Sanitation), where mangrove roots help filter pollutants, improving water quality; SDG 13 (Climate Action), where mangroves serve as natural buffers, protecting coastal areas from storm surges and rising sea levels; SDG 14 (Life Below Water), where sustainable mangrove conservation ensures the preservation of marine biodiversity; and SDG 15 (Life on Land), where mangroves contribute to terrestrial ecosystem restoration and sustainability.

2 METHODOLOGY

2.1 Study Area

The study was conducted in Roseller T. Lim, a municipality in Zamboanga Sibugay, Philippines (Figure 1). The municipality covers a total land area of approximately 30,000 hectares and is subdivided into 26 barangays, six of which are coastal. Mangrove assessment was undertaken in June 2024. Situated along the coast of Sibuguey Bay, Roseller T. Lim is recognized for its rich coastal and marine ecosystems. Its mangrove forests play critical ecological roles by protecting shorelines from erosion, serving as nursery grounds for fisheries, and providing habitats for a variety of marine and terrestrial species. These ecosystems contribute to coastal resilience and support the sustainability of local livelihoods. Prior to fieldwork, permission for site access was secured through a request submitted to the Local Government Unit through the Municipal Agriculture Office (MAO) of Roseller T. Lim. The assessment was conducted in compliance with local environmental protocols and guidelines.

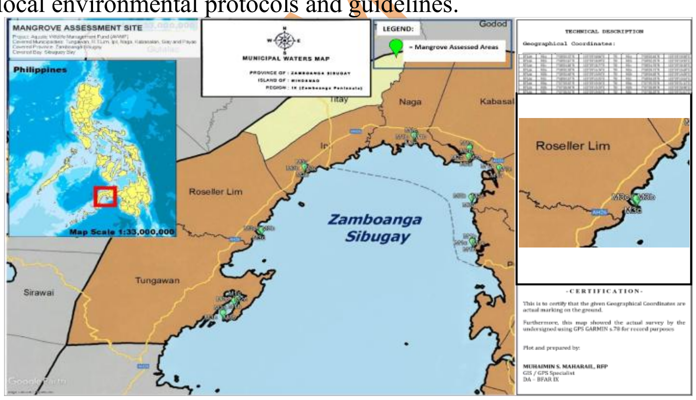


Figure 1. Location map of the study site in RT Lim, Zamboanga Sibugay

2.2 Sampling Design and Data Collection

Mangrove assessment was conducted using transect lines and quadrats, following the methodology outlined in the *Participatory Coastal Resource Assessment Training Guide* by Deguit et al. (2004). Key parameters recorded included percent crown cover, regeneration density (individuals/m²), average tree height, and species composition.

Three 50-meter transect line were laid perpendicular to the shoreline, starting from the landward edge of the mangrove forest toward the seaward side in the sampling sites. Along this transect, five contiguous 10 × 10-meter quadrats were established for consistent data collection. Within each quadrat, three randomly placed 1 × 1-meter sub-quadrats were used to assess seedling and sapling regeneration. All mangrove seedlings within these sub-quadrats were counted and recorded separately. The field guide manual to Philippines Mangroves by Primavera et. al. (2004) was used to identify the mangroves species in situ based on their morphological characteristics. Other published mangrove identification manuals were also used as references for further classification.

In addition to quantitative data, qualitative observations on environmental conditions and human disturbances were also noted to provide contextual insight into the health of the mangrove ecosystem.

2.3 Data Analysis

Mangrove diversity was assessed using the Paleontological Statistical Software Package (PAST) developed by Hammer et al. (2001). PAST is a widely used freeware tool in biodiversity studies, particularly for flora and fauna inventories such as mangrove assessments. We calculated species richness, relative abundance, and the Shannon–Wiener diversity index (H'), interpreting values of H' as follows: < 1.0 indicating low diversity, 1.0–3.0 moderate, and > 3.0 high (Magurran, 2004). Species dominance was assessed using Simpson's dominance index (D), where higher values reflect greater dominance by a few species. The Importance Value Index (IVI), derived from relative density, frequency, and dominance, was used to gauge each species' ecological significance (Curtis & McIntosh, 1951). These indices offer valuable insights into community structure but have limitations; diversity indices like Shannon–Wiener are sensitive to sample size and may misrepresent rare species, while the IVI's equal weighting of its components may not fully reflect ecological importance. Conceptual and statistical challenges in comparing diversity values across communities have been noted (Barrantes & Sandoval, 2009), suggesting that multivariate analyses could complement traditional indices for more robust ecological interpretation.

In evaluating the condition of the mangrove forest in RT Lim, the study followed the methodology from the *Participatory Coastal Resource Assessment (PCRA) Training Guide* by Deguit et al. (2004). Mangrove health was classified into four categories—excellent, good, fair, and poor—based on ecological indicators such as percent crown cover, regeneration density (individuals/m²), and average tree height. This standardized classification system enabled a clear and comprehensive understanding of the forest's current ecological status and conservation needs.

3 RESULTS AND DISCUSSION

3.1 Species composition and conservation status

Twelve (12) mangrove species belonging to six families were documented across the three transects established in Roseller T. Lim, Zamboanga Sibugay (Table 1, Figure 2). Ten (10) species identified are classified as Least Concern (LC), indicating that they are not currently prioritized for conservation efforts. However, two (2) species (*Pemphis acidula* and *Xylocarpus moluccensis)* are categorized as Near Threatened (NT), suggesting a declining population and potential risk of being endangered soon. This underscores the need for ongoing monitoring and proactive conservation measures to prevent further decline.

The family Rhizophoraceae has exhibited the highest species composition, accounting for 55.03% of all documented individuals including: *Rhizophora apiculate*, *R. mucronata*, *R. stylosa*, *Bruguiera sexangula*, and *B. cylindrica*. The Lythraceae family followed at 22.49%, composed of *Sonneratia alba*, *S. ovata*, and *Pemphis acidula*. The remaining families include Acanthaceae (*Avicennia marina*, 8.47%), Combretaceae (*Lumnitzera racemosa*, 5.56%), Meliaceae (*Xylocarpus moluccensis*, 4.77%), and Primulaceae (*Aegiceras corniculatum*, 3.70%).

This composition reflects the ecological tendencies of mangrove ecosystems in the Philippines, particularly those undergoing active rehabilitation. The dominance of Rhizophoraceae is a common outcome in mangrove restoration sites, where species such as *R. apiculata* and *R. mucronata* are heavily utilized due to their rapid growth, ease of propagation, and tolerance to environmental stress (Melana et al., 2005; Primavera, 2005). In contrast, underrepresented species like *X. moluccensis* and *A. corniculatum* are less commonly included in planting programs despite their ecological value, potentially explaining their lower abundance.

Table 1. Mangrove species identified in RT Lim, Zamboanga Sibugay and their conservation status.

Scientific Name	Family	English Name	Local Name	IUCN Conservation Status
Aegiceras corniculatum	Primulaceae	River mangrove	Saging-saging / Malatangal	LC
Avicennia marina	Acanthaceae	Grey mangrove	Piapi / Bungalon	LC
Bruguiera cylindrica	Rhizophoraceae	Orange mangrove	Pototan babae	LC
Bruguiera sexangula	Rhizophoraceae	Upriver orange mangrove	Pototan lalaki	LC
Lumnitzera racemosa	Combretaceae	White-flowered black mangrove	Tabigi	LC
Rhizophora apiculata	Rhizophoraceae	Tall stilt mangrove	Bakauan lalaki	LC
Rhizophora mucronata	Rhizophoraceae	Asiatic mangrove	Bakauan babae	LC
Rhizophora stylosa	Rhizophoraceae	Spotted stilt mangrove	Bakauan bato	LC
Pemphis acidula	Lythraceae	Ironwood	Bantigue / Kabantigi	NT
Sonneratia alba	Lythraceae	Mangrove apple	Pagatpat	LC
Sonneratia ovata	Lythraceae	Egg mangrove	Pedada / Kalapinay	LC
Xylocarpus moluccensis	Meliaceae	Cannonball mangrove	Piagau / Piyapi lalaki	NT

Note: LC-Least Concern; NT: Nearly Threatened

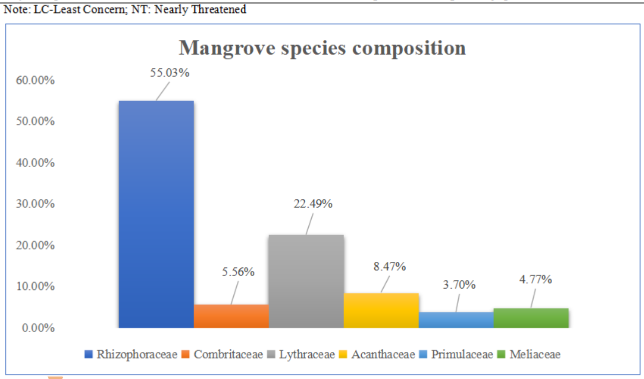


Figure 2. Mangrove families present in the assessed areas of RT Lim

Compared to more diverse mangrove sites in the Philippines—such as Panay Island, which hosts over 20 species (Gevaña et al., 2019), or Palawan's Busuanga Island with 23 species (Abino et al., 2014)—the species richness in R.T. Lim is relatively moderate. This discrepancy could be attributed to historical disturbances such as aquaculture development and timber harvesting, which have been documented to reduce diversity and favor resilient, fast-growing species like those in the Rhizophora genus (Mendoza & Casimero, 2017; Lee et al., 2014).

Nevertheless, the presence of twelve species—including several with Near Threatened status under the IUCN (e.g., *Pemphis acidula* and *Xylocarpus moluccensis*)—underscores the ecological importance of the area. The findings align with national biodiversity profiles indicating that the Philippines is home to approximately 35–40 true mangrove species (DENR-BMB, 2017), affirming that RT Lim supports a meaningful subset of the country's mangrove diversity. To promote long-term sustainability and ecological balance, future conservation and reforestation initiatives in the area should aim to diversify planting beyond the dominant Rhizophoraceae species by incorporating less utilized but functionally significant taxa such as *Bruguiera gymnorrhiza*, *Ceriops tagal*, and *Xylocarpus granatum*.

3.2 Relative abundance

The results indicated that Rhizophora apiculata was the most dominant species, accounting for 22.1% of all individuals recorded (Table 2). This was followed by Rhizophora mucronata at 17.3%, and Sonneratia alba at 14.4%. Other species such as Pemphis acidula, Avicennia marina, and Sonneratia ovata each contributed 5.8%, while Xylocarpus moluccensis and Aegiceras corniculatum showed the lowest relative abundances at 2.9% and 1.9%, respectively.

Figure 3 presents the species composition across quadrat–transects, which further illustrates the dominance of R. apiculata and R. mucronata. These two species were recorded in nearly all quadrats and frequently showed higher counts compared to other species. For instance, R. apiculata exhibited exceptionally high numbers in several quadrats such as Transect 2–Quadrat 3, while R. mucronata was consistently present across different transects with moderate to high counts. In contrast, species like X. moluccensis, Bruguiera sexangula, and A. corniculatum appeared only in scattered quadrats with very low individual counts, underscoring their restricted distribution within the study area.

Table 2. Relative Abundance of Mangrove Species in RT Lim, Zamboanga Sibugay

No.	Species	Number of Individuals	Relative Abundance (%)
1	*Rhizophora apiculata*	23	22.1
2	*Rhizophora mucronata*	18	17.3
3	*Sonneratia alba*	15	14.4
4	*Pemphis acidula*	6	5.8
5	*Avicennia marina*	6	5.8
6	*Bruguiera sexangula*	5	4.8
7	*Bruguiera cylindrica*	5	4.8
8	*Rhizophora stylosa*	4	3.8
9	*Sonneratia ovata*	6	5.8
10	*Lumnitzera racemosa*	3	2.9
11	*Xylocarpus moluccensis*	3	2.9
12	*Aegiceras corniculatum*	2	1.9

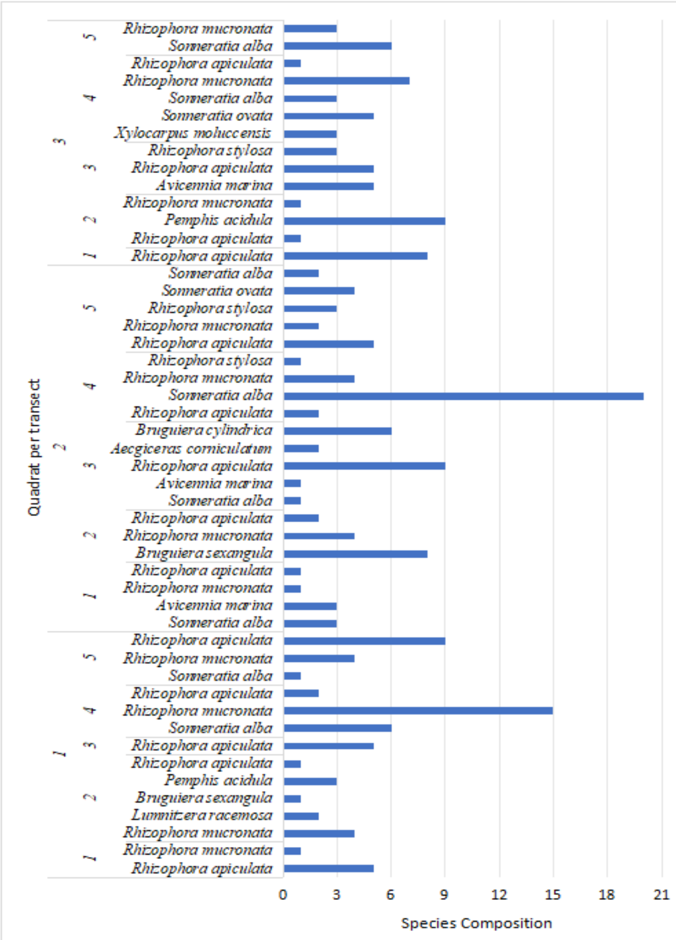


Figure 3. Species composition (number of individuals) per quadrat–transect in RT Lim, Zamboanga Sibugay

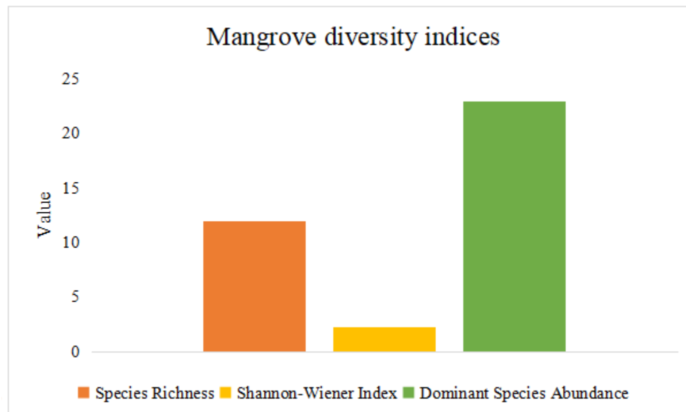
The high relative abundance of Rhizophora species, particularly *R. apiculata* and *R. mucronata*, reflects their ecological adaptability and extensive use in reforestation and rehabilitation projects across the Philippines. These species are known for their robust prop root systems, which allow them to establish and thrive in dynamic intertidal environments with varying salinity and sedimentation conditions (Alongi, 2002; Primavera, 2005). Their dominance in the study area is consistent with findings from other Philippine sites such as Bohol and Panay Island, where Rhizophora species also dominate replanted and disturbed areas (Melana et al., 2005; Gevaña et al., 2019).

Conversely, the low relative abundance and sporadic occurrence of species like *X. moluccensis* and *A. corniculatum* (Figure 3) may be due to their limited natural regeneration or exclusion from local reforestation schemes. As noted by Garcia et al. (2020), these species often occur in specific microhabitats or are outcompeted by more aggressive colonizers in disturbed environments.

Assessing relative abundance is therefore essential for understanding the structure and ecological dynamics of mangrove communities. It helps identify dominant species that may influence forest structure and function, as well as highlight less-represented species that may require targeted conservation. The current results suggest that while the mangrove forest in R.T. Lim maintains a stable core of dominant species, broader species representation is necessary to enhance biodiversity, ecological resilience, and long-term sustainability. Table 2 and Figure 3 not only shows the overall dominance patterns but also the spatial distribution and patchiness of mangrove species across the study area.

3.3 Mangrove diversity indices

The surveyed areas in RT Lim, Zamboanga Sibugay has a species richness of 12 (Figure 4), indicating a moderately diverse mangrove assemblage. This number is relatively higher compared to studies in Barangay Imelda, Dinagat Island with 10 species (Cañizares & Seronay, 2016) and Butuan Bay with 9–11 species (Goloran et al., 2020), suggesting that the study area supports a wider variety of mangrove flora despite evidence of past disturbance.



Sibugay

The calculated Shannon-Wiener Diversity Index (H') was 2.20, which also indicates moderate species diversity. This value suggests a fairly balanced ecosystem in which no single species overwhelmingly dominates. However, as seen in the relative abundance data, *R. apiculata* and *R. mucronata* remain the most dominant species, while other species such as *A.corniculatum* and *X. moluccensis* were minimally represented. While this is still within the range considered healthy for mangrove forests, it also highlights the potential ecological imbalance that may occur if dominance by few species persists without enrichment.

Species dominance analysis confirmed that *Rhizophora* species, particularly *R. apiculata*, exert significant ecological influence. Their widespread presence is consistent with patterns observed in reforested or disturbed mangrove sites throughout the Philippines, including Palawan, Bohol, and parts of Zamboanga Peninsula (Melana et al., 2005; Mendoza & Casimero, 2017). These results underscore the importance of species diversification in rehabilitation programs to prevent monoculture dominance and enhance ecological resilience.

The findings suggest that although the mangrove ecosystem in RT Lim remains moderately diverse and structurally stable, future conservation efforts should focus on increasing species evenness and encouraging the growth of underrepresented native species. Such measures will help maintain long-term ecosystem functionality and resistance to environmental changes.

3.4 Mangrove vegetation structure

Among the twelve recorded mangrove species, *R. apiculata* exhibited the highest population density, followed by *R. mucronata* and *Sonneratia alba* (Figure 5). These species were not only the most numerous but also widely distributed across the transects, indicating their ecological dominance and adaptability to the prevailing environmental conditions.

In terms of relative density, *R. apiculata* accounted for 22.1% of the total population, while *R. mucronata* and *S. alba* contributed 17.3% and 14.4%, respectively. These figures are supported by relative frequency values, which again highlight the frequent occurrence of these three dominant species in the sampled plots. Relative dominance, which reflects the total basal area occupied by each species, further reinforced their structural importance within the mangrove stand.

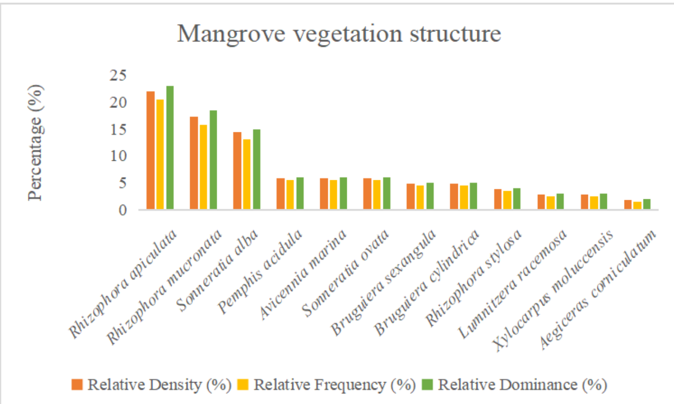


Figure 5. Relative density, frequency and dominance of mangroves in RT Lim, Zamboanga Sibugay

The importance value index (IVI), confirmed the ecological significance of *R. apiculata*, yielding the highest IVI score of 65.6. This was followed by *R. mucronata* (51.6) and *S. alba* (42.6) (Figure 6). These high IVI values underscore the dominant role these species play in shaping the forest's structural and ecological dynamics.

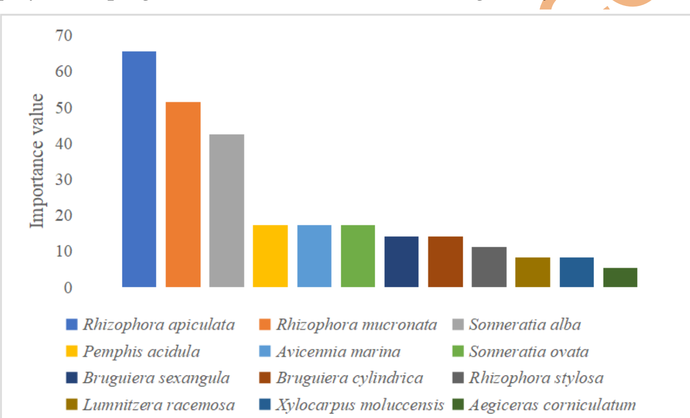


Figure 6. Importance value of mangrove species in RT Lim, Zamboanga Sibugay

Compared to findings in nearby areas such as Kabasalan and Zamboanga City, where similar dominance patterns were observed (Walag et al., 2015; Garcia et al., 2020), the results suggest that the mangrove forest in R.T. Lim supports a stable core of dominant species. However, other species like *Xylocarpus moluccensis*, *Aegiceras corniculatum*, and *Lumnitzera racemosa* recorded much lower structural values, pointing to their limited distribution and potential vulnerability.

Overall, the vegetation structure assessment indicates a relatively stable but compositionally skewed mangrove ecosystem dominated by a few resilient species. This dominance pattern reflects a history of disturbance and targeted planting, emphasizing the need for enrichment planting and conservation strategies that promote species diversity and ecological balance.

Table 3. Mangrove habitat condition in RT Lim, Zamboanga Sibugay

TRANSECT	Average Height (m)	Percent Crown Cover (%)	Condition	Regeneration per m^2	Average Height (m)	Condition
1	2.99	68.78	Good	3.07	0.66	Excellent
2	4.22	74.11	Good	1.93	0.7	Excellent
3	4.20	35.63	Fair	1.47	0.58	Excellent
Mean	3.80	59.51	GOOD	2.16	0.65	GOOD

The percent crown cover among the three transects exhibited considerable variation, ranging from 35.63% in Transect 3 to 74.11% in Transect 2, with a mean value of 59.51%. Based on the Participatory Coastal Resource Assessment (PCRA) Training Guide by Deguit et al. (2004), this mean crown cover falls within the "Good" category of mangrove health. This classification indicates that the mangrove stand remains relatively healthy, with a canopy that is sufficiently intact to provide ecological functions such as habitat provision and shoreline stabilization. However, the marked disparity among transects highlights localized disturbances, particularly in areas with lower crown cover, which may be attributed to anthropogenic pressures such as cutting and waste accumulation observed during fieldwork. These findings suggest that while the forest retains much of its ecological integrity, targeted conservation and rehabilitation measures are necessary to address degraded patches and to prevent further decline.

Compared to the other studies, the crown cover in R.T. Lim is lower than in community-managed mangrove forests in Western Visayas, which had denser canopies and higher health ratings (Florido et al., 2020). This difference highlights the importance of effective local management in maintaining forest structure. Similarly, in the assessment in Puerto Princesa Bay by Dangan-Galon et al., (2016) observed significantly higher crown cover and basal area, which they attributed to the presence of old-growth mangroves and limited disturbance.

In terms of average tree height, Transect 1 recorded 2.99 meters, Transect 2 had 4.22 meters, and Transect 3 measured 4.20 meters. The mean height across all transects was 3.80 meters, placing it within the "good" category. This indicates relatively healthy tree stands and minimal vertical growth disturbance. Comparable values were noted in the mangrove areas of Kabasalan, Zamboanga Sibugay, where *Rhizophora* and *Avicennia* species dominated medium-height forest layers (Garcia et al., 2014). The similarity suggests that both areas share common biophysical characteristics and levels of recovery.

A key indicator of forest regeneration, the number of seedlings per square meter, varied across transects, ranging from 1.47 to 3.07 seedlings per m², with a mean of 2.16 seedlings per m². Based on standard classification, this places the mangrove forest of R.T. Lim under the "Good" category. Although regeneration was not consistently high in all transects, the relatively strong rates still indicate favorable conditions for natural recruitment. Similar regeneration dynamics were noted by Mendoza and Casimero (2017) in mangrove stands of the Zamboanga Peninsula dominated by *Sonneratia alba* and *Rhizophora* species. These results suggest that, despite existing pressures, the forest retains sufficient regenerative capacity to support long-term recovery, though site-specific variations highlight the need for targeted management interventions in areas with lower seedling densities.

Overall, the mangrove habitat in R.T. Lim is in a moderately healthy state. While Transect 2 shows relatively robust structure and cover, Transects 1 and 3 exhibit signs of degradation. Compared to more protected or less disturbed areas like Palawan or Northern Luzon (Gevaña et al., 2019; Camacho & Gevaña, 2016), the mangrove forest in R.T. Lim reveals room for improvement, particularly through rehabilitation and enrichment planting. However, the consistent regeneration and relatively good average height offer a promising outlook for sustainable management and restoration.

4 Conclusion

This study documented twelve (12) mangrove species belonging to six families in the coastal areas of Roseller T. Lim, Zamboanga Sibugay, with the family Rhizophoraceae contributing to the majority of individuals. *Rhizophora apiculata, R. mucronata*, and *Sonneratia alba* emerged as the most dominant and structurally significant species, while less represented taxa such as *Xylocarpus moluccensis, Aegiceras corniculatum*, and *Lumnitzera racemosa* were recorded in low abundance. Overall, the mangrove forest exhibits moderate species diversity, a relatively stable vegetation structure, and strong natural regeneration capacity, but is ecologically skewed toward a few dominant species.

The findings suggest that the mangrove ecosystem in R.T. Lim remains functionally stable and capable of recovery, though its composition reflects both historical disturbance and targeted reforestation practices favoring Rhizophora. While these species contribute to forest resilience, the low representation of other ecologically valuable taxa highlights the need for biodiversity-focused management strategies. Enrichment planting of underutilized native species and protection of vulnerable taxa are therefore essential to enhance long-term ecological balance and resilience.

Future research should focus on monitoring the survival and growth performance of less represented species, assessing ecosystem services such as carbon sequestration and coastal protection, and integrating socio-economic perspectives to strengthen community-based conservation. Such studies will provide deeper insights into the ecological trajectory of the forest and inform adaptive strategies for sustainable mangrove management in R.T. Lim and similar coastal areas in the Philippines.

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