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Research Article

Assessment of Vascular Epiphyte Diversity in a University Arboretum

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Abstract: Vascular epiphytes are an ecological important of plants that perform a variety of important ecological roles such as mediating nutrient cycles, providing food for canopy fauna and storing water. Despite having a large contribution, information regarding the species composition and diversity of vascular epiphytes in the USU arboretum is not yet available. Therefore, this research was conducted to identifyhe diversity of epiphytes in the arboretum of the Universitas Sumatera Utara. Data collection was carried out using an inventory method in the entire arboretum area (census). Epiphyte morphological characteristics, number of individuals, and host tree species were recorded as primary data. The results of the research show that there are 17 (seventeen) epiphyte species belonging to 7 families in the USU arboretum. Pyrosia piloselloides, Asplenium nidus, and Pyrossia eleagnifolia were the species that obtained the highest Importance Value Index (IVI)s with respective values obtained at 45.48%, 29.43%, and 16.82%. The epiphyte diversity index at the research location is classified as moderate with a value obtained of 1.75. Meanwhile, the species evenness index was classified as high (E=0.62) and the species dominance index showed low results (C=0.27).

Keywords: Arboretum; Census; Diversity; Epiphyte; Vegetation.

1. INTRODUCTION

Epiphytes are the main plant components that grow in various tropical and subtropical forests, where their number can reach more than 30,000 species and constitute 10% of the diversity of vascular plants (Zotz et al., 2021). In contrast to parasitic parasites, epiphytes do not utilize water and nutrient supplies from their hosts (Zotz, 2016). Still, they are autotrophic and depend on the host plant only as a buffer (Benzing, 1990). Epiphytes form commensal relationships with host trees so that their presence does not harm their hosts (Naranjo et al., 2019). Ecologically, this group of plants plays an important role worldwide and contributes to biodiversity, where epiphytes increase water retention and mediate nutrient cycles (Coxson & Nadkarni, 1995; Stan & Pypker, 2015). Apart from contributing to the nutrient cycle, epiphytes also provide shelter, food, and water for canopy fauna (McCracken & Forstner, 2014; Boechat et al., 2019), thus playing an important role in supporting the survival of fauna in nature.

Broad ecological interests have motivated many researchers to explore epiphyte diversity in nature, including in artificial ecosystems such as arboretums and urban green areas, as done by (Pundiak, 2021; Rahman et al., 2023; Susilowati et al., 2022). However, vascular epiphytes are still poorly studied compared to other land plants (such as lianas and trees) (Ceballos, 2023). As a built-up forest area classified as secondary forest, the arboretum contributes to local and global plant conservation. As many as 25% to 30% of plant species are

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estimated to be accessible as living collections in arboretums or botanical gardens globally (Mounce et al., 2017; Chen & Sun, 2018). Although their structure tends to be homogeneous and has a smaller diversity of tree species than primary forests, secondary forests harbor important biodiversity in tropical regions and contribute to preserving various groups of organisms, including vascular epiphytes (Einzmann & Zotz, 2016).

As one of the urban green spaces, the University of Sumatera Utara (USU) Arboretum plays an important role in various aspects, including providing environmental services and preserving biodiversity. As it develops, the emergence of numerous species, including epiphytes, has occurred in the USU Arboretum and has contributed to the complexity of the ecosystem being formed. Unfortunately, information regarding epiphyte species' diversity has not been obtained. This information is needed to support conservation efforts and become the basis for the development and management of the USU Arboretum in the future. Therefore, this research was conducted to identify and explore the diversity of epiphytes in the USU Arboretum.

2. RESEARCH METHOD

a. Time and research location

Vascular epiphyte diversity was explored at the Arboretum of the University of Sumatera Utara, Kuala Bekala, Pancur Batu District, Deli Serdang Regency, North Sumatra (Figure 1). Geographically, the USU arboretum is located at 98°39'12.90” to 99°10'2.83” East Longitude and 3°32'7.00” to 3°34'8.06” N Latitude (Rahmawaty et al., 2019). This research was conducted for five months, from March 2022 to August 2022. The USU Arboretum was built in 2006 by planting various trees and was divided into predetermined plots. Based on the USU Rector's speech in 2006, it is known that the USU arboretum has a total area of ± 55 ha, but the vegetated area is only around 31 Ha.

Figure 1. Research location in Arboretum USU (Source: Data Processing, 2025)

b. Data collection and analysis

Data was collected using an inventory method in the entire arboretum area (census). Epiphyte morphological characteristics, number of individuals, and host tree species were recorded as primary data using binoculars. The importance value index (IVI) is calculated using the formula developed by Curtish and Mclontosh (Curtis & McIntosh, 1950), by adding up the relative density (RD) and Relative Frequency (RF) with the following formula:

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$$\text{Relative Density} = \frac{\text{Total number of individual species}}{\text{Total number of all individual of species}} \times 100\% \ldots\ldots (1)$$

$$\text{Relative Frequency} = \frac{\text{Frequency of respective species}}{\text{Frequency of all species}} \times 100\% \ldots\ldots (2)$$

To identify the level of epiphyte species diversity, several ecological indices, including species diversity (H'), species evenness (E), and species richness (C), were calculated in this study. Species diversity and uniformity indices were carried out using the Shannon-Wiener Diversity Index (H') and the Shannon-Wiener Evenness Index (E) (Indriyanto, 2025), using the following formula:

$$H' = -\sum_{i=1}^{S} Pi \ln Pi \ldots\ldots (3)$$

Where H' represents the diversity index, Pi is the ratio of the number of individuals of a species to the total number of individuals of all species, and S is the total epiphyte species found. Besides species diversity (H'), species evenness analysis is also calculated using the following formula:

$$E = \frac{H'}{ln(S)} \ldots\ldots (4)$$

Where E is the species evenness index, H' is the species diversity index, and S is the number of all species found. The results of species evenness calculations can be classified into three categories: low evenness if $E < 0.5$, medium evenness if $0.5 < E < 0.6$, and high evenness if $E > 0.6$. Apart from species diversity and evenness, species dominance (Simpson's Index) was also calculated to determine the dominance of epiphyte species at the research location. Species dominance is calculated using the following formula:

$$C = \sum \ (Pi)^2 \ldots\ldots (5)$$

Where C is Simpson's dominance index, and Pi is the ratio between the number of individuals of a species (ni) and the number of individuals in the entire species (N). According to (Odum, 1993), the dominance index ranges from 0 to 1, where if the value obtained is close to 0, it can be concluded that no species dominates. The number of individuals tends to be evenly distributed. On the other hand, if the value obtained is close to 1, it can be concluded that a species dominates the research location.

3. RESULTS AND DISCUSSION

a. Epiphyte composition in the USU Arboretum

In the process of successional development, land cover and the number of epiphytes tend to increase along with the number and area of trees, and do not depend on how old the forest is. The area of land cover and the number of trees are important for epiphytes, where the presence of trees contributes to increasing the cover area and forming microhabitats for epiphytes (Woods & DeWalt, 2013; Woodzs et al., 2015). The results of the research show that there are 17 (seventeen) epiphyte species in the USU arboretum, which are divided into seven families: Polypodiaceae, Aspleniaceae, Orchidaceae, Vittariaceae, Dryopteridaceae, Nephrolepidaceae, and Ophioglossaceae. Based on the research results, it is known that Pyrrosia piloselloides obtained the highest IVI, namely 45.48% (Table 1). The highest IVI on Pyrrosia piloselloides showed that this species became the most dominant in the research area. Apart from P. piloselloides, P. eleagnifolia was also recorded to have obtained the highest IVI and was in third place after Asplenium nidus, with respective IVI obtained of 29.43% and 16.82% (Table 1).

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Table 1. IVI of vascular epiphytes in the USU arboretum.

No.	Species	Family	KR (%)	FR (%)	INP (%)
1	Pyrrosia piloselloides	Polypodiaceae	39,6	5,88	45,48
2	Asplenium nidus L	Aspleniaceae	23,54	5,88	29,43
3	Pyrrosia eleagnifolia	Polypodiaceae	10,93	5,88	16,82
4	Dendrobium crumenatum	Orchidaceae	10,63	5,88	16,52
5	Vittaria lineata	Vittariaceae	5,41	5,88	11,29
6	Rumohra adiantiformis	Dryopteridaceae	3,92	5,88	9,8
7	Pyrrosia longifolia	Polypodiaceae	1,38	5,88	7,26
8	Asplenium salignum	Aspleniaceae	1,37	5,88	7,25
9	Nephrolepis biserrata	Nephrolepidaceae	0,97	5,88	6,85
10	Pyrrosia lanceolata	Polypodiaceae	0,74	5,88	6,62
11	Microsorum scolopendria	Polypodiaceae	0,55	5,88	6,43
12	Drynaria quercifolia	Polypodiaceae	0,39	5,88	6,27
13	Polypodium sp.	Polypodiaceae	0,19	5,88	6,08
14	Ophioglossum pendulum	Ophioglossaceae	0,17	5,88	6,05
15	Thrixspermum centipeda	Orchidaceae	0,13	5,88	6,01
16	Cymbidium finlasonianum	Orchidaceae	0,04	5,88	5,93
17	Acriopsis javanica	Orchidaceae	0,03	5,88	5,91

(Source: Data Processing, 2025)

The dominance of the *Pyrossia* genus was also revealed by (Susilowati et al., 2022), where in their research, 4,150 individuals of *P. piloselloides* were found, and it became the most dominant species. The high adaptability of the Pyrrosia genus is thought to be the main factor in the abundance of this species. The complex morphology is thought to have helped this species survive and thrive in various environmental conditions. According to (Brownsey & Perrie, 2014), *Pyrrosia eleagnifolia* (genus Pyrrosia) is classified as a group of hardy ferns and can survive in dry conditions because it has thick, fleshy leaf sheaths, dense hair cover, and minimal lamina area.

Apart from obtaining the highest IVI, *P. piloselloides* and *P. eleagnifolia* occupied the most host trees. The research results found that *P. piloselloides* grew on 33 host tree species (86.84%), and *P. eleagnifolia* was found growing on 22 host tree species (57.89%). This indicates that the morphology of these two species is also very helpful in adapting to various tree bark textures, where, in general, different host tree species tend to have different bark textures. In contrast to *P. piloselloides* and *P. eleagnifolia*, *Cymbidium finlasonianum,* and *Acriopsis javanica* were recorded as epiphytic species that obtained the lowest IVI, with respective IVI values of only 5.93% and 5.91% (Table 1). In contrast to Pyrrosia, *Cymbidium finlasonianum,* and *Acriopsis javanica,* which belong to the Orchidaceae family, require specific habitat characteristics and a symbiotic relationship with several mycorrhizae to grow and develop. According to (Li et al., 2021; Rasmussen et al., 2015), the symbiosis of orchid mycorrhizal fungi is essential for the distribution, growth, and dynamics of orchid populations, where all orchids require a supply of nutrients from mycorrhizal fungi during early ontogeny and germination due to the minimal nutrient reserves in the seeds (Rasmussen & Rasmussen, 2009).

b. Epiphyte diversity index in the USU Arboretum

Species diversity is an ecological index that can describe an area's species diversity level. Recent research has described striking differences in the diversity of epiphytes compared to terrestrial plant groups such as Pteridophyta (Nervo et al., 2016; Taylor et al., 2021) , indicating that terrestrial and epiphytic plant groups have different responses to environmental change (Taylor et al., 2022). The research results show that the epiphyte species diversity (H') level in the USU Arboretum is classified as moderate, with a value of 1.75 (Figure 2). The species diversity value is moderate, indicating that the community includes a fairly vast number of species and an equitable distribution of individuals amongst species, but does not exhibit significant dominance or diversity. Ecosystems with intermediate diversity have relatively strong ecological stability, although they are less complicated than ecosystems with high levels of diversity.

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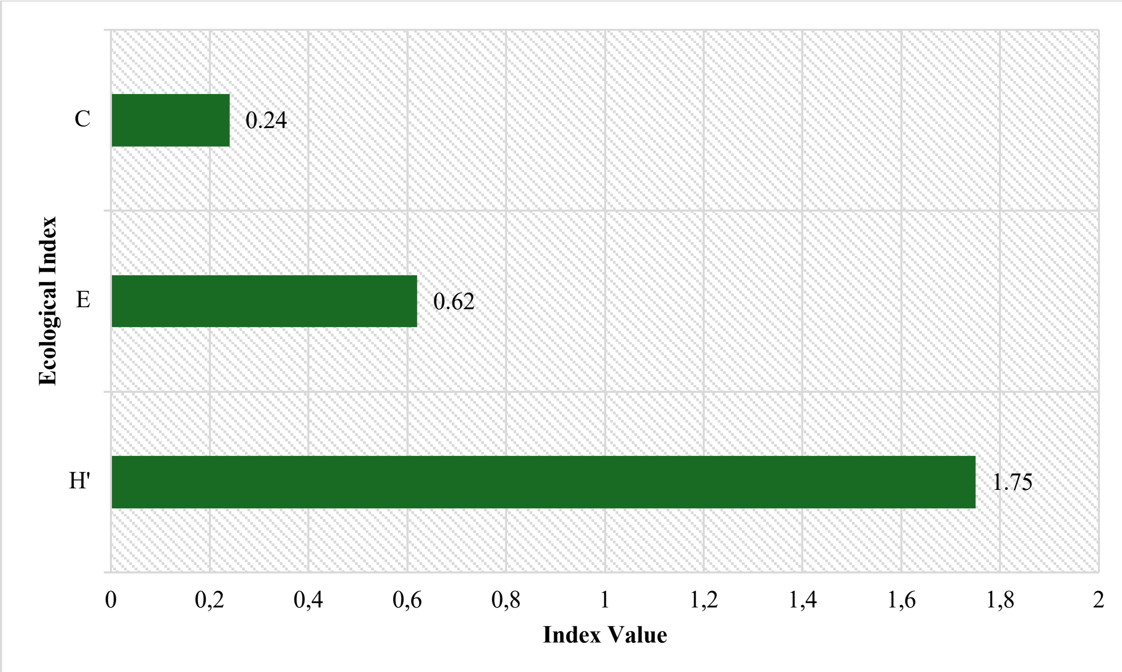

Figure 2. Ecological index of vascular epiphytes in the USU arboretum (Source: Data Processing, 2025)

A relatively low level of species diversity can be caused by various factors, including an imbalance in the number of individuals and species (Magrach et al., 2014; Praptosuwiryo et al., 2019). However, the small number of species discovered may be the factor most responsible for the low diversity value produced. According to (Mendieta-Leiva et al., 2020), epiphytes tend to be closer to atmospheric conditions than terrestrial plants. This is because epiphytes tend to grow in the air and have limited access to water, which significantly influences the vertical distribution of epiphytes in the canopy. As a secondary forest that is gradually recovering, the USU arboretum has trees of various ages that tend to be uniform, with sizes that are not yet optimal. This causes the number of epiphytes that grow to be limited, considering that the appearance of epiphytes at the research location occurs naturally without human intervention. (Peterken & Game, 1984) also stated that the age and history of the stand strongly influence the abundance and distribution of forest plants.

In contrast to the diversity index, the research results show that the evenness index for epiphyte species in the USU Arboretum is relatively high, namely 0.62 (E>0.60) (Figure 2). A high evenness index indicates that the number of individuals in all species tends to be evenly distributed, and particular species are not dominant in the research location. In line with the results of species evenness, the dominance index showed a low value (C = 0.24). This can be attributed to the evenness index, which tends to be high where the evenness index and species dominance index have an inverse relationship and are strongly influenced by the composition of individuals in all species. It cannot be denied that the age and composition of tree species that grow and develop at the research location significantly influence the abundance of epiphytes, which is closely related to the number of host trees and the microclimate that is formed.

4. CONCLUSION

A total of 17 (seventeen) epiphyte species belonging to 7 families were identified as growing in the USU arboretum. *Pyrosia piloselloides*, *Asplenium nidus*, and *Pyrossia eleagnifolia* were the species that obtained the highest INP values, with respective values obtained at 45.48%, 29.43%, and 16.82%. The epiphyte diversity index in the USU Arboretum is classified as moderate, with a value of 1.75. Meanwhile, the species evenness index was classified as high (E=0.62), and the species dominance index showed low results (C=0.27).

doi: http://doi.org/

5. REFERENCE LIST

Benzing, D. H. (1990). Vascular Epiphytes: General Biology and Related Biota. Cambridge University Press; Cambridge Core. https://doi.org/10.1017/CBO9780511525438

Boechat, R. F., Da Silva, B. F., & Nunes-Freitas, A. F. (2019). Bird-epiphyte interactions in three Atlantic Forest environments in southeastern Brazil. Revista Brasileira de Ornitologia, 27(2), 108–114. https://doi.org/10.1007/BF03544454

Brownsey, P., & Perrie, L. (2014). Brownsey, P.J. & Perrie, L.R. (2014) Osmundaceae. In: Breitwieser I., Heenan P., Wilton A. (eds) Flora of New Zealand – Seed Plants. Fascicle 4. Manaaki Whenua Press, Lincoln. https://doi.org/10.7931/J2BG2KW4

Ceballos, S. J. (2023). Vascular epiphytes in Argentinian Yungas: Distribution, diversity, and ecology. The Botanical Review, 89(1), 91–113. https://doi.org/10.1007/s12229-022-09281-7

Chen, G., & Sun, W. (2018). The role of botanical gardens in scientific research, conservation, and citizen science. Plant Diversity, 40(4), 181–188. https://doi.org/10.1016/j.pld.2018.07.006

Coxson, D. S., & Nadkarni, N. M. (1995). Ecological roles of epiphytes in nutrient cycles of forest ecosystems. Academic Press. https://www.cabidigitallibrary.org/doi/full/10.5555/19960603908

Curtis, J. T., & McIntosh, R. P. (1950). The Interrelations of Certain Analytic and Synthetic Phytosociological Characters. Ecology, 31(3), 434–455. https://doi.org/10.2307/1931497

Einzmann, H. J. R., & Zotz, G. (2016). How Diverse are Epiphyte Assemblages in Plantations and Secondary Forests in Tropical Lowlands? Tropical Conservation Science, 9(2), 629–647. https://doi.org/10.1177/194008291600900205

Indriyanto, I. (2025). Ekologi Hutan. Bumi Aksara. https://books.google.co.id/books?id=c9BVuAAACAAJ

Magrach, A., Rodríguez-Pérez, J., Campbell, M., & Laurance, W. F. (2014). Edge effects shape the spatial distribution of lianas and epiphytic ferns in Australian tropical rain forest fragments. Applied Vegetation Science, 17(4), 754–764. https://doi.org/10.1111/avsc.12104

McCracken, S. F., & Forstner, M. R. J. (2014). Herpetofaunal community of a high canopy tank bromeliad (Aechmea zebrina) in the Yasuní Biosphere Reserve of Amazonian Ecuador, with comments on the use of "arboreal" in the herpetological literature. 8(1), 65–75.

Mendieta-Leiva, G., Porada, P., & Bader, M. Y. (2020). Interactions of Epiphytes with Precipitation Partitioning. In I. Van Stan John T., E. Gutmann, & J. Friesen (Eds.), Precipitation Partitioning by Vegetation: A Global Synthesis (pp. 133–146). Springer International Publishing. https://doi.org/10.1007/978-3-030-29702-2_9

Mounce, R., Smith, P., & Brockington, S. (2017). Ex situ conservation of plant diversity in the world's botanic gardens. Nature Plants, 3(10), 795–802. https://doi.org/10.1038/s41477-017-0019-3

Naranjo, C., Iriondo, J. M., Riofrio, M. L., & Lara-Romero, C. (2019). Evaluating the structure of commensalistic epiphyte–phorophyte networks: A comparative perspective of biotic interactions. AoB PLANTS, 11(2). https://doi.org/10.1093/aobpla/plz011

Nervo, M. H., da Silva Coelho, F. V., Windisch, P. G., & Overbeck, G. E. (2016). Fern and lycophyte communities at contrasting altitudes in Brazil's subtropical Atlantic Rain Forest. Folia Geobotanica, 51(4), 305–317. JSTOR. https://doi.org/10.1007/s12224-016-9253-0

Peterken, G. F., & Game, M. (1984). Historical Factors Affecting the Number and Distribution of Vascular Plant Species in the Woodlands of Central Lincolnshire. Journal of Ecology, 72(1), 155–182. JSTOR. https://doi.org/10.2307/2260011

Praptosuwiryo, T. N., Sumanto, S., & Cahyaningsih, R. (2019). Diversity and host preferences of ferns and lycopods epiphytes on palm trees. Biodiversitas Journal of Biological Diversity, 20(12). https://doi.org/10.13057/biodiv/d201236

Pundiak, O. (2021). Epiphyllous bryophytes in Arboretum Stradch (Ukraine). Acta Fytotechnica et Zootechnica, 24(4). https://doi.org/10.15414/afz.2021.24.04.265-271

Rahman, A. A., Perwitasari-Farajallah, D., & Mulyani, Y. A. (2023). Use of epiphyte by bird communities in IPB Dramaga campus. IOP Conference Series: Earth and Environmental Science, 1271(1), 012020. https://doi.org/10.1088/1755-1315/1271/1/012020

doi: http://doi.org/

Rahmawaty, R., Samosir, J. B., Batubara, R., & Rauf, A. (2019). Diversity and distribution of medicinal plants in the Universitas Sumatera Utara Arboretum of Deli Serdang, North Sumatra, Indonesia. Biodiversitas Journal of Biological Diversity, 20(5). https://doi.org/10.13057/biodiv/d200539

Rasmussen, H. N., Dixon, K. W., Jersáková, J., & Těšitelová, T. (2015). Germination and seedling establishment in orchids: A complex of requirements. Annals of Botany, 116(3), 391–402. https://doi.org/10.1093/aob/mcv087

Rasmussen, H. N., & Rasmussen, F. N. (2009). Orchid mycorrhiza: Implications of a mycophagous life style. Oikos, 118(3), 334–345. https://doi.org/10.1111/j.1600-0706.2008.17116.x

Stan, J. T. V., & Pypker, T. G. (2015). Review and evaluation of forest canopy epiphyte roles in the partitioning and chemical alteration of precipitation. Unpublished. https://doi.org/10.13140/RG.2.1.1677.0646

Susilowati, A., Ginting, I. M., Rachmat, H. H., Elfiati, D., Sucipto, T., & Nadeak, H. (2022). The diversity of the Polypodiaceae in University green space. IOP Conference Series: Earth and Environmental Science, 1115(1), 012004. https://doi.org/10.1088/1755-1315/1115/1/012004

Taylor, A., Keppel, G., Weigelt, P., Zotz, G., & Kreft, H. (2021). Functional traits are key to understanding orchid diversity on islands. Ecography, 44(5), 703–714. https://doi.org/10.1111/ecog.05410

Taylor, A., Zotz, G., Weigelt, P., Cai, L., Karger, D. N., König, C., & Kreft, H. (2022). Vascular epiphytes contribute disproportionately to global centres of plant diversity. Global Ecology and Biogeography, 31(1), 62–74. https://doi.org/10.1111/geb.13411

Woods, C. L., Cardelús, C. L., & DeWalt, S. J. (2015). Microhabitat associations of vascular epiphytes in a wet tropical forest canopy. Journal of Ecology, 103(2), 421–430. https://doi.org/10.1111/1365-2745.12357

Woods, C. L., & DeWalt, S. J. (2013). The Conservation Value of Secondary Forests for Vascular Epiphytes in Central Panama. Biotropica, 45(1), 119–127. https://doi.org/10.1111/j.1744-7429.2012.00883.x

Zotz, G. (2016). Plants on Plants – The Biology of Vascular Epiphytes. Springer International Publishing. https://doi.org/10.1007/978-3-319-39237-0

Zotz, G., Weigelt, P., Kessler, M., Kreft, H., & Taylor, A. (2021). EpiList 1.0: A global checklist of vascular epiphytes. Ecology, 102(6), e03326. https://doi.org/10.1002/ecy.3326

doi: http://doi.org/