



## DISTRIBUTION AND TRENDS OF MANGROVE SPECIES DIVERSITY ACROSS COASTAL BARANGAYS

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### ABSTRACT

This study presented the status of mangroves in the seven (7) coastal barangays in Sapang Dalaga, Misamis Occidental, in terms of abundance and diversity. Eighteen (18) mangrove species were recorded in the municipality where eight (8) of these are major mangroves namely, *Avicennia marina*, *Avicennia rumphiana*, *Sonneratia alba*, *Nypa fruticans*, *Rhizophora stylosa*, *Sonneratia ovata*, *Rhizophora apiculata* and *Rhizophora mucronata*; five (5) minor mangroves namely *Acrostichum aureum*, *Lumnitzera littorea*, *Acrostichum speciosum*, *Aegiceras floridum* and *Pemphis acidula* and five (5) associate mangroves namely *Pandanus tectorius*, *Syagrus romanzoffiana*, *Milletia pinnata*, *Terminalia catappa* and *Cocos nucifera*. Eight (8) species of mangroves were found in Barangay Casul, seven (7) species in Barangay Manla, five (5) species in Barangay Dioyo and Macabibo, four (4) species in Barangay Caluya and Libertad, and three (3) species in Barangay Sapang Ama. Computed diversity indices in all seven coastal barangays in Sapang Dalaga fall below the range of 1.5 - 3.5, which is considered diverse (Magurran, 1986). Statistical results showed that there is no significant difference among the seven (7) coastal barangays in Sapang Dalaga, Misamis Occidental, in terms of mangrove abundance. Still, they differ significantly in terms of diversity, as indicated by the computed p-values of 0.26 and 0.02, respectively, at a 95% level of significance. Since

this is a preliminary study, further monitoring of the mangrove ecosystem in the municipality for future work may also be considered.

**Keywords:** *mangroves, ecosystem, diversity, abundance, Sapang Dalaga*

## INTRODUCTION

Sapang Dalaga, a fifth-class municipality in Misamis Occidental, comprises seven coastal barangays: Dioyo, Macabibo, Sapang Ama, Caluya, Manla, Casul, and Libertad. Notably, it is among the areas within the province that host a significant concentration of mangrove forests.

Mangroves are of great ecological significance and economic importance, as they are specialized coastal ecosystems found in protected estuaries, riverbanks, and lagoons within tropical and subtropical regions. The term “mangrove” denotes both these unique ecosystems and the plant families that have explicitly adapted to thrive in such tidal environments (Kathiresan, 2021; Tomlinson, 1986). These ecosystems are vital for supporting local livelihoods by providing resources and offering natural protection against waves and water movements. Furthermore, mangroves play a crucial role in mitigating climate change; a hectare of mangroves can sequester up to five times more carbon than many tropical forests globally (Ferreira et al., 2022; Chatting et al., 2022; Adame et al., 2021; Alongi, 2021).

There are approximately 80 identified species of mangrove trees, which typically grow in waterlogged soils with low oxygen levels, where fine sediments tend to accumulate due to slow-moving waters. Because they cannot tolerate freezing temperatures, mangroves are primarily restricted to tropical and subtropical zones near the equator (Saenger & Snedaker, 2022; Devadatha et al., 2021). Recognizable by their dense, stilt-like prop roots, these trees adapt to the daily tidal fluctuations by flooding at least twice daily. Their root systems trap sediments, thereby constructing muddy substrates and stabilizing coastlines against erosion caused by storm surges, currents, waves, and tides (Krauss et al., 2023). The complex roots also support diverse marine fauna by providing food and shelter from predators.

Mangroves belong predominantly to the families Rhizophoraceae, Acanthaceae, Lythraceae, Combretaceae, and Arecaceae. These woody plants form dense forests along tidal estuaries, salt marshes, and muddy coasts, characterized by specialized roots—prop roots for support and pneumatophores (respiratory roots)—which extend above the mud to facilitate gas exchange (lenticels). Such adaptations enable mangroves to survive in saline, oxygen-deprived environments (Singh et al., 2025; Rahman et al., 2023; Sarkar, 2022).

As one of the most productive tropical ecosystems, mangrove forests serve as a critical ecological bridge connecting terrestrial and marine systems. They provide essential services such as habitat for aquatic species and shoreline protection against storm surges and tsunamis (Islam et al., 2024; Akram et al., 2023; Alongi, 2020).

Moreover, mangroves are among the most carbon-dense forests on earth, often exceeding tropical rainforests in their capacity to store carbon—an attribute key to combating climate change (Nguyen et al., 2024). Despite their ecological importance, ongoing threats from development and climate impacts necessitate continuous monitoring of mangrove ecosystems (Ramos et al., 2023; Friess et al., 2022; Gerona et al., 2022; Quevedo et al., 2022; Buitre et al., 2019).

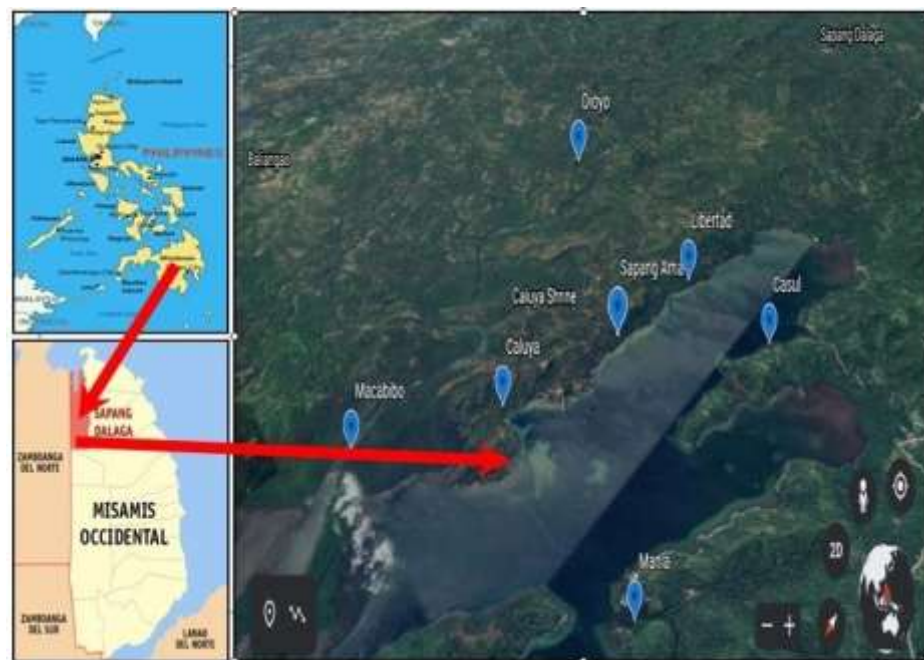
Despite limited prior research on mangrove diversity within the study area, the Local Government Unit of Sapang Dalaga recognizes the importance of understanding these ecosystems. Thus, the proponents initiated a study which aimed at assessing the diversity and species composition of mangroves across the coastal barangays of Sapang Dalaga, Misamis Occidental.

## METHODOLOGY

This chapter discusses the method and procedure of the study. It also includes the analysis of data, and the materials used.

### Research Setting

Seven coastal barangays in Sapang Dalaga, Misamis Occidental, namely Dioyo, Macabibo, Sapang Ama, Caluya, Manla, Casul and Libertad, were assessed to identify the abundance and diversity of the mangrove ecosystem in the area. It was situated at approximately 8032' North, 123034' East on the island of Mindanao.



*Figure 2. Geographical Map of Sapang Dalaga, Misamis Occidental, Philippines.*

## Research Method

This study employed a descriptive-comparative research method. Prior to the actual conduct of the study, a preliminary survey was conducted as the basis for establishing stations and replicates. There are a total of seven (7) sampling stations were chosen during the initial study. Three replicates were established in each station using the Box Plot method.

## Sampling Procedure

Seven (7) coastal barangays, namely Dioyo, Macabibo, Sapang Ama, Caluya, Manla, Casul, and Libertad, were considered sampling sites. Each site was replicated three (3) times. The researchers laid a box plot using a line transect, which measures 10m x 10m. The mangrove species found within the area were counted individually and grouped into classifications as major, minor and associate mangroves.

## Analysis of Data

A Shannon diversity index was used in getting the diversity value, which was computed as the individual population ( $P_i$ ) divided by the total population multiplied by the log of its population ( $H' = -\sum P_i \ln P_i$ ). The specialized group was not included in the computation of the diversity value to ensure a fair result.

## RESULTS

This section deals with the presentation of gathered data and the interpretation of the corresponding results.

| Table 1. Mangrove Species Found in the Coastal Barangays of Sapang Dalaga, Misamis Occidental (Based On the Criteria Set by Tomlinson, 1986) |                        |
|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Scientific Names                                                                                                                             | Local Name             |
| <b>Major Mangrove species*</b>                                                                                                               |                        |
| <i>Avicennia marina</i>                                                                                                                      | Piapi, bungalon, miapi |
| <i>Avicennia rumphiana</i>                                                                                                                   | Piapi, bungalon, miapi |
| <i>Sonneratia alba</i>                                                                                                                       | Pagatpat,              |
| <i>Nypa fruticans</i>                                                                                                                        | Nipa                   |
| <i>Rhizophora stylosa</i>                                                                                                                    | Bakhaw bato,           |
| <i>Sonneratia ovata</i>                                                                                                                      | Pedada                 |
| <i>Rhizophora apiculata</i>                                                                                                                  | Bakawan lalaki         |
| <i>Rhizophora mucronata</i>                                                                                                                  | Bakawan babae          |
| <b>Minor Mangrove species*</b>                                                                                                               |                        |
| <i>Acrostichum aureum</i>                                                                                                                    | Pagaypay, Palaypay     |
| <i>Lumnitzera littorea</i>                                                                                                                   | Tabao, Culasi          |
| <i>Acrostichum speciosum</i>                                                                                                                 | Palaypay               |
| <i>Aegiceras floridum</i>                                                                                                                    | Saging-saging          |
| <i>Pemphis acidula</i>                                                                                                                       | Bantigi                |
| <b>Mangrove associates*</b>                                                                                                                  |                        |
| <i>Pandanus tectorius</i>                                                                                                                    | Pandan                 |
| <i>Syagrus romanzoffiana</i>                                                                                                                 | Lubi-lubi              |
| <i>Milletia pinnata</i>                                                                                                                      | Baluk-baluk            |
| <i>Terminalia catappa</i>                                                                                                                    | Talisay                |
| <i>Cocos nucifera</i>                                                                                                                        | Lubi                   |

Table 1 shows eighteen (18) species of mangroves found in the coastal barangays of Sapang Dalaga, Misamis Occidental, including their local names. Major mangrove species groups listed were eight (8) species, five (5) species for minor mangrove and five (5) species for mangrove associates.

| Mangrove Species             | Dioyo       | Macabibo    | Sapang Ama | Caluya      | Manla       | Casul       | Libertad    |
|------------------------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|
| <i>Nypa fruticans</i>        | 36.7        | 55.3        | 38.3       | 4.3         | 0           | 15.3        | 0           |
| <i>Acrostichum aureum</i>    | 16.3        | 0.3         | 0          | 0           | 0           | 0           | 0           |
| <i>Acrostichum speciosum</i> | 4           | 3.3         | 0          | 0           | 0           | 0           | 0           |
| <i>Cocos nucifera</i>        | 1.3         | 0.3         | 0.7        | 0           | 0           | 0.7         | 0           |
| <i>Terminalia catappa</i>    | 2.3         | 0           | 0          | 0           | 0           | 0           | 0           |
| <i>Pandanus tectorius</i>    | 0.3         | 0           | 0          | 0           | 0           | 0           | 0           |
| <i>Syagrus romanzoffiana</i> | 0           | 0.3         | 0          | 0           | 0           | 0           | 0           |
| <i>Rhizophora mucronata</i>  | 0           | 0           | 12         | 21          | 4.3         | 2.3         | 5.7         |
| <i>Rhizophora apiculata</i>  | 0           | 0           | 6          | 17.7        | 6           | 2.3         | 6           |
| <i>Sonneratia ovata</i>      | 0           | 0           | 0          | 0.7         | 0           | 0           | 0           |
| <i>Rhizophora stylosa</i>    | 0           | 0           | 0          | 0           | 1.7         | 0           | 0           |
| <i>Pemphis acidula</i>       | 0           | 0           | 0          | 0           | 1           | 0           | 0           |
| <i>Avicennia marina</i>      | 0           | 0           | 0          | 0           | 0.3         | 0           | 0           |
| <i>Sonneratia alba</i>       | 0           | 0           | 0          | 0           | 0.3         | 2           | 1.7         |
| <i>Lumnitzera littorea</i>   | 0           | 0           | 0          | 0           | 0.3         | 0           | 0           |
| <i>Avicennia rumphiana</i>   | 0           | 0           | 0          | 0           | 0           | 0.3         | 0           |
| <i>Millettia pinnata</i>     | 0           | 0           | 0          | 0           | 0           | 0.3         | 0.7         |
| <i>Aegiceras floridum</i>    | 0           | 0           | 0          | 0           | 0           | 0.3         | 0           |
| <b>TOTAL=18</b>              | <b>60.9</b> | <b>59.5</b> | <b>57</b>  | <b>43.7</b> | <b>13.9</b> | <b>23.5</b> | <b>14.1</b> |

Table 2 shows the average abundance of mangrove species in the seven (7) coastal barangays of Sapang Dalaga, Misamis Occidental. It was found that in Barangay Dioyo, six (6) species were recorded. *Nypa fruticans* got the highest abundance with an average of 36.7 individuals per 100 square meters, followed by *Acrostichum aureum* with 16.3 individuals and *Acrostichum speciosum* with four (4) individuals; *Pandanus tectorius* recorded the lowest with an average of 0.3 individuals only. The growing population in the coastal area of this barangay affected the abundance of mangroves, as observed. The pressures of an increase in population, food production, and industrial and urban development have led to a large proportion of the world's mangrove resources being

threatened by destruction. On the other hand, Barangay Macabibo had only five (5) mangrove species and was dominated by the *Nypa fruticans*, with an average abundance of 55.3 species per 100 square meters of the sampling site.

*Nypa fruticans* also dominated Barangay Sapang Ama mangrove areas with an average abundance of 38.3 individuals followed by *Rhizophora mucronata* with twelve (12) individuals and *Rhizophora apiculata* with six (6) individuals.

In Barangay Caluya, the species with the highest abundance were *Rhizophora mucronata*, with 21 individuals, and *Rhizophora apiculata*, with 17.7 individuals, followed by *Nypa fruticans*, with 4.1 individuals. It was observed that the substrate in the area is a muddy, sandy mixture, which is suitable for major mangroves to thrive, such as *Rhizophora* and *Sonneratia* species.

In Barangay Manla, the highest in abundance is *Rhizophora apiculata* with six (6) individuals, followed by *Rhizophora mucronata* with 4.1 individuals; *Rhizophora stylosa* with 1.7 individuals; *Pemphis acidula* with one (1) individual while *Avicennia marina*, *Sonneratia alba*, and *Lumnitzera littorea* had the lowest average abundance with an average of 0.3 individuals.

In Barangay Casul, eight (8) species were identified and *Nypa fruticans* got the highest average abundance with 15.3 individuals followed by the *Rhizophora apiculata* and *Rhizophora mucronata* with 2.3 individuals; *Sonneratia alba* with two individuals; *Cocos nucifera* with 0.7 average individuals while *Avicennia rumphiana*, *Milletia pinnata*, and *Aegiceras floridum* had the lowest abundance with only average 0.3 individuals per 100 square meters.

Factors that affect mangrove distribution include wave energy, water logging, unstable and oxygen-deficient soils, drainage, and nutrient levels. Where one species finds tolerable conditions, it tends to become dominant. The findings resulted in the clear zonation among mangrove species. Mangroves adapted to cope with these conditions.

Table 3.  
*Diversity Value of Mangrove Species in the Seven (7) Coastal Barangays of Sapang Dalaga, Misamis Occidental.*

| Coastal Barangays   | Diversity Index |
|---------------------|-----------------|
| Barangay Dioyo      | 0.70            |
| Barangay Macabibo   | 0.32            |
| Barangay Sapang Ama | 0.28            |
| Barangay Caluya     | 0.84            |
| Barangay Manla      | 1.25            |
| Barangay Casul      | 1.01            |
| Barangay Libertad   | 0.83            |

Diversity indices in the seven (7) coastal barangays are presented in Table 3. Magurran (1986) stated that all values that fall between 1.5 and 3.5 are considered diverse. Hence, based on the computed values of diversity indices, all seven coastal barangays in Sapang Dalaga fall below the range to be considered diverse in terms of mangrove diversity.

Table 4. *Statistical Results On the Comparison of Abundance and Diversity Indices of Mangroves Among the Seven (7) Coastal Barangays of Sapang Dalaga, Misamis Occidental.*

| Property  | p-value | Level of Significance | Decision             |
|-----------|---------|-----------------------|----------------------|
| Abundance | 0.26    | 0.05                  | Fail to Reject $H_0$ |
| Diversity | 0.02    | 0.05                  | Reject $H_0$         |

Based on the statistical results through One-way Analysis of Variance (ANOVA), the probability value obtained on the comparison among the coastal barangays in Sapang Dalaga in terms of abundance is 0.26, which is greater than the 95% confidence level (alpha, 0.05 level of significance), which fails to reject the null hypothesis. Therefore, there is no significant difference among the seven (7) coastal barangays in terms of the abundance of mangroves. However, in terms of diversity, the p-value of 0.02 is less than alpha, leading to the rejection of the null hypothesis. Thus, there is a significant difference in terms of mangrove diversity among the seven (7) coastal barangays in Sapang Dalaga, Misamis Occidental.

## DISCUSSIONS

The study identified a total of 18 mangrove species within the coastal barangays of Sapang Dalaga, categorized into major, minor, and associated types based on their ecological significance and prevalence (Tomlinson, 1986). The dominance of *Nypa fruticans* (Nipa) across multiple barangays—particularly in Dioyo and Macabibo—reflects its adaptability to the specific environmental conditions present in these areas. Nipa's prevalence may be linked to its tolerance for brackish water and fluctuating water levels, which are common in areas impacted by human activity and natural hydrological changes (Alongi, 2020).

Table 2 highlights notable differences in the abundance of mangrove species across the seven barangays. For example, *Nypa fruticans* was most abundant in Dioyo (36.7%), while it reached even higher levels in Macabibo (55.3%) and Sapang Ama (38.3%). In contrast, barangays like Manla and Libertad demonstrated much lower abundances of *Nypa* and other mangroves, which can be ascribed to the environmental factors such as substrate type, water salinity, and anthropogenic pressures (Krauss et al., 2023).

The dominance of *Rhizophora* species (*R. mucronata* and *R. apiculata*) in Caluya and Manla aligns with their known preference for muddy-sandy substrates and high tidal influence, facilitating zonation patterns typical of mangrove ecosystems (Saenger & Snedaker, 2022). The low abundances of certain species in specific barangays suggest localized environmental constraints or recent disturbances that are affecting species composition.

Using the diversity index framework by Magurran (1986), the calculated values across all barangays were below 1.5, indicating low mangrove diversity within the study area. Specifically, the highest diversity was observed in Barangay Manla (1.25), while Barangay Macabibo had the lowest (0.32). These low diversity values may suggest that dominant species, such as *Nypa* and *Rhizophora*, are out-competing less tolerant species, potentially due to anthropogenic disturbances like land conversion, pollution, and resource extraction.

Pertaining to low mangrove diversity, this poses an impact to ecosystem resilience describing the monocultures or limited species assemblages are less capable of adapting to environmental stresses (Alongi, 2021). This insight highlights the importance of implementing conservation measures to promote species richness and ecological stability.

The ANOVA results showed and paved no significant differences in overall mangrove abundance among the seven barangays ( $p = 0.26$ ), suggesting relatively uniform distribution levels at the spatial scale studied. However, a significant difference was found in mangrove diversity ( $p = 0.02$ ), revealing that certain barangays have comparatively more diverse mangrove assemblages than others. This disparity may be driven by localized environmental conditions, management practices, or historical land-use patterns (Krauss et al., 2023).

## Conclusions

After the conduct of the study, the researchers concluded that eighteen (18) species of mangroves were found in the seven (7) coastal barangays of Sapang Dalaga, Misamis Occidental, namely *Rhizophora mucronata*, *Rhizophora apiculata*, *Rhizophora stylosa*, *Avicennia marina*, *Avicennia rumphiana*, *Terminalia catappa*, *Sonneratia ovata*, *Sonneratia alba*, *Nypa fruticans*, *Cocos nucifera*, *Millettia pinnata*, *Acrostichum speciosum*, *Acrostichum aureum*, *Lumnitzera littorea*, *Pemphis acidula*, *Pandanus tectorius*, *Syagrus romanzoffiana*, and *Aegiceras floridum*. Most barangays (4 out of 7) were dominated by *Nypa fruticans*.

The growing population of the coastal barangays in the municipality significantly affects the mangrove ecosystem, based on the average values of abundance and diversity indices, where diversity values fall below the range considered for a diverse mangrove ecosystem.

Based on the statistical findings, it revealed that there is no significant difference among the seven (7) coastal barangays in Sapang Dalaga, Misamis Occidental, in terms of abundance. Still, they differ significantly in terms of diversity.

## **Recommendations**

With the foregoing findings and conclusions of the study, the following recommendations are hereby presented:

1. More research on mangrove ecosystems may be undertaken in the future to understand the value of mangroves, particularly to fisheries resources.
2. More awareness of the importance of mangrove ecosystem.
3. Local Government Unit (LGU) may collaborate with other agencies that are expert on mangrove conservation and protection to achieve a diverse mangrove ecosystem by planting different species of mangroves.
4. Regular monitoring of the growth and survival of mangroves and strict implementation of laws on marine resources conservation shall also be prioritized.
5. For future researchers, it is advisable to assess all mangrove areas rather than relying on just a few replicates to obtain a comprehensive picture of the area.

## **Compliance with Ethical Standards**

The study prioritized transparency by ensuring that all participants, administrators, clients, and workers were thoroughly informed about the research's purpose and nature. Participant confidentiality and data privacy were carefully protected through secure data handling procedures designed to prevent unauthorized access. The researchers followed ethical standards throughout data collection and analysis, actively avoiding biases and ensuring the accuracy of the reported results. These practices reflect a strong commitment to ethical principles, fostering trustworthiness and integrity in both the study process and the application of its findings.

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