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Floristic Inventory, Composition, and Distribution of Angiosperms in Lianga, Surigao Del Sur, Caraga Region, Mindanao Island, Philippines

Jeffry M. Saro[1*], April Joy B. Alamban[2], Ashley Cris G. Bonite[3], Janel Layo[4]

[1-4]Prosperidad National High School, Prosperidad District, Division of Agusan del Sur, DepEd, Philippines
Corresponding Author's Email: jeffrysaro123@gmail.com

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ABSTRACT

Angiosperms are vital for ecosystem services such as carbon storage, soil stabilization, and biodiversity maintenance. This study conducted a floristic inventory in Lianga, Surigao del Sur, to document local angiosperm diversity and support conservation planning. Using 20 m × 20 m quadrats replicated along 50–100 m transects, species were identified, counted, and photographed, with verification through scientific tools and expert consultation. Conservation status was assessed using the IUCN Red List. A total of 19 species from 11 families were recorded. The Shannon-Weiner Diversity Index (H' = 2.241) reflected low diversity and uneven species distribution, indicating ecological vulnerability. This highlights the urgency of conservation actions to protect rare and less abundant species. The study provides baseline data for future research and conservation initiatives. Key recommendations include habitat restoration, promotion of native species, community involvement, and regular biodiversity monitoring to ensure long-term ecological stability.

INTRODUCTION

The floristic diversity of angiosperms (flowering plants) played a crucial role in ecosystem services such as carbon sequestration, soil stabilization, and biodiversity conservation (Singh, 2020). These plants' composition, distribution, and ecological roles were vital for sustaining natural resources and mitigating the effects of climate change (Smith et al., 2021; Saro et al., 2022). In the Philippines, one of the world's biodiversity hotspots, the rapid loss of forests and urbanization have resulted in a critical need for detailed studies on the floristic diversity of various regions (Flores-Argüelles et al., 2022). Despite this, there remained a gap in comprehensive floristic inventories in remote and less-explored areas and local sites, which could provide valuable insights and inputs into the province's ecological and environmental health and the development of conservation strategies (Marquez & Santos, 2022). Recent studies emphasized the importance of floristic inventories in preserving biodiversity and supporting sustainable development goals (Fernando et al., 2023; Gomes-da-Silva & Forzza, 2021). Accordingly, recent research on angiosperms provided valuable data on plant species richness, ecological relationships, and the impacts of environmental changes on plant communities (De Guzman & Mendoza, 2023). However, such studies were often concentrated in more developed or accessible regions, with limited research conducted in the

remote parts of Mindanao, where areas like Lianga remained understudied. More so, such as those undertaken in nearby provinces like Agusan del Sur (Dela Cruz, 2021; Lleno et al., 2023), indicated that floristic diversity was yet to be fully documented, particularly in the context of local ecological and anthropogenic factors that affected plant distribution.

Despite ongoing efforts, several significant gaps remained in floristic research on the diversity and distribution of angiosperms at the national, regional, and local levels. However, most studies focused on tropical rainforests or protected areas, neglecting more miniature, more accessible landscapes (Casanelles-Abella et al., 2021; Lee & Anderson, 2022). The Philippines had an established tradition of floristic studies, yet municipalities such as Lianga in Surigao del Sur had been largely overlooked. There were few local studies within Surigao del Sur, and those available often lacked detailed species inventories or failed to analyze distribution patterns in response to environmental changes, making the available data insufficient for effective conservation planning (Panda et al., 2020; Santos et al., 2023).

This study investigated the floristic inventory of angiosperms in Lianga, Surigao del Sur, focusing on identifying the species present, their composition, and their distribution patterns. The main objective was to comprehensively document the municipality's plant diversity and contribute valuable data to support local conservation initiatives. In doing so, a thorough record of the area's plant species was compiled. The study sought to inform biodiversity management strategies, enhance understanding of ecological relationships, and assist in developing sustainable land-use practices or a community-based conservation plan. Additionally, it aimed to support efforts to protect endangered species and promote effective conservation policies in Surigao del Sur.

MATERIALS AND METHODS

Study Area

The study was conducted in Surigao del Sur, Philippines, focusing on Esta Juana Beach Resort, Lawis, Lianga, in November 2024. The study sampling site was selected because there was no further research or literature on the angiosperm species in a coastal area such as Lawis. By this, the study site was located at the following coordinates: 8.637831° N, 126.63832° E. Additionally, this study aligns with Republic Act 9147, the Wildlife Resources Conservation and Protection Act, which primarily mandates conserving and protecting wildlife resources and their habitats. All necessary protocols and ethical considerations were followed, such as non-destructive ways of identifying the species.

Sampling Design

The study employed a 20 m x 20 m quadrat (by transect) as the standard sampling measurement to assess angiosperm diversity. Each quadrat was replicated at least five times along a 50—to 100-meter transect. These replicates ensure sufficient data coverage and improve the reliability of the results by capturing variations in species composition and abundance across the study area (Krebs, 2014). The angiosperm species were identified, counted, and photographed following standard scientific protocols. Online identification tools and expert verification were used to accurately determine species composition and distribution. The IUCN Red List of Threatened Species (2021) was consulted to assess conservation status. Thus, combining these methods enabled a comprehensive understanding of the angiosperm diversity in the study area.

Data Analysis

Using Microsoft Excel 2019 to analyze the data from the single sampling site to analyze the single sampling site data, descriptive statistics and visual graphs were generated. The mean was calculated as a measure of central tendency. To assess species diversity, the Shannon-Weiner diversity index and values were calculated, following the guidelines of Fernando (1998). The table below provides the corresponding values.

Table 1

Classification of Diversity Values (Fernando, 1998)

H' Values	Relative Values
>3.50	Very High
3.00 – 3.49	High
2.50 – 2.99	Moderate

2.00 – 2.49	Low
<1.99	Very Low

RESULTS AND DISCUSSION

Nineteen angiosperm species belonging to 11 families were identified in Lianga, Surigao del Sur. Families such as Acanthaceae, Apocynaceae, Cleomaceae, Lythraceae, Verbenaceae, and Orchidaceae were represented by single species. In contrast, Amaranthaceae, Asteraceae, Malvaceae, Rubiaceae, and Oleaceae had multiple species. *Sida acuta* was the most abundant species with 80 individuals, while *Alternanthera ficoidea, Catharanthus roseus, Jasminum sambac, and Spermacoce latifolia* were the least abundant with only one individual each. Seven species were considered least concerned, including *C. roseus, V. cinerea, S. trilobata, U. lobata, J. officinale, J. sambac, and S. jamaicensis*. However, Shannon's diversity index indicated low biodiversity among the angiosperm species in the study area.

Species Composition

The Lianga, Surigao del Sur study revealed diverse angiosperm species with unique characteristics and potential medicinal properties. Nineteen species belonging to 11 families were identified, highlighting the area's rich biodiversity. Many of the identified species possess significant medicinal value. For instance, *Catharanthus roseus*, commonly known as Madagascar Periwinkle, is renowned for its anticancer properties (Vinayagam et al., 2021). Additionally, species like *Alternanthera ficoide*s, *Achyranthes aspera*, and *Cleome rutidosperma* have been traditionally used to treat various ailments, including skin infections, wounds, and inflammatory conditions (Kumar et al., 2023). On the other hand, *Hibiscus rosa-sinensis* and *Jasminum* species are known for their anti-inflammatory and analgesic properties (Sharma et al., 2022).

However, it is crucial to note that the conservation status of many of these species remains uncertain. While some, such as *Catharanthus roseus* and *Sphagneticola trilobata*, are categorized as Least Concern, others have not yet been assessed by the IUCN Red List (IUCN, 2021). This emphasizes the need for further research and conservation efforts to protect these valuable plant resources. As the demand for natural remedies grows, sustaining and utilizing these plants is imperative. Thus, it could ensure the preservation of these beneficial species for future generations (Table 2).

Table 2

Species Composition, Conservation, Distribution, and Medicinal Properties of Angiosperms

Family	Species	Common Name	IUCN Red List	Distribution Status	Medicinal Properties
Acanthaceae	*Thunbergia arnhemica*	Black-eyed Susan Vine	NE	N	Limited information on specific medicinal uses for this species.
Amaranthaceae	*Alternanthera ficoidea*	Joyweed	NE	N	Used to treat skin infections, wounds, ulcers, kidney stones, and urinary tract infections.
Amaranthaceae	*Achyranthes aspera*	Prickly Chaff Flower	NE	N	Used to treat fever, cough, and inflammation.
Apocynaceae	*Catharanthus roseus*	Rosas de Madagascar	LC	N	Contains alkaloids with anticancer properties and is used to treat hypertension and diabetes.
Asteraceae	*Vernonia cinerea*	Purple Fleabane	LC	N	Used in traditional medicine to treat malaria and other parasitic infections.
Asteraceae	*Synedrella nodiflora*	Tuhod-manok	NE	N	Has anti-inflammatory and analgesic properties.
Asteraceae (Compositae)	*Sphagneticola trilobata*	Wedelia	LC	I	Used in traditional medicine to treat fever and cough.
Cleomaceae	*Cleome rutidosperma*	Spider Flower	NE	N	Used in traditional medicine to treat various ailments, including fever, cough, and skin infections.
Lythraceae	*Cuphea hyssopifolia*	Mexican Heather	NE	N	Limited information on specific medicinal uses for this species.
Malvaceae	*Urena lobata*	Caesar's Weed	LC	N	Used in traditional medicine to treat skin infections and wounds.

Malvaceae	*Hibiscus rosa-sinensis*	Gumamela	NE	N	It has anti-inflammatory and analgesic properties. Traditional medicine also uses it to treat menstrual cramps and other gynecological issues.
Malvaceae	*Sida acuta*	Lady's Finger	NE	N	Has diuretic and laxative properties.
Oleaceae	*Jasminum officinale*	White Jasmine	LC	N	Used to treat anxiety, depression, and insomnia.
Oleaceae	*Jasminum sambac*	Sampaguita	LC	N	Used to treat anxiety, depression, and insomnia.
Orchidaceae	*Epidendrum radicans*	Orchid	NE	N	Some orchid species have been used in traditional medicine to treat various ailments, including coughs, fever, and inflammation.
Rubiaceae	*Ixora finlaysoniana*	Santan	NE	N	Has anti-inflammatory and analgesic properties.
Rubiaceae	*Ixora coccinea*	Santan	NE	N	Has anti-inflammatory and analgesic properties.
Rubiaceae	*Spermacoce latifolia*	Buttonweed	NE	N	Used in traditional medicine to treat skin infections, wounds, and ulcers.
Verbenaceae	*Stachytarpheta jamaicensis*	Blue Porterweed	LC	I	Used in traditional medicine to treat fever, cough, and inflammation.

Note: LC – Least Concern; NE – Not Evaluated (Not Yet Assessed); N – Native; I – Introduced

Table 3 presents the count of Angiosperms and reveals a diverse assemblage of angiosperm species, highlighting their ecological significance. The dominance of *Sida acuta* emphasizes its adaptability and potential environmental role within the ecosystem (Kumar et al., 2023; Lleno et al., 2023). However, rare species like *Alternanthera ficoidea* and *Catharanthus roseus* emphasize the need for conservation efforts to safeguard biodiversity. Further research must focus more deeply on these plant species' ethnobotanical significance. Understanding their traditional uses and medicinal properties can provide valuable insights and viewpoints into these plants' cultural heritage and potential applications (Vinayagam et al., 2021; Saro et al., 2022). In so doing, by documenting and preserving traditional knowledge, it can be assured to have a sustainable use of these resources. Additionally, exploring the ecological roles of these species, such as their interactions with pollinators and seed dispersers, is crucial for effective conservation strategies. The data highlights the composition and abundance of plant species across various families in a specific area. The Malvaceae family exhibits the highest species abundance, particularly with *Sida acuta* having 80 individuals, indicating its dominance in the area. In contrast, families such as Amaranthaceae, Apocynaceae, and Rubiaceae include species like *Achyranthes aspera, Catharanthus roseus, and Spermacoce latifolia*, respectively, each represented by only 1–3 individuals. Nonetheless, the data also reflect diversity in species richness, with some families (e.g., Asteraceae) contributing multiple species *(Vernonia cinerea, Synedrella nodiflora, Sphagneticola trilobata)* that vary significantly in individual counts. These observations are crucial for assessing ecological balance, species interactions, and conservation needs in the studied environment.

Table 3

Count of Angiosperms in Lianga, Surigao del Sur

Family	Species	Individuals
Acanthaceae	*Thunbergia arnhemica*	32
Amaranthaceae	*Alternanthera ficoidea*	1
Amaranthaceae	*Achyranthes aspera*	3
Apocynaceae	*Catharanthus roseus*	1
Asteraceae	*Vernonia cinerea*	17
Asteraceae	*Synedrella nodiflora*	32
Asteraceae	*Sphagneticola trilobata*	6
Cleomaceae	*Cleome rutidosperma*	47
Lythraceae	*Cuphea hyssopifolia*	28
Malvaceae	*Urena lobata*	2
Malvaceae	*Hibiscus rosa-sinensis*	2
Malvaceae	*Sida acuta*	80
Oleaceae	*Jasminum officinale*	17
Oleaceae	*Jasminum sambac*	1
Orchidaceae	*Epidendrum radicans*	2

Rubiaceae	*Ixora finlaysoniana*	2
Rubiaceae	*Ixora coccinea*	14
Rubiaceae	*Spermacoce latifolia*	1
Verbenaceae	*Stachytarpheta jamaicensis*	5

The Shannon-Wiener Diversity Index (H') for the angiosperms in Lianga, Surigao del Sur, indicates a low diversity level with an overall score of 2.241, based on the classification by Fernando (1998). This value reflects an ecosystem where species richness and evenness are imbalanced, mainly due to the dominance of particular species like *Sida acuta* (Malvaceae) and *Cleome rutidosperma* (Cleomaceae), which are present in high abundances. Moreover, the low abundance of species such as *Alternanthera ficoidea* (Amaranthaceae) and *Catharanthus roseus* (Apocynaceae) reduces overall evenness. Such low diversity suggests that while the area may support particular dominant species, it might lack the ecological balance typically found in highly biodiverse systems (Abreu et al., 2020; Saro et al., 2024).

Among the families observed, Malvaceae emerged as a dominant family, primarily due to the high individual count of *Sida acuta* (80 individuals). This dominance skews the overall diversity and reflects possible ecological adaptations or a competitive advantage in the local environment. The significant presence of *Sida acuta* might also indicate a disturbed or semi-natural habitat, where hardy and fast-growing species tend to thrive. Understanding such patterns is essential for conservation efforts and maintaining biodiversity (Zhou et al., 2021). The data highlights several species with very low individual counts, such as *Catharanthus roseus* (Apocynaceae) and *Spermacoce latifolia* (Rubiaceae), each represented by only one individual. These rare species are critical in maintaining genetic diversity and ecological interactions, but are more vulnerable to extinction. Their presence emphasizes the need for targeted conservation measures, particularly in habitats under anthropogenic pressure (Jalilova et al., 2019).

The species evenness observed through the Shannon-Wiener Index reveals an uneven distribution of individuals across species, with dominance by a few species (*Sida acuta* and *Cleome rutidosperma*). This unevenness lowers the diversity index, emphasizing the importance of preserving less abundant species to enhance ecological balance. Maintaining species evenness is crucial for promoting resilience against environmental changes and supporting ecosystem functions (Pachauri & Pandey, 2022). Conservation strategies should focus on protecting low-abundance species and ensuring sustainable management of dominant species. Encouraging native plant growth and minimizing habitat disturbances can bolster ecosystem health and maintain long-term biodiversity (Moreno et al., 2023).

Table 4

Shannon-Wiener Diversity Index of Angiosperms in Lianga, Surigao del Sur

Family	Species	Ind (p)	p_i	ln (p_i)	p_i ln (p_i)	- p_i ln (p_i)
Acanthaceae	*Thunbergia arnhemica*	32	0.109215	-2.214437	-0.241850	0.241850
Amaranthaceae	*Alternanthera ficoidea*	1	0.003413	-5.680173	-0.019386	0.019386
Amaranthaceae	*Achyranthes aspera*	3	0.010239	-4.581560	-0.046910	0.046910
Apocynaceae	*Catharanthus roseus*	1	0.003413	-5.680173	-0.019386	0.019386
Asteraceae	*Vernonia cinerea*	17	0.058020	-2.846959	-0.165182	0.165182
Asteraceae	*Synedrella nodiflora*	32	0.109215	-2.214437	-0.241850	0.241850
Asteraceae	*Sphagneticola trilobata*	6	0.020478	-3.888413	-0.079626	0.079626
Cleomaceae	*Cleome rutidosperma*	47	0.160410	-1.830025	-0.293553	0.293553
Lythraceae	*Cuphea hyssopifolia*	28	0.095563	2.347968	-0.224379	0.224379
Malvaceae	*Urena lobata*	2	0.006826	-4.987025	-0.034041	0.034041
Malvaceae	*Hibiscus rosa-sinensis*	2	0.006826	-4.987025	-0.034041	0.034041

Malvaceae	*Sida acuta*	80	0.273038	-1.298146	-0.354443	0.354443
Oleaceae	*Jasminum officinale*	17	0.058020	-2.846959	-0.165182	0.165182
Oleaceae	*Jasminum sambac*	1	0.003413	-5.680173	-0.019386	0.019386
Orchidaceae	*Epidendrum radicans*	2	0.006826	-4.987025	-0.034041	0.034041
Rubiaceae	*Ixora finlaysoniana*	2	0.006826	-4.987025	-0.034041	0.034041
Rubiaceae	*Ixora coccinea*	14	0.047782	-3.041115	-0.145309	0.145309
Rubiaceae	*Spermacoce latifolia*	1	0.003413	-5.680173	-0.019386	0.019386
Verbenaceae	*Stachytarpheta jamaicensis*	5	0.017065	-4.070735	-0.069466	0.069466
TOTAL		**293**			**2.241458**	**2.241458**

Note: >3.50 Very High; 3.00 – 3.49 High; 2.50 – 2.99 Moderate; 2.00 – 2.49 Low; < 1.99 Very Low (Fernando, 1998)

The graph illustrates the distribution of angiosperm species in Lianga, Surigao del Sur, Philippines, emphasizing significant variations in species counts among families (Figure 2). The Malvaceae family, represented by *Sida acuta* with 80 individuals, dominates the dataset, showcasing its ecological prevalence in the area. This dominance suggests that the local environment may favor the growth and proliferation of this family due to factors like adaptability, resilience to disturbances, or favorable climatic conditions (Zhou et al., 2021). Several species from families such as Amaranthaceae *(Alternanthera ficoidea, Achyranthes aspera)* and *Apocynaceae (Catharanthus roseus)* are represented by only a few individuals, highlighting their rarity. This disparity between dominant and rare species points to uneven distribution, which can lower overall biodiversity and affect ecological interactions (Pachauri & Pandey, 2022). The data also reveals families like Asteraceae and Rubiaceae, which contribute multiple species, albeit with varied individual counts. *Synedrella nodiflora* (Asteraceae) has a substantial population, while *Ixora coccinea* (Rubiaceae) exhibits moderate abundance. Such variability indicates diverse ecological niches and adaptability among these families, reflecting their environmental roles and interactions within the habitat (Moreno et al., 2023). The graph highlights the critical need for conservation efforts, particularly for low-abundance species, to ensure ecological balance and sustain biodiversity. Addressing habitat degradation and promoting the growth of native species will be essential in maintaining a stable ecosystem (Jalilova et al., 2019).

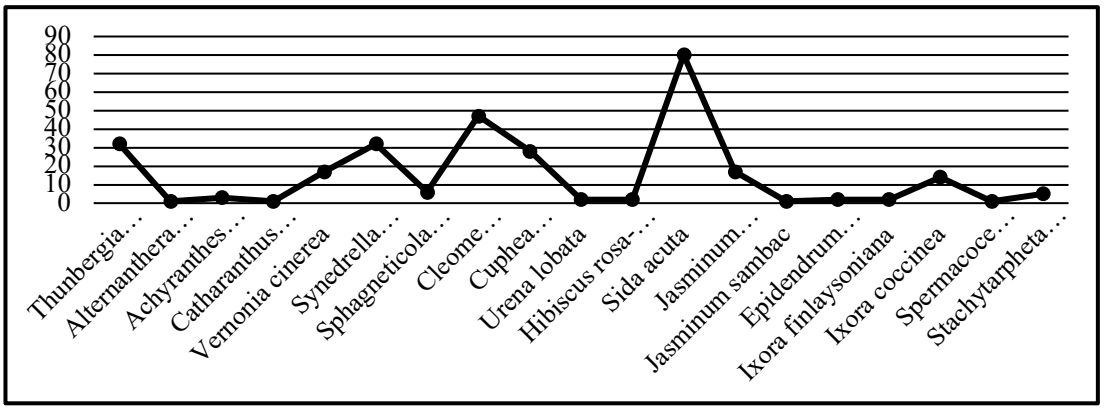

Figure 1. *Overall Graph of Angiosperm Species Counts in Lianga, Surigao del Sur, Philippines*

Conclusion and Recommendations

The assessment of angiosperm diversity in Lianga, Surigao del Sur, showed a low level of biodiversity, with particular species dominating the area while others were underrepresented. This uneven distribution indicated the need for conservation efforts to protect less abundant and rare species, ensuring a more balanced ecosystem. Implementing habitat restoration projects, promoting the growth of native species, and engaging the local community in biodiversity conservation initiatives were recommended. Regular monitoring and education campaigns were also suggested to help maintain ecological balance and support long-term sustainability in the region.

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Conflict of Interest
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