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Diversity of Tree Species in Campus Forest of UIN Sulthan Thaha Saifuddin Jambi

Ayu Widya Wati, Try Susanti(*), Aini Qomariah Manurung, Hesti Riany

Tadris Biology, UIN Sulthan Thaha Saifuddin Jambi
Jl. Arif Rahman hakim No. 111, Simpang IV Sipin, Telanaipura District,
Jambi City, 36124, Indonesia

***Corresponding Author**: trysusanti@uinjambi.ac.id

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Abstract

An indicator of the stability of a community within an ecosystem is diversity of species. The absence of data regarding the species diversity in the campus forest of UIN Sulthan Thaha Saifuddin Jambi prompted the conduct of this study, which aimed to identify tree types and calculate the diversity index and evenness index for the campus forest. To achieve this aim, the research site was selected through the implementation of purposive sampling, whereas the plot was determined through the utilization of systematic sampling. Aside from that, tree data was collected in 22 plots using a quadratic method with dimensions of 20 m x 20 m. The research findings revealed the acquisition of 83 tree species, comprising 30 families and a total of 464/8.62 ha individuals. The species of tree that contains the greatest number of individuals is Ixonanthes sp. The genus Ixonanthes exhibited the greatest INP, which measured 37.64%. At 3.70, the species diversity index (H') indicates a significant degree of diversity across categories. Furthermore, the evenness index (E) acquired a value of 0.84, placing it within the category of high evenness

Keywords: *Campus Forest, Diversity, Trees*

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INTRODUCTION

Forests are vital components of the life support system and therefore constitute valuable natural resources. In addition to providing habitat for a diverse array of organisms that engage in ecological interactions, forests fulfill a tangible function by conserving resources such as water and soil, thereby contributing to environmental stability (Wahyudi et al., 2018). Frequent plant species in campus forest of UIN Sulthan Thaha Saifuddin Jambi include *Melastoma malabathricum*, *Macaranga trichocarpa*, *Eurya acuminata*, *Acacacia mangium*, and *Clidemia hirta*. Animal species such as *Macaca sp.*, *Sus barbatus*, and *Varanus albigularis* inhabit the campus forest.

Additionally, *Steptopelia chinensis*, *Pycnonotus aurigaster*, and *Estrilda amandava* are among the local birds that visit the campus forest area (Susanti & Yamin, 2017).

Campus forests contribute to educational, research, and development objectives. Campus forests comprise a diverse array of plant species, with particular emphasis on trees that undergo a life cycle beginning with seed production, developing into tree saplings, and ultimately maturing into mature trees. These trees serve as carbon dioxide (CO2) emitters, synthesized through respiration, decomposition, and decay, with the assistance of numerous microorganisms (Nurrochmat & Abdulah, 2014).

As intended for the forthcoming advancement of UIN Sulthan Thaha Saifuddin Jambi, the transformation of construction land into usable space for building construction will entail numerous alterations. According to Armanda et al., (2020), an essential component of information that is critical for facilitating effective management of plant resources is the identification of phenotypic and habitat characteristics. This data serves as the foundation for conservation initiatives. Hence, this research aims to determine the diversity of tree species in the campus forest of UIN Sulthan Thaha Saifuddin Jambi.

METHOD

The study was carried out at the Forest Campus of UIN Sulthan Thaha Saifuddin Jambi, specifically at Campus II Sungai Duren, located at coordinates 1°36.449'S-103°30.604'E to 1°36.451'A-103°30.603'E, on the boundary between Jambi City and Muara Bulian Km. 16 Simpang Sungai Duren, Muaro Jambi Regency (Susanti & Yamin, 2017). The time for this research was during July 2022-March 2023.

The instruments used in this study included a tape measure, GPS (Global Positioning System), compass, thermometer, soil tester, digital camera, machete, raffia rope, writing instruments (pencil, pencil, marker, etc.), plant scissors, a plastic bag, labels, scissors, newsprint, and identification books. The substances employed in this investigation comprised plant specimens and 70% alcohol.

Figure 1. Research Location

We identified the research site using purposive sampling. Purposive sampling entailed the initial determination of plots based on the distribution of vegetation observed during the sampling process. We accomplished the plot determination through systematic sampling; specifically, we conducted the initial plot determination at random, followed by a systematic determination. Simultaneously, the researchers implemented quadratic data collection to gather information on trees measuring 20 m x 20 m in dimensions. The researchers conducted observations in each plot, which included the identification of species (both scientific and local names) and the measurement of tree diameter (DBH; diameter at breast height) by assessing the trunk diameter at a vertical distance of 1.3 meters from the ground. 8.62 ha comprises the campus forest of UIN Sulthan Thaha Saifuddin Jambi. By calculating 10% of the total forest area for plot determination, we obtained 22 plots. The length of the transects was about 1,500 meters. We established four to six plots for each transect, with a 30 m inter-plot separation. The data acquired during fieldwork was analyzed by the subsequent equation,

a. Absolute Density (KM)

$$\frac{\textbf{\textit{The total of individuals of a species}}}{\textbf{\textit{Example plot area}}}$$

b. Relative Density (KR)

$$\frac{\textbf{\textit{Absolute density of a species}}}{\textbf{\textit{The total absolute density of all species}}} \textbf{\textit{x}}\ \textbf{100\%}$$

c. Absolute Frequency (FM)

$$\frac{\textit{The total of plots occupied by a species}}{\textit{Number of all observation plots}}$$

d. Relative Frequency (FR)

$$\frac{\textbf{\textit{Frequency of a type}}}{\textbf{\textit{Total frequency of all types}}} x\ 100\%$$

e. Absolute Dominance (DM)

$$\frac{The\ basic\ area\ of\ a\ type}{Sample\ area\ wide}$$

f. Relative Dominance (DR)

$$\frac{The\ total\ of\ dominance\ of\ a\ species}{Total\ dominance\ of\ all\ species} x\ 100\%$$

g. Important Value Index (INP)

KR=FR+DR

Diversity Index

Species diversity data was calculated using the Shannon-Wiener diversity index (H′) (Odum 1993; Fachrul, 2012). The diversity index is calculated using the following formula,

$$H' = -\sum Pi\ In\ Pi$$

$$pi = \frac{ni}{N}$$

Information:
H′ : Diversity index
Pi : The total of individuals of a species/total number of all species
ni : The total of individuals of a species
N : The total of individuals of all species.

The value of H′ has categories:
H′ > 3 = High species diversity,
H′ 1 ≤ H′ ≤ 3 = Species diversity is moderate
H′< 1 = low species diversity.

Index of Evennes

The index of evenness is used to determine community balance, namely a measure of the similarity in the number of individuals between species in a community. The formula is as follows.

$$E = H'/\ln S$$

Information:
E : Index of Evenness
H′ : Index of Diversity
Ln : Natural Logarithm
S : Total of Genus/Types

The index of evenness (E) is categorized into three criteria:
< 0,3 : The index of evenness is relatively low
0,3-0,6 : The index of evenness is classified as moderate
> 0,6 : The index of evenness is relatively high.

RESULTS AND DISCUSSION

The campus forest of UIN Sulthan Thaha Saifuddin Jambi was the site of an investigation which yielded the discovery of 83 tree species, comprising 30 families and 464 individuals. *Ixonanthes sp.* (52 individuals), *Pternandra sp.* (40 individuals), and *Dyera costulata* (Miq.) Hook.f. (33 individuals) contain the greatest number of individuals.

The research data collected in the field will be computed based on vegetation parameters, specifically relative density (KR), relative frequency (FR), relative dominance (DR), and important value index (INP). The tree species with the highest ice nucleating particle (INP) concentration is *Ixonanthes sp.*, specifically at 37.64%. On the other hand, *Syzygium hirtum* (Korth.). Merr. & Perry has the lowest ice nucleating particle (INP) concentration, measuring at 0.68%.

Table 1. Relative Density, Relative Frequency, Relative Dominance Tree Types in the UIN Sulthan Thaha Saifuddin Jambi Campus Forest

No.	Name of Species	KR %	FR %	LBD	DR %	INP
1	*Acacia mangium* Willd.	1.72	0.79	0.22	1.22	3.74
2	*Aglaia* sp.	2.59	1.98	0.56	3.08	7.65
3	*Aidia densiflora* (Wall.) Masam.	0.65	0.79	0.05	0.27	1.71
4	*Alstonia angustifolia* Wall. Ex A.DC.	1.94	1.98	0.31	1.71	5.64
5	*Alstonia scholaris* (L.) R.Br.	1.29	0.79	0.22	1.20	3.28
6	*Anacardiaceae* sp1	0.22	0.40	0.02	0.13	0.74
7	*Antidesma leucopodum* Miq.	0.22	0.40	0.04	0.21	0.82
8	*Aporosa* sp.	1.51	1.98	0.41	2.27	5.76
9	*Aquilaria* sp.	0.22	0.40	0.02	0.11	0.72
10	*Ardisia lurida* Blume	0.22	0.40	0.02	0.13	0.74
11	*Artocarpus elasticus* Reinw. ex Blume	0.22	0.40	0.07	0.37	0.98
12	*Artocarpus heterophyllus* Lam.	0.43	0.79	0.04	0.23	1.46
13	*Artocarpus integer* (Thunb.) Merr.	1.08	1.19	0.41	2.28	4.54
14	*Artocarpus* sp.	1.29	1.98	0.27	1.48	4.75
15	*Baccaurea sumatrana* (Miq.) Mull.Arg.	3.02	3.17	1.08	5.99	12.18
16	*Barringtonia* sp.	0.43	0.79	0.03	0.17	1.39
17	*Blumeodendron* sp.	0.43	0.40	0.12	0.66	1.49
18	*Bouea macrophylla* Griff.	0.86	0.79	0.28	1.54	3.20
19	*Bridelia* sp.	0.65	0.40	0.06	0.31	1.35
20	*Canarium denticulatum* Blume	1.29	1.98	0.15	0.84	4.12
21	*Canarium odorata* (Lam.) Hook.f. & Thoms.	0.86	0.79	0.12	0.67	2.32
22	*Canarium* sp.	4.09	2.78	0.51	2.83	9.70
23	*Chisocheton* sp.	0.65	0.40	0.10	0.54	1.59
24	*Coffea* sp.	0.22	0.40	0.06	0.32	0.94
25	*Commersonia bartramia (*L.) Merr.	0.65	0.79	0.06	0.32	1.76
26	*Diospyros borneensis* Hiern.	0.22	0.40	0.02	0.13	0.74
27	*Diospyros buxifolia* (Blume) Hiern.	0.22	0.40	0.01	0.08	0.69
28	*Diospyros confertiflora* (Hiern.) Bakh.	0.22	0.40	0.07	0.36	0.97
29	*Diospyros* sp.	1.29	2.38	0.19	1.05	4.72
30	*Dyera costulata* (Miq.) Hook.f.	7.11	4.76	1.14	6.30	18.17
31	*Endospermum diadenum* (Miq.) Airy Shaw	3.45	3.57	1.00	5.52	12.54
32	*Ficus* sp.	0.22	0.40	0.03	0.14	0.76
33	*Flacourtia* sp.	0.22	0.40	0.02	0.10	0.71

34	*Garcinia bancana* Miq.	1.29	1.59	0.28	1.55	4.43
35	*Garcinia hendersoniana* T.C.Whitmore	0.22	0.40	0.03	0.15	0.76
36	*Garcinia* sp.	0.22	0.40	0.03	0.14	0.75
37	*Gironniera subaequalis* Planch.	0.65	0.40	0.13	0.74	1.79
38	*Gironniera* sp.	2.16	2.38	0.32	1.75	6.29
39	*Gordonia* sp.	0.22	0.40	0.01	0.08	0.69
40	*Gymnacranthera forbesii* (King) Warb.	0.43	0.40	0.08	0.46	1.29
41	*Gynotroches axillaris* Blume	0.65	1.19	0.04	0.23	2.06
42	*Gynotroches* sp.	0.65	0.79	0.07	0.39	1.83
43	*Hevea brasiliensis* (Willd. ex A. Juss.) Mull. Arg.	0.65	0.79	0.12	0.66	2.10
44	*Horsfieldia* sp.	0.22	0.40	0.01	0.05	0.66
45	*Ixonanthes beccarii* Hallier f.	0.22	0.40	0.02	0.14	0.75
46	*Ixonanthes* sp.	11.21	5.56	3.78	20.87	37.64
47	*Knema laurina* (Blume) Warb.	0.86	1.59	0.10	0.53	2.98
48	*Lasianthus* sp.	0.22	0.40	0.01	0.08	0.69
49	*Litsea castanea* Hook.f.	0.22	0.40	0.05	0.26	0.87
50	*Litsea* sp.	3.23	3.17	0.51	2.80	9.21
51	*Macaranga conifera* (Zoll.) Mull.Arg.	0.22	0.40	0.02	0.11	0.72
52	*Macaranga gigantea* (Reichb.f. & Zoll.) Mull. Arg	1.08	0.79	0.29	1.60	3.47
53	*Macaranga* sp.	0.22	0.40	0.01	0.06	0.68
54	*Mallotus* sp.	0.43	0.79	0.06	0.31	1.54
55	*Melicope lunu ankenda* (Gaertn.) T.G. Hartley	0.43	0.79	0.04	0.24	1.46
56	*Microcos fibrocarpa* (Mast.) Burret	0.22	0.40	0.02	0.09	0.70
57	*Myristica elliptica* Wall. Ex Hook.f. & Thomson	0.43	0.40	0.28	1.56	2.38
58	*Neonauclea* sp.	0.43	0.79	0.07	0.40	1.62
59	*Neoscortechinia* sp.	0.43	0.40	0.03	0.19	1.02
60	*Palaquium* sp.	0.22	0.40	0.03	0.16	0.77
61	*Pavetta indica* L.	0.43	0.79	0.04	0.20	1.43
62	*Pavetta* sp.	1.72	2.38	0.18	1.02	5.12
63	*Porterandia anisophylla* (Jack ex Roxb.) Ridl.	1.08	1.59	0.10	0.54	3.20
64	*Psychotria* sp.	0.22	0.40	0.05	0.28	0.89
65	*Pternandra* sp.	8.62	3.57	0.81	4.50	16.69
66	*Pyrenaria* sp.	0.43	0.79	0.08	0.45	1.68
67	*Rhodamnia cinerea* Jack	0.22	0.40	0.02	0.10	0.71
68	*Saurauia glabra* Merr.	0.22	0.40	0.04	0.20	0.81
69	*Saurauia* sp.	0.22	0.40	0.01	0.08	0.69
70	*Styrax paralleloneurus* Perkins	0.43	0.79	0.06	0.34	1.56
71	*Swintonia* sp.	0.65	0.40	0.11	0.61	1.66
72	*Syzygium aromaticum* (L.) Merr. & Perry	0.22	0.40	0.01	0.08	0.69
73	*Syzygium chloranthum* (Duthie) Merrill & Perry	0.22	0.40	0.01	0.08	0.69
74	*Syzygium hirtum* (Korth.) Merr. & Perry	0.22	0.40	0.01	0.07	0.68
75	*Syzygium oligomyrum* Diels	0.86	1.19	0.16	0.87	2.92
76	*Syzygium racemosum (*Blume) A.D.C	0.22	0.40	0.04	0.20	0.81
77	*Syzygium* sp1	1.08	1.98	0.14	0.75	3.82
78	*Syzygium* sp2	1.94	2.78	0.37	2.04	6.76
79	*Terminalia* sp.	0.22	0.40	0.02	0.12	0.73
80	*Urophyllum* sp.	5.17	5.16	0.60	3.32	13.65

81	*Vitex pinnata* L.	3.45	3.57	0.40	2.21	9.23
82	*Vitex pubescens* Vahl.	0.22	0.40	0.01	0.08	0.69
83	*Vitex* sp.	4.96	5.16	0.67	3.73	13.84
	TOTAL	100	100	18.09	100	300

Diversity Index (H′)

The species diversity index calculated using the Shannon-Wiener formula produces a value of 3.70 which shows that the UIN Sulthan Thaha Saifuddin Jambi Campus Forest has a high diversity of tree species, in accordance with the H′ value criteria according to Indriani et al., (2008) if the species diversity index value is > 3 then the species diversity is classified as high.

Index of Evennes

The index of evenness (E) of tree species in the campus forest of UIN Sulthan Thaha Saifuddin Jambi shows a value of 0.84. Based on criteria (Magurran, 1998; Mirdat et al., 2017) If the index of evenness (E) value is above 0.6 then an ecosystem is categorized as having a high evenness index.

DISCUSSION

The tree species that exhibited the highest number of individuals discovered at the site of the research were *Ixonanthes sp.* with a total of 52 specimens, *Pternandra sp.* with 40 specimens, and Dyera costulata (Miq.) Hook.f. with 33 specimens. *Ixonanthes sp.* species comprise the majority of the sampling area because, according to Anwar & Zaery, (2022), the observation location comprises multiple plots featuring open areas, and *Ixonanthes sp.* predominates among them, indicating that these plants are able to thrive in such conditions.

Ixonanthes sp., *Pternandra sp.*, and *Dyera costulata* (Miq.) Hook.f have the highest relative density (KR) values, measuring 11.21%, 8.62%, and 7.11%, respectively (see Table 1). This indicates that as species density increases, the number of individuals present at the research site also increases. According to Chairul & Arwin, (2023), the high KR value is attributable to the species' capacity to adapt in a way that makes it suitable for forest habitats; environmental factors also contribute to the species' distribution pattern. The environmental factors under consideration consist of a neutral soil pH category of 6.6 and an air temperature of 28.96°C at the research site, which is considered ideal for plant growth. Consequently, research sites frequently harbor specimens of these species, which exhibit favorable growth rates and remarkable environmental adaptability.

At a value of 5.56%, the relative frequency (FR) of Ixonanthes sp. was the highest observed. The FR value provides evidence that Ixonanthes sp. This occurs predominantly in the Campus Forest of UIN Sulthan Thaha Saifuddin Jambi. Determining the distribution of individuals within a community is possible based on

the proportion between the number of trees of a particular species and the number of other species.

Ixonanthes sp. holds the highest relative dominance (DR) value at 20.8%. In contrast, Horsfieldia sp. holds the lowest DR value at 0.048%. The reduction in stem diameter of a species impacts the basal area, which in turn affects the relative dominance value. The strength of dominance is directly proportional to the diameter of the stem and the population size of the species (Nurfiana & Sulaiman, 2014).

Ixonanthes sp. has the highest INP of all the tree species found in the UIN Sulthan Thaha Saifuddin Jambi campus forest, at 37.64%. This is because it has high values for relative density, frequency, and dominance. By 0.68 %, *Syzigium hirtum* (Korth.) Merr. & Perry has the lowest INP. *Ixonanthes sp.* species possess a septicidal capsule, which serves to partition the adjacent carpel septa upon fruit rupture. Consequently, research in the campus forest of UIN Sulthan Thaha Saifuddin Jambi revealed that *Ixonanthes sp.* had nearly colonized each observation plot because, according to Setia (2008), various animals, such as birds, rodents, and monkeys, can disseminate the seeds of the tree in addition to natural dispersal through seed drop, depositing the seeds in the surrounding vicinity.

Syzygium hirtum (Korth.) Merr. & Perry exhibits the lowest Ice Nucleating Particle (INP) concentration, measuring at 0.68% because, accoring to (Astuti et al., (2021), *Syzygium hirtum* (Korth.) Merr. & Perry is a plant with limited regenerative ability in comparison to other plant species, purportedly due to hindrances in the fertilization or germination process that affect its success rate.

A community uses the Importance Value Index (INP) as a metric to evaluate the significance of a species. We refer to the INP as the sum of relative density, relative frequency, and relative dominance. The significance of a type (species) in the community is directly proportional to the high value of the INP and inversely proportional to the low value of the INP (Rawana et al., 2023).

The size of the INP (Interaction Network Position) of a species indicates the specific function or role that the species plays within the community. A species with a higher INP than others demonstrates its ability to effectively compete with the surrounding environment and has a greater likelihood of survival compared to other species in the community. Conversely, a tree species with the lowest INP indicates that its distribution is uneven, suggesting that it is less capable of competing with the environment in which it grows (Lestari & Christie, 2020).

Species Diversity Index (H′)

The tree species diversity index (H′) in the campus forest of UIN Sulthan Thaha Saifuddin Jambi was determined using the Shannon-Wienner method, resulting in a value of 3.70. According to Barbour et al. (1987) and Nurfiana & Sulaiman (2014), the species diversity index (H′) falls within the category of high species diversity. A higher value of the diversity index (H′) indicates a greater diversity of tree species and number of individuals, as well as increased species diversity, ecosystem productivity, pressure on the ecosystem, and ecosystem stability.

The vegetation in secondary forests is characterized by a diverse range of tree types, including those found in the UIN Sulthan Thaha Saifuddin Jambi Campus Forest. A high diversity index signifies a highly productive ecosystem with moderate ecological pressure and a well-balanced ecosystem condition. All necessary ecosystem components, including both biotic and abiotic factors, are present in adequate quantities, in accordance with the specific characteristics of each ecosystem.

Index of Evennes

The evenness index obtained in the UIN Sulthan Thaha Saifuddin Jambi campus forest was 0.84. According to Krebs (1985) and Cahyanto et al. (2014), the evenness index falls under the evenness category. A species is considered to have a high evenness index if its value exceeds 0.5.

The index of evenness quantifies the degree of uniformity in the distribution of species within a community, thereby indicating the community's stability. A smaller E value, approaching zero, indicates that a particular species dominates the distribution of species in a community. Conversely, a larger E value, approaching one, suggests that the distribution of species in a community is more even (Wahyudi et al., 2014).

CONCLUSION

In the campus forest of UIN Sulthan Thaha Saifuddin Jambi, a total of 464 individual trees from 83 different species belonging to 30 families were identified. These trees were found in 22 different plots. The tree species diversity index (H′) in the campus forest of UIN Sulthan Thaha Saifuddin Jambi is 3.70, indicating a classification of high species diversity. The evenness index value, also known as the Index of Evenness, is 0.84. This indicates that the distribution of these tree types is evenly spread. Additional investigation is required to study the classification of tree-level plants in the campus forest of UIN Sulthan Thaha Saifuddin Jambi.

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