ASEAN Journal of
Agriculture and Food Engineering

Journal homepage: https://ejournal.bumipublikasinusantara.id/index.php/ajafe

Identification of Herb and Shrub Species in Kalikasan Park, Albay, Philippines

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ABSTRACT

This study aimed to identify the herb and shrub species in the forest ecosystem of Kalikasan Park, Albay, Philippines. A fifty-meter transect line was established in the three sampling sites, with large 25-square-meter plots surveyed for species. A total of 20 species from 11 families were recorded, consisting of 14 herb species from nine (9) families and six (6) shrub species from four (4) families. Results indicated low diversity and medium species richness in the herb species, while the shrub species exhibited moderate diversity and richness, with species dominance suggesting ecological imbalance. Notably, seven (7) species were classified as "Least Concern" (LC), while half of the species sampled had "Unavailable Data" (UD), and some were categorized as "Widespread" (W). Interestingly, the sampled herb and shrub species possessed significant medicinal properties, including anti-inflammatory, antibacterial, and antioxidant applications. It is recommended to implement conservation strategies, conduct continuous species monitoring, and establish reforestation programs. Furthermore, promoting sustainable use of medicinal plants through community engagement and raising public awareness of biodiversity helps ensure long-term ecosystem conservation.

ARTICLE INFO

Article History:
Submitted/Received 26 Nov 2024
First Revised 29 Dec 2024
Accepted 08 Feb 2025
First Available online 09 Feb 2025
Publication Date 01 Mar 2025

Keyword:
Herbs,
Identification,
Kalikasan park,
Philippines,
Shrubs,
Species.

1. INTRODUCTION

Plants are essential because they provide nutrients, produce beneficial products, and support various industries. Their contributions to health, agriculture, and environmental sustainability highlight the vast value of plants in everyday life. However, the high deforestation rate of natural forests on the planet and of pristine ecosystems have significantly altered, resulting in degradation and fragmentation, threatening the survival of both fauna and flora species in several countries (Haddad *et al*., 2015). As ecosystems continue to face these challenges, the importance of conservation efforts to protect biodiversity becomes more urgent. Therefore, sustainable management practices, with restoration initiatives, are critical for mitigating the impacts of deforestation and preserving plant species for future generations.

Additionally, Götmark *et al.* (2016) described herbaceous species as plants with no persistent woody stem above ground. They can be annual, biennials, or perennials. Some relatively fast-growing herbaceous plants are pioneers or early-successional plant species. Others form the primary vegetation of many stable habitats, occurring in the ground layer of forests or naturally open habitats such as meadows, salt marshes, or deserts (Smith, 2011). Further, herbs are well known for being used in the medical field, but they are also used as food and flavoring or in making fragrances due to their savory or aromatic properties. Shrubs, on the other hand, are small to medium-sized woody plants that are less than 8 meters (26 ft.) high and usually have many stems arising at or near the base. Depending on the growing conditions, plants of many species may grow either into shrubs or into trees. Shrub land is a plant community characterized by vegetation dominated by shrubs that may either occur naturally or be a result of human activity. Lastly, shrubland species show a wide range of adaptations to fire (Osbome *et al*., 2018; Knuckey *et al*., 2016; He & Lamont, 2018; Adeney *et al*., 2016).

In addition, the sudden increase of research on environmental-related subjects highlights the rapid changes in the ecosystem vegetation in general. Essential factors influence the future plant species including the severity and rate of changes in the environment. These changes have serious consequences on the ability of plants, especially those with less genetic diversity and narrow ecological amplitude, to adjust to changing conditions (Davis & Zabinski, 1992). A recent study shows that there is a fast-growing trend in ecological research to investigate the relationships between abiotic and biotic components of an ecosystem (Khan *et al*. 2016; Yuan et al., 2018; Ammer *et al*., 2018; Kurm *et al*., 2017; Lau & Lennon, 2011). Several plant species may adapt to changing conditions or due to the environmental pressures driven by different factors, such as the changing morphological attributes of plants in terms of growth, development, and life cycles. These changes result in variations in the formation of plant communities, and these ease the way for some invasive species (Tavili & Jafari, 2009).

In the current study, Kalikasan Park is located near the boundary of Legazpi and Daraga Albay, Philippines. The area is situated at the back of the main campus of Bicol University. This man-made forest reserve of the Department of Environment and Natural Resources Bicol has an approximate area of 10 hectares planted with 38 different forest tree species. It is a home for other different flora and fauna species. Additionally, the forest reserve is comprised of woody rainforest trees and highland shrubs and is bounded by the Sagumayon River on its west. Moreover, several studies in Kalikasan Park have reported the conditions of birds (Serrano *et al*., 2019), bryophytes (Salvador-Membreve *et al*., 2019), and pteridophytes (Mirandilla *et al*., 2020). Meanwhile, the present study was conducted to identify the herb and shrub species in the forest ecosystem of Kalikasan Park, Albay, Philippines.

2. METHODS

2.1. The Study Area

The study was conducted in three sampling areas in Kalikasan Park, Albay, Philippines (**Figure 1**). The area surveyed has varying elevations and steep to very steep terrain. Grasslands and pioneer species are present, starting from the foot up to about half of the forest. The first sampling area is characterized by a sloped or downward area located near the entry of the forest (13.141563, 123.72286). This area is comprised of different types of grasses and herbaceous plants, including ferns and non-vascular plants. The second sampling site was located in the northern part of the forest near the exit slope area (13.141452, 123.721645). This region is comprised of pioneer species, tall grasses, and different non-vascular plants. The third sampling area was located near the central part of the forest (13.141320, 123.721781). This region was exposed to the sun and is comprised of several herbaceous plants and short grasses.

Figure 1. Locations of the sampling sites in Kalikasan Park, Albay, Philippines

2.2. Sampling Method and Design

This study aimed to identify the herb and shrub species in Kalikasan Park. To achieve this, a fifty-meter transect line was established for each study site. Large plots, each with an area of 25 square meters, were employed in every sampling site. Within these plots, all herb and shrub species were carefully enumerated, documented, and identified. The sampling process was conducted across multiple sites, with ten distinct plots sampled per site.

2.3. Data Gathering, Documentation, and Collection of Samples

The data gathered in the investigation included the scientific name, plant habit, number of individuals per species, and the area and plots where the species occurred. These were used to compute various ecological parameters. Additionally, the plants were photographed in their natural habitat, and samples were also collected to aid in accurate identification and for future reference.

2.4. Data Processing and Analysis

The identified plant species were classified into two categories, namely herbs and shrubs. To ensure accurate identification, a professor at the Bicol University College of Agriculture and Forestry was consulted to confirm the initial identification. Moreover, the frequency of each plant species was determined to estimate its total population per meter by dividing its total population by the sampled area. Lastly, Shannon Index (H'), Evenness Pielou Index (E), Simpson's Index (D), and Margalef's Index (R) were calculated using the PAST Diversity.

3. RESULTS AND DISCUSSION

A total of 20 species (**Figure 2**), representing 11 families, were documented across all sampling sites within the forest ecosystem of Kalikasan Park, Albay, Philippines. Of these, 14 herb species from nine (9) families were identified, while six (6) shrub species belonging to four (4) families were recorded (**Table 1**). Four herb species were found to occur across all sampling areas: Blumea balsamifera, Chromolaena odorata, Mimosa pudica, and Stachytarpheta jamaicensis. Meanwhile, only one (1) shrub species, Arachis pintoi, was consistently observed in the three sampling areas. Bryophyllum pinnata, Hedyotis thomsonii, Mukia maderaspatana, and Callicarpa rubella were observed only in Site 1. Meanwhile, Dalbergia stipulacea was found exclusively in Site 2. Lastly, Emilia sonchifolia, Mucuna pruriens, Scoparia dulcis, Piper retrofractum, Vitex negundo, Mallotus sp., and Lantana camara were exclusively found in Site 3.

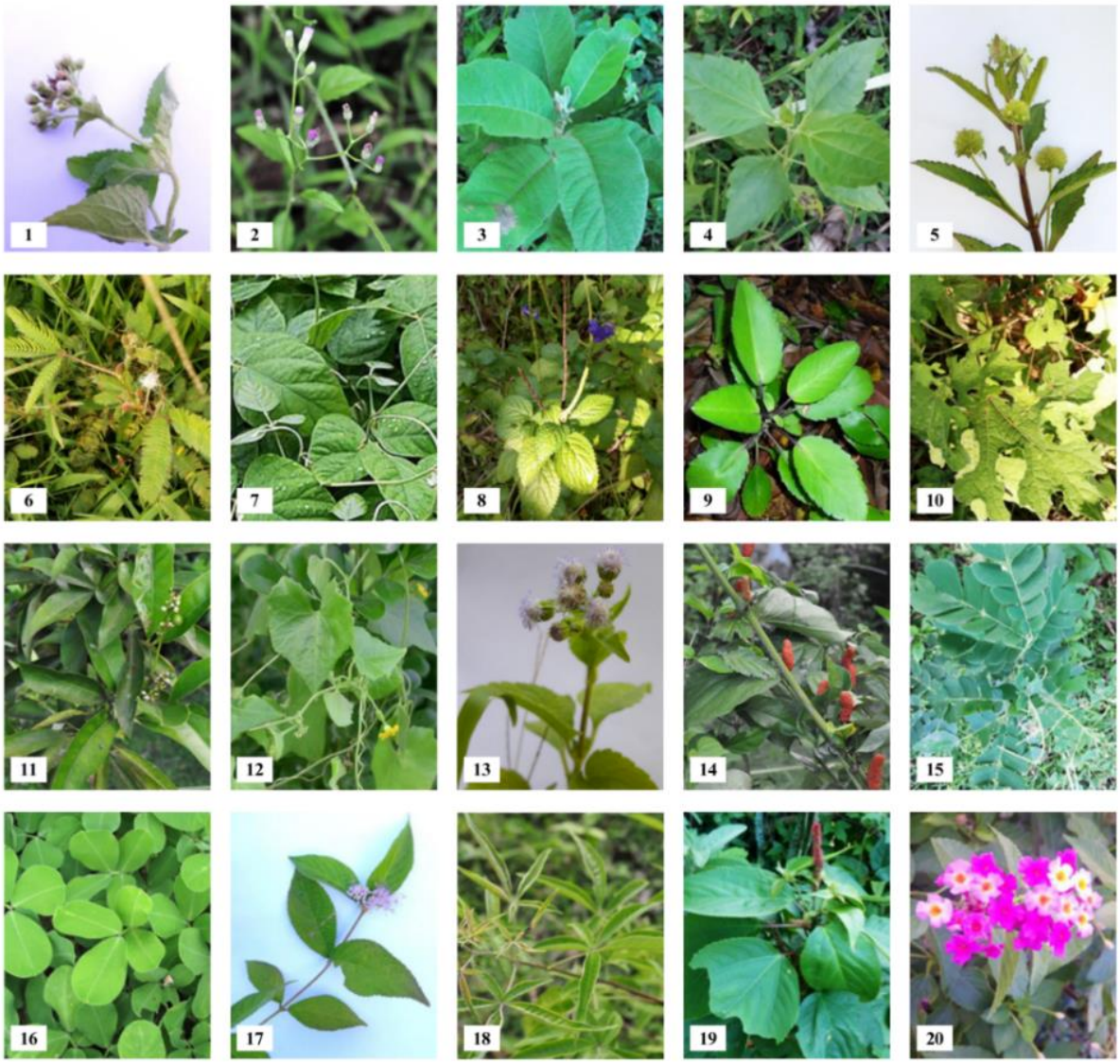

Figure 2. Identified herb and shrub species in Kalikasan Park, Albay, Philippines.

Table 1. Frequency and relative frequency (RF) of the identified herb and shrub species.

Type	Family	Species	Position Photo in Figure 2	Site 1	Site 2	Site 3
Herbs	Asteraceae	*Ageratum conyzoides*	Figure 2.1	✓		✓
		Emilia sonchifolia	Figure 2.2			✓
		Blumea balsamifera	Figure 2.3	✓	✓	✓
		Chromolaena odorata	Figure 2.4	✓	✓	✓
		Elephantopus scaber	Figure 2.5		✓	✓
	Fabaceae	*Mimosa pudica*	Figure 2.6	✓	✓	✓
		Mucuna pruriens	Figure 2.7			✓
	Verbenaceae	*Stachytarpheta jamaicensis*	Figure 2.8	✓	✓	✓
	Crassulaceae	*Bryophyllum pinnata*	Figure 2.9	✓		
	Solanaceae	*Solanum violaceum*	Figure 2.10	✓	✓	
	Rubiaceae	*Hedyotis thomsonii*	Figure 2.11	✓		
	Cucurbitaceae	*Mukia maderaspatana*	Figure 2.12	✓		
	Plantaginaceae	*Scoparia dulcis*	Figure 2.13			✓
	Piperaceae	*Piper retrofractum*	Figure 2.14			✓
Shrubs	Fabaceae	*Dalbergia stipulacea*	Figure 2.15		✓	
		Arachis pintoi	Figure 2.16	✓	✓	✓
	Lamiaceae	*Callicarpa rubella*	Figure 2.17	✓		
		Vitex negundo	Figure 2.18			✓
	Euphorbiaceae	*Mallotus* sp.	Figure 2.19			✓
	Verbenaceae	*Lantana camara*	Figure 2.20			✓

As shown in **Table 2**, the community analysis of the herbaceous species reveals that the Shannon Index (H') value is 2.32, which indicates low diversity. This suggests that while there is a variety of herb species, some are more dominant. Moreover, the Evenness Pielou Index value of 0.60 implies semi-balance; this can be attributed to somewhat uneven distribution where some species are more abundant than others. Meanwhile, the Simpson's Index (D) recorded a value of 0.13; this further confirms low diversity, as there is a high likelihood of selecting the same herb species in random sampling, indicating that fewer species dominate the area. Lastly, the Margalef's Index had a value of 2.91, which suggests medium species richness; this result highlights a moderate variety of herb species in the sampled area. Overall, the herb community demonstrates low diversity, semi-balanced evenness, and medium species richness.

Table 2. Summary of ecological indices of herbs species in Kalikasan Park, Albay, Philippines

Indices	Value	Verbal Interpretation
Shannon Index (H')	2.32	Low
Evenness Pielou Index (E)	0.60	Semi-balance
Simpson's Index (D)	0.13	Low diversity
Margalef's Index (R)	2.91	Medium species richness

**interpretation from Napaldet (2023)*

Table 3 shows the computed indices for shrubs in Kalikasan Park. The Shannon Index (H') value of 2.60 indicates a moderate level of diversity, suggesting that while several shrub species are present, their distribution across the sampling sites is not entirely even. This observation is supported by the Evenness Pielou Index value of 0.71, which reveals a semi-balanced distribution, meaning a few shrub species dominate while others are less abundant. The Simpson's Index (D) value of 0.10 reflects low diversity, highlighting that a small number of dominant shrub species heavily influences the ecosystem. Meanwhile, Margalef's Index value of 4.65 indicates a medium species richness, signifying a moderate variety of shrub species in the sampled area. Overall, the results suggest that while the shrub community in Kalikasan Park shows moderate species richness, the dominance of a few species affects the overall diversity and evenness. This imbalance could be due to environmental conditions, competition for resources, or other ecological factors. Conservation efforts should focus on promoting species evenness and mitigating disturbances to maintain the health and stability of the shrub community within the area.

Table 3. Summary of ecological indices of shrub species in Kalikasan Park, Albay, Philippines.

Indices	Value	Verbal Interpretation*
Shannon Index (H')	2.60	Moderate
Evenness Pielou Index (E)	0.71	Semi-balanced
Simpson's Index (D)	0.10	Low diversity
Margalef's Index (R)	4.65	Medium species richness

**interpretation from Napaldet (2023)*

On the other hand, diversity leads to stability or a balanced ecosystem due to the functional linkages or interrelationships of the different organisms found in ecosystems. Meanwhile, degradation and fragmentation threaten the survival of both fauna and flora species. In mountain ecosystems, the initial trophic level is made up of vegetation; therefore, proper quantification, documentation of vegetation, species composition, and community structure are required (Khan *et al*., 2016). Population density of a plant species in the forest is essential for the availability of its seeds or propagules and favorable micro-climate for germination and development (Udoh *et al*., 2009).

In the study, the ecological indices used are the Shannon Index (H'), Evenness Pielou Index (E), Simpson's Index (D), and Margalef's Index (R). Results showed that the computations of the diversity, dominance, and evenness of shrubs and herbs species were affected by the fact that some species were only represented by the same individual. This indicates that species present in an area may not be as diverse, for only one individual or species was sampled. Furthermore, a species represented by a single individual can only contribute a small amount to the diversity of an area. The site with the most diverse herb species was the first sampling area, while the third sampling site exhibited the most diverse shrub species among the other areas sampled. Most of the shrub frequencies were observed in the second sampling site. Moreover, the northern part of the forest was comprised of different pioneer species and tall grass. The community structure of the area can be attributed to a favorable micro-climate and a variety of viable seeds that sustain regeneration (Nelson *et al*., 2015). Additionally, most of the plant species found in the first sampling area were classified as herbs. It can be inferred that these plants were introduced to the area as it is located on a slope near a residential part of the forest, where a notable decline in vegetation cover has been observed. Lastly, increasing exposure of the land to sunlight, wind, and water will be more beneficial to the flora present in the area.

Noteworthy, the researcher assessed the conservation status of the identified species. **Table 4** shows that half of the species documented in the study are unavailable from the list of the International Union for Conservation of Nature (IUCN). Moreover, seven (7) species are considered least concern (LC), while two (2) species are identified as widespread. Additionally, the sampled herbs and shrubs possess medicinal value, indicating significant economic importance for people living near the forest. This result is consistent with the study of Cajuday and Bañares (2019), who reported the importance of medicinal plants from Kalikasan Park. Furthermore, they asserted the need for pharmacological studies to determine the medicinal properties of different plants assessed in the area. This result is essential for rural communities in developing countries, where access to primary health care and medicine is often inadequate (Thorsen & Pouliot, 2016). Overall, this current investigation highlights that the area is rich in plants with medicinal applications.

Table 4. Current status and medicinal applications of identified herbs and shrubs in Kalikasan Park, Albay, Philippines.

Type	Family	Species	Status*	Medical Applications (Sources)
Herbs	Asteraceae	*Ageratum conyzoides*	Least Concern	Antibacterial (Kouame et al., 2018)
		Emilia sonchifolia	Unavailable Data	Wound healing (Uche et al., 2024)
		Blumea balsamifera	Least Concern	Anti-inflammation (Pang et al., 2014)
		Chromolaena odorata	Widespread	Wound healing (Okpara, 2014)
		Elephantopus scaber	Unavailable Data	Anti-neuroinflammatory (Chan et al., 2017)
	Fabaceae	*Mimosa pudica*	Least Concern	Anti-depressant (Patro et al., 2016)
		Mucuna pruriens	Least Concern	Anti-oxidant (Lampariello et al., 2012)
	Verbenaceae	*Stachytarpheta jamaicensis*	Least Concern	Antifungal (Liew & Yong, 2016)
	Crassulaceae	*Bryophyllum pinnata*	Unavailable Data	Anticancer (Mahata et al., 2012)
	Solanaceae	*Solanum violaceum*	Unavailable Data	Anti-inflammatory (Thakur & Nath, 2024)
	Rubiaceae	*Hedyotis Thomson*	Unavailable Data	Immunomodulatory (Chen et al., 2016)
	Cucurbitaceae	*Mukia maderaspatana*	Unavailable Data	Anti-oxidant (Samad et al., 2020)
	Plantaginaceae	*Scoparia dulcis*	Unavailable Data	Anti-diabetic (Mishra et al., 2024)
	Piperaceae	*Piper retrofractum*	Unavailable Data	Antibacterial (Jamelarin & Balinado, 2019)
Shrubs	Fabaceae	*Dalbergia stipulacea*	Least Concern	Antihelminthic (Ulla et al., 2015)
		Arachis pintoi	Unavailable Data	Antioxidant (de Sousa-Machado et al., 2018)
	Lamiaceae	*Callicarpa rubella*	Least Concern	Anti-inflammatory (Wu et al., 2020)
		Vitex negundo	Least Concern	Cardioprotective (Nyamweya et al., 2023)

Table 4 (Continue). Current status and medicinal applications of identified herbs and shrubs in Kalikasan Park, Albay, Philippines.

Type	Family	Species	Status*	Medical Applications (Sources)
	Euphorbiaceae	*Mallotus* sp.	Unavailable Data	Antiviral (Gangwar et al., 2014)
	Verbenaceae	*Lantana camara*	Widespread	Antibacterial (Barreto et al., 2010)

** International Union for Conservation of Nature (IUCN) Red List of Threatened Species and NatureServe Conservation Status System*

4. CONCLUSION

This study documented a total of 20 plant species belonging to 11 families in Kalikasan Park, Albay, Philippines. Moreover, fourteen herb species were identified, representing nine (9) families, while six (6) shrub species were recorded from four (4) families. The overall herb community demonstrated low diversity and medium species richness, while the shrub community exhibited moderate diversity and species richness. Dominance by a few species indicates ecological imbalance, suggesting targeted management strategies to sustain biodiversity within the area. Moreover, seven (7) species were classified as "Least Concern" (LC), while half of the sampled species had "Unavailable Data" (UD), and two (2) were categorized as "Widespread" (W). Lastly, the sampled herbs and shrubs have significant medicinal properties, such as anti-inflammatory, antibacterial, and antioxidant applications. Given the results and conclusions cited, the following recommendations are provided for consideration.

(i) Implement conservation strategies to protect and sustain the herb and shrub species. Efforts should focus on preventing habitat degradation and fragmentation.
(ii) Continuous monitoring and documentation of plant species, particularly those without data on conservation status in the IUCN list. This will aid in assessing their population trends and potential threats.
(iii) Reforestation and restoration programs in degraded areas, particularly those near residential zones, promote species regeneration and ecosystem stability.
(iv) Sustainable use of identified medicinal plants (e.g., *Blumea balsamifera* and *Chromolaena odorata*) by engaging local communities through awareness programs, encouraging responsible harvesting, and exploring potential economic opportunities.
(v) Develop educational initiatives to enhance public awareness of plant biodiversity, ecosystem stability, and the importance of maintaining species evenness. Collaboration with schools, researchers, and government agencies can also foster a culture of environmental stewardship.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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