



Tree Species Composition and Spatial Distribution in a Primary Lowland Forest of Sitio Inadan, San Miguel, Surigao del Sur, Philippines

Jade Kristelle E. Tagok , John Vincent M. Mission , Janel P. Anito ,
Jhon Dave S. Amoguis , Clinton D. Sequihod 

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Keywords: Lowland dipterocarp forest, Species composition, Shade-tolerant species, Pioneer species, Spatial distribution.

Abstract: This study assessed tree species composition and spatial distribution patterns within a 0.32-ha lowland dipterocarp forest in the Philippines. Eight 20 m × 20 m plots were established to document tree species meeting the minimum diameter criterion. Species richness, relative abundance, and selected structural attributes were calculated, and a chi-square test was applied to assess plot-level distribution patterns. A total of 14 tree species were recorded, including dipterocarps and other canopy-associated taxa, as well as shade-tolerant understory species and several light-demanding pioneer species. The presence of shade-tolerant families such as Fagaceae and Lauraceae indicates ongoing recruitment under closed-canopy conditions, while the occurrence of pioneer species suggests localized canopy openings within the sampled area. Distribution analysis showed that some species exhibited aggregated patterns, whereas others did not significantly deviate from random distribution. This indicates that certain species tend to cluster in areas with favorable environmental conditions or resources, while others are more evenly dispersed across the habitat. Given the limited sampling extent and number of plots, the findings are interpreted only at the scale of the study area and do not imply broader forest-level structural conditions. Although species richness was lower than typically reported for larger lowland dipterocarp forest inventories in the Philippines, the results provide preliminary insights into local stand composition and small-scale spatial structure.

Introduction

Trees in untouched ecosystems are critical for global biodiversity, climate regulation, and ecological resilience. Nature found that primary forests (untouched by human activity) store 30% more carbon than secondary forests, making them vital for mitigating climate change (1). Tree diversity of trees are important for ways of conserving trees and to understand the state and health of the forest (2). It plays a critical role for people and the planet (3).

In the Philippines, not all trees have been documented. The composition and diversity of tree information in the planning and implementation of biodiversity conservation efforts is important (4). There is an estimated 73,000 reported species of trees and still 9,000 trees that are just to be discovered (5). Different species flora lives in various primary forests but decline due to human activities, climate change, and alien species that aided to biodiversity loss (6). Study conducted by

Sarmiento *et al.*, (2) in Carrascal within the nickel mining resulted that there are native, endemic, and endangered varieties of tree species; however, despite these national and regional findings, there is a total absence of documented tree information in San Miguel, Surigao Del Sur specifically in Inadan.

The present study was undertaken in Sitio Inadan, Barangay Magroyong, Municipality of San Miguel, Surigao del Sur. Situated approximately 15 to 20 minute-drive from the municipal center of San Miguel, Surigao del Sur, Sitio Inadan is distinguished by its primary forest characteristics, rich biodiversity, and extensive agricultural land use. The economic and ecological importance of this area is intrinsically linked to its agricultural activities, thereby necessitating a comprehensive analysis of its dynamics and potential to inform sustainable development strategies.

Given the continuous expansion of these agricultural activities and the threat of biodiversity loss, there is an

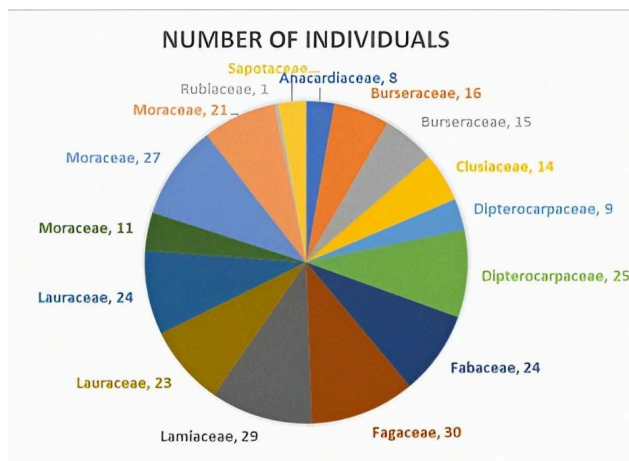


Figure 1. The number of individual trees found in Inadan, San Miguel, Surigao del Sur.

immediate and critical urgency to conduct this baseline study. To enhance the understanding and management of this valuable ecosystem, there is a critical imperative to determine the composition and distribution of tree species within the sitio before irreversible changes occur. This research endeavor will furnish essential data for conservation initiatives, sustainable land-use planning, and the preservation of Inadan's natural heritage.

Specifically, the study aimed to: 1) Determine the tree species composition in the study area; 2) Assess the conservation status of the recorded tree species; and 3) Describe the spatial distribution patterns of trees within the sampled plots.

Material and Methods

Materials

The materials used in this study included a 20-meter rope for establishing sampling plots and measuring distances within the study area. A measuring tape was used to measure the Diameter at Breast Height (DBH) of selected trees. Pruning shears were utilized to collect branch and leaf, flowers, and fruit samples from identified trees.

Collected specimens were placed in plastic bags for temporary storage and transport. Denatured alcohol was used to preserve the plant specimens and prevent decomposition. The preserved samples were wrapped in clean, used newspapers to absorb excess moisture and protect them during drying. Tags were attached to each specimen to indicate the local name of the tree, date of collection, and other necessary information.

Field notes were recorded to document measurements and observations during data collection.

In Vivo Test

Data collection was conducted *in vivo*, with all trees observed and measured directly in their natural habitat to ensure accurate recording of species identity, Diameter at Breast Height (DBH), health condition, and ecological interactions. Sample administration was carefully organized by establishing 20 m × 20 m fixed-area plots at 20-meter intervals, assigning identification numbers to each plot, and systematically recording all trees with DBH ≥ 10 inches. Field teams collected and labeled voucher

specimens for taxonomic verification, pressed and preserved samples in denatured alcohol, and maintained detailed field notes for each plot. GPS coordinates were recorded to map species distribution, and photo documentation captured key morphological features. This approach ensured reliable management of samples and data while minimizing disturbance to the living trees and their environment.

In addition, the conservation status of each identified species was verified using the International Union for Conservation of Nature (IUCN) Red List (7) and the Philippine national assessment under the Department of Environment and Natural Resources–Biodiversity Management Bureau's list of threatened species (CDF). This ensured that both global and national conservation classifications were considered in evaluating the ecological significance of the recorded tree species.

Sample Administration

Vegetative and reproductive parts of the trees were carefully collected using pruning shears to avoid excessive damage to the plant. The collected samples were pressed between sheets of newspaper and tied with plastic twine to ensure they remained flat and organized during transport. To prevent decay and preserve the specimens for further analysis, they were stored in polyethylene bags containing denatured alcohol. Each specimen was labeled with a unique collection number and the local name of the tree for proper identification. Detailed information about each sample, including its location, physical characteristics, and any notable observations, was recorded systematically in field notes to maintain accurate and organized documentation of the collected data.

Results and Discussion

A total of 16 tree species belonging to 11 families were documented in Inadan, San Miguel. The most represented families were Moraceae (3 species), Lauraceae (2), Burseraceae (2), and Dipterocarpaceae (2), while the remaining families were represented by a single species. The presence of ecologically important genera such as *Shorea*, *Canarium*, and *Pterocarpus* indicates that the area retains the structural characteristics of a lowland dipterocarp forest (**Figure 1**).

Although the forest remains relatively undisturbed, the observed species richness is moderate. This is primarily due to the ≥ 10 cm DBH inclusion criterion, which excluded saplings and juvenile individuals that contribute to total diversity.

Methodological and ecological factors further influenced the recorded richness. The limited plot size and DBH threshold may have underestimated total species counts, particularly understory and regenerating taxa. In addition, the relative isolation of the study site from larger forest complexes such as Mount Hamiguitan and Mount Apo may restrict species dispersal and colonization.

Despite these constraints, the coexistence of Dipterocarpaceae and Lauraceae species reflects ecological stability and minimal anthropogenic disturbance within the forest ecosystem.

Conservation assessment based on the International Union for Conservation of Nature (IUCN) Red List and Co's Digital Flora (CDF) showed that most species are

categorized as Least Concern (**Table 1**). However, *Litsea urdanetensis* is classified as Vulnerable, and *Pterocarpus indicus* is listed as Endangered, highlighting the conservation importance of the site. Several taxa remain Not Assessed, indicating the need for further evaluation and monitoring.

Spatial analysis across eight 20 m × 20 m plots revealed both random and aggregated distribution patterns (**Table 2**). Aggregated distributions observed in some species suggest localized clustering influenced by

microhabitat conditions, resource availability, and dispersal mechanisms, whereas randomly distributed species indicate relatively uniform environmental conditions. These patterns collectively reflect habitat heterogeneity and contribute to the overall forest structure of the study area.

Conclusion

This study successfully characterized the tree species composition of the forest in Sitio Inadan, San Miguel,

Table 1. Results of Conservation Status of tree species in Inadan, San Miguel, Surigao Del Sur.

Family	Species Name	IUCN	CDF
Anacardiaceae.	<i>Buchanania sp.</i>	Not assessed	Not assessed
Burseraceae	<i>Canarium asperum</i> Benth.	Least Concerned	Least Concerned
Burseraceae	<i>Canarium euryphyllum</i> Perkins	Least Concerned	Least Concerned
Rubiaceae.	<i>Urophyllum sp.</i>	Not assessed	Not assessed
Moraceae	<i>Artocarpus sp.</i>	Not assessed	Not assessed
Dipterocarpaceae	<i>Shorea negrosensis</i> Foxw.	Least Concerned	Least Concerned
Dipterocarpaceae	<i>Shorea assamica</i> Dyer,	Least Concerned	Least Concerned
Fagaceae	<i>Lithocarpus sp.</i>	Not assessed	Not assessed
Lauraceae	<i>Litsea urdanetensis</i> Elmer	Vulnerable	Vulnerable
Lauraceae.	<i>Litsea sp.</i>	Not assessed	Not assessed
Clusiaceae.	<i>Garcinia sp.</i>	Not assessed	Not assessed
Lamiaceae	<i>Teijsmanniodendron pteropodum</i> (Miq.) Bakh.	Least Concerned	Least Concerned
Moraceae	<i>Ficus altissima</i> Blume.	Least Concerned	Least Concerned
Fabaceae.	<i>Pterocarpus indicus</i> Willd.	Endangered	Endangered
Sapotaceae	<i>Palaquium sp.</i>	Not assessed	Not assessed
Moraceae	<i>Ficus caulocarpa</i> (Miq.)	Least Concerned	Least Concerned

Table 2. Distribution pattern of tree species in Sitio Inadan.

Species	Variance	Mean	Chi-sq	d. f	Probability	Aggregation
<i>Artocarpus sp.</i>	3.9821	1.375	20.2727	7	0.0051477	Aggregated
<i>Buchanania sp.</i>	1.4286	1	10	7	0.1876098	Random
<i>Canarium asperum</i> Benth.	4.2857	2	15	7	70.0358132	Random
<i>Canarium euryphyllum</i> Perkins	3.4286	3.4286	2	7	70.09978	Random
<i>Urophyllum sp.</i>	0.125	0.125	7	7	0.4292931	Random
<i>Shorea negrosensis</i> Foxw.	4.125	1.125	7	7	0.0006404	Aggregated
<i>Shorea assamica</i> Dyer	6.125	3.125	13.72	7	0.0559718	Random
<i>Lithocarpus sp.</i>	8.5	3.75	15.8667	7	0.0262969	Random
<i>Litsea urdanetensis</i> Elmer	2.9821	2.875	7.26097	7	0.4024365	Random
<i>Litsea sp.</i>	7.7143	3	18	7	0.0120707	Aggregated
<i>Garcinia sp.</i>	2.5	1.75	10	7	0.1876098	Random
<i>Teijsmanniodendron pteropodum</i> (Miq.) Bakh.	3.15	9.9821	19.27	7	0.0800162	Aggregated
<i>Ficus altissima</i> Blume	6.7857	3.75	12.6667	7	0.1876098	Random
<i>Pterocarpus indicus</i> Willd.	4.2857	3	10	7	0.342247	Random
<i>Palaquium sp.</i>	1.2679	1.125	7.8889	7	5.31E-05	Random
<i>Ficus caulocarpa</i> (Miq.)	11.9821	2.625	31.9524	7	70.0074993	Aggregated

documenting 285 individuals representing 16 species, 11 families, and 12 genera within a 3,200 m² area. The dominance of native families such as Dipterocarpaceae, Lauraceae, Moraceae, and Fagaceae confirms that the site retains the structural attributes of a relatively undisturbed lowland forest and maintains good ecological integrity.

Conservation assessment using the International Union for Conservation of Nature (IUCN) and Co's Digital Flora (CDF) showed that most species are categorized as Least Concern, while one species is Vulnerable and one is Endangered, highlighting the presence of conservation-significant taxa.

The observed random and aggregated distribution patterns indicate active natural regeneration and ecological stability. Although the forest remains resilient, the presence of threatened and low-abundance species underscores the need for continued monitoring and proactive conservation strategies to safeguard biodiversity amid increasing external pressures.

Abbreviations

IUCN = International Union for Conservation of Nature;
CDF = Co's Digital Flora.

Declaration

Author Information

Jade Kristelle E. Tagok

*Corresponding author

San Miguel National Comprehensive High School, San Miguel - 3023, Philippines.

Contribution: Conceptualization, Data Curation, Formal analysis, Writing – Original Draft, Writing – Review & Editing, Methodology.

John Vincent M. Mission

*Corresponding author

San Miguel National Comprehensive High School, San Miguel - 3023, Philippines.

Contribution: Conceptualization, Formal analysis, Writing – Original Draft, Writing – Review & Editing.

Janel P. Anito

*Corresponding author

San Miguel National Comprehensive High School, San Miguel - 3023, Philippines.

Contribution: Conceptualization, Formal analysis, Writing – Original Draft, Writing – Review & Editing.

Jhon Dave S. Amoguis

*Corresponding author

San Miguel National Comprehensive High School, San Miguel - 3023, Philippines.

Contribution: Conceptualization, Writing – Original Draft, Writing – Review & Editing.

Clinton D. Sequihod

*Corresponding author

Staff of San Miguel National Comprehensive High School, San Miguel - 3023, Philippines.

Contribution: Conceptualization, Formal analysis, Visualization, Supervision, Formal Analysis.

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Conflict of Interest

The authors declare no conflicting interest.

Data Availability

All data generated or analyzed during this study are included in this published article.

Ethics Statement

Ethical approval was not required for this study.

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