JBIO : journal of biosciences
(the journal of bioscenes)
Vol. 10. No. 1. Maret 2024

ISSN 2443-1230 (print)
ISSN 2460-6804(online)
DOI: https://doi.org/10.24114/jbio.v10i1.40387

JBIO: jurnal biosains (the journal of biosciences)
http://jurnal.unimed.ac.id/2012/index.php/biosains
email : jbiosains@unimed.ac.id
Universitas Negeri Medan

ANALYSIS OF THE DIVERSITY OF UNDERSTORY SPECIES AT THE GREENHOUSE DEPARTMENT OF BIOLOGY, UIN ALAUDDIN MAKASSAR

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Received : Agust 2023
Revised : February 2024
Accepted : March 2024

First Publish Online : March, 30, 2024

Keywords : Diversity; Dominance; Ecology; Understory; Vegetation

ABSTRACT

Undergrowth is one of the constituents of a forest vegetation ecosystem. Over time, the condition of the land that has experienced succession will be overgrown by pioneer species and become understory. This research is to determine the distribution of understory species at the post-land clearing location at the greenhouse construction site, Department of Biology, UIN Alauddin Makassar. The variables of this research are diversity, evenness, dominance, and community similarity of understory plants that live in that location. Based on observations, the species distribution at the study site reached 35 species in 3 observation points. This condition indicates that the understory species in the research area are abundant and dominated by *L. Nummularia*, *S. obtusifolia*, and *C. dactylon*. The community similarity index shows a figure of 12%, which means the categories are not the same. The species diversity index shows that the three observation plots are moderate. Regarding the evenness, only *S. nodiflora* had a moderate evenness ($0.6 \leq e \leq 0.4$). Meanwhile, species with low evenness ($e < 0.4$) were *C. dactylon*, *S. tora*, and *S. obtusifolia*.

ISSN 2443-1230 (print)
ISSN 2460-6804(online)
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Introduction

Undergrowth is one of the constituents of a forest vegetation ecosystem (Abellanas & Pérez-Moreno, 2018). The understorey is a stratifying community on the forest floor or areas on the ground (Schilperoort et al., 2020). The striking difference between understorey plants is the categorization that does not include and cannot grow to reach the tree stage (Wei et al., 2021). The presence of understorey is one of the biodiversity (Botequim et al., 2021), protecting the soil from erosion, protecting organisms and soil fertility (Wardhani, Rofi'i, Kusumandari, Subrata, & Wianti, 2020), creating a microclimate, as medicinal plants (Anggraini, Surayya, Putri, & Dasumiati, 2016), as well as maintaining the soil foundation (Hilwan, Mulyana, & Pananjung, 2013). In addition, the presence of understorey can also reduce the dominance of stands from homogeneous forests.

Undergrowth is not only under forest vegetation. However, it is also found in open land (Setiawan, Sutedjo, & Matius, 2018), both of which have experienced primary and secondary succession. Succession is an environmental condition that has changed plant species within a certain period (Hasanah, Syarofah, Sulistiani, & Zatunni'mah, 2020). Over time, land conditions that have undergone succession will be overgrown by pioneer species. The pioneer species will then become understorey.

This research was then conducted to determine the diversity, evenness, dominance, and community similarity of understorey species at the post-land clearing location to construct a greenhouse, Department of Biology, UIN Alauddin Makassar in Romangpolong Village, Somba Opu, Gowa Regency, South Sulawesi.

Materials and Methods

The research was conducted in December 2021, located at the greenhouse construction site of the Department of Biology, Faculty of Science and Technology, UIN Alauddin Makassar (

Figure 1). The variables of this study were dominance, uniformity, community similarity, and diversity of understorey vegetation in the research location. Finally, diversity is the number of species at the observation site contained in the observation plot.

This research was preceded by making initial observations through the species-area curve method. This method uses an observation plot expansion system of 1 m^2, 2 m^2 (Nurjaman, Kusmoro, & Santoso, 2017), 4 m^2, 8 m^2, and so on (Figure 2). The expansion of this observation plot is stopped when the incoming species is considered not to increase, or the addition is less than 30%. The calculated sample was then analyzed quantitatively using variables of dominance (Etemi et al., 2020), diversity (Pribadi, Humaira, Haryadi, Buana, & Ihsan, 2020), community similarity (Laxmana, Kasim, & Hamzah, 2020), and diversity (Ningrum & Kuntjoro, 2021).

The description of each variable is as follows:

1. The dominance index aims to obtain data on the concentration and distribution of species. Therefore, the magnitude of the dominance value is directly proportional to the number of similar species in the research location. Determination of dominance value using the formula:

$$C = \sum_{i=1}^{n} \left[\frac{n_i}{N}\right]^2$$

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Information:
C = Dominance Index
ni = Number of individuals of the *i-th* species
N = Number of individuals of all species

The dominance value has the following criteria:

a. ID < 0.5 is considered to have low dominance

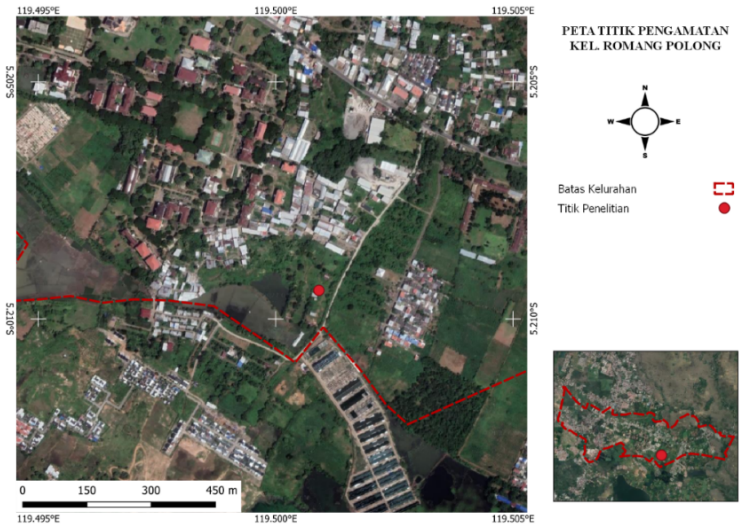

Figure 1. research site map

b. ID 0.5 < ID < 0.75 is considered to have moderate dominance
c. ID > 1 is considered to have high dominance (Sukawati, Restu, & Saraswati, 2017)

2. The species evenness index is used to determine the level of community balance. The evenness index value indicates the level of similarity in the number of individuals of a species which is directly proportional to the level of balance. Calculation of evenness index using the formula:

$$e = \frac{H'}{\ln S}$$

Information:
H' = diversity index
S = Number of species i
e = Evenness index

The evenness index has the following range of values:

a. e > 0.6, which means the species evenness index is high
b. 0.6 ≤ e ≤ 0.4, which means the species evenness index is moderate
c. e < 0.4, which means the species evenness index low (Asiah, Sukendi, Harjoyudanto, Junianto, & Yustiati, 2021)

3. According to (Bhargava, Rajaram, Olson, & Tiede, 2019), species differences in a community can be known through the calculation of the community similarity index below:

$$IS = \frac{3W}{a+b+c} x100\%$$

Information:
IS = Community similarity index
W = Number of the same species between communities a, b, and c
a = Number of species at the first observation point
b = Number of species at the second observation point
c = Number of species at the third observation point

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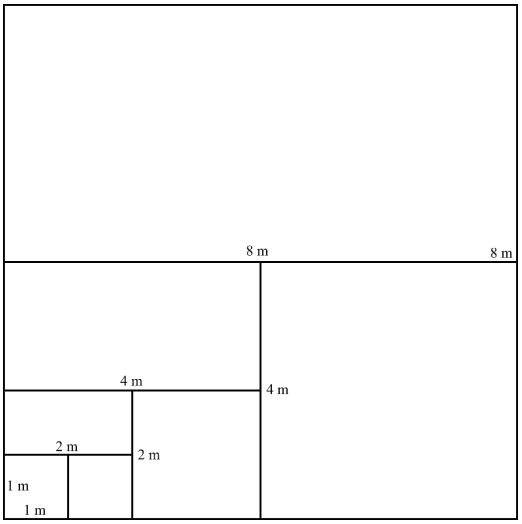

Figure 2. species area curve observation plot shape

If the community similarity index value is below 75%, the community is considered different. However, if the value is more than 75%, the community will be considered the same (Wildi, 2013)

4. The diversity variable uses the Shannon-Wienner Index (H') formula. This index can calculate the number and diversity of species classified into low, medium, and high categories. This index value is calculated using the formula:

$$H' = \sum \frac{ni}{N} \log \frac{ni}{N}$$

Information:
H' = Shannon-Wiener diversity index
ni = Number of individuals of the *i-th* species
N = Number of individuals of all species

The value of the Shannon-Wienner index is categorized as follows:

a. If the value of H' > 3, then the value of species diversity is high
b. If the value of 1 ≤ H' ≤ 3, then the value of species diversity is moderate
c. If the value of H' < 1, then the value of species diversity is low (Rohmayani, Sari M., Romadhon, & Wahyuni, 2021)

5. Species identification is made so that the plant's identity can be known. Identification is made by observing the morphology of the species in detail. Identification is usually made through four methods. These methods include the key to determination, comparison of specimens, writing descriptions, and expert opinion.

Results and Discussion

The results of observations on the distribution of individual undergrowth at the Greenhouse Department of Biology construction site, UIN Alauddin Makassar, were 35 species, divided into three observation plots (

Figure 3). However, each observation plot showed a different number of individual presences (

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Figure 4).

The first plot consisted of 284 individuals, with the species *Adenostemma Lavenia*, *Alternanthera sessilis*, *Arachis pintoi, Arthraxon hispidus*, *Axonopus compressus, Blechum pyramidatum*, *Chromolaena odorata*, *Cynodon dactylon*, *Cyperus fuscus*, *Desmodium triflorum*, *Digitaria ciliaris*, *Glycine soja*, *Kyllinga monocephala*, *Kyllinga nemoralis*, *Lysimachia nummularia*, *Lythrum hyssopifolia*, *Manihot esculenta*, *Mercurialis perrenis L*, *Mimosa pudica*, *Momordica charantia*, *Ocimum basilum*, *Phyllanthus urinaria*, *Richardia scabra*, *Senna tora*, *Sida acuta*, and *Vernonia cinerea L*. The second observation plot has a total of 313 individuals with the species being *A. compressus*, *C. odorata*, *Cyanthillium cinereum*, *C. dactylon*, *Kyllinga brevifolia*, *M. pudica*, *Polycarpon tetraphyllum*, *Scoparia dulcis*, *Senna obtusifolia*, *S. acuta*, *Synedrella nodiflora*, *Ulmus pumila*, and *Urena lobata*. Finally, the third observation plot has inhabited by 224 individuals consisting of *C. cinereum*, *C. dactylon*, *Hibiscus sabdariffa*, *K. brevifolia*, *M. pudica*, *P. tetraphyllum*, *S. dulcis*, *S. obtusifolia*, *S. tora*, *S. nodiflora*, *U. pumila*, and *U. lobata*. However, several species were later present in the two observation plots, namely *A. compressus*, *C. cinereum*, *C. odorata*, *K. brevifolia*, *P. tetraphyllum*, *S. acuta*, *S. dulcis*, *S. nodiflora*, *S. obtusifolia*, *S. tora*, *U. lobata*, and *U. pumila*. These species are invasive (Setyawati, Sunardi, & Tjitrosoedirdjo, 2021; Tjitrosoedirdjo, 2005), so they can be present in every observation plot. The condition happens because they have a high dispersal ability, are adaptive to environmental changes, and have no predators or competitors (Radiansyah et al., 2015). Furthermore, Presiden Republik Indonesia (1994) confirms that these invasive species are the result of introductions and spread out of their natural habitats so that they can threaten biodiversity.

Based on the analysis results related to the level of community similarity in each observation plot, it is concluded that all the observation plots have a low or unequal level of similarity (IS = 12%). This condition is under the provisions of the minimum limit value of similarity between communities so that it can be said to be different, namely 75% (Humaira, Izmiarti, & Zakaria, 2016). This condition occurs in the third and second plots, where the analysis results exceed the minimum limit.

Many factors can cause this condition, such as altitude, air and soil humidity, pH, and the influence of the dominant wind speed and direction (Nurjaman et al., 2017).

Figure 3. comparison of the real presence of species in each observation plot

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ISSN 2460-6804(online)
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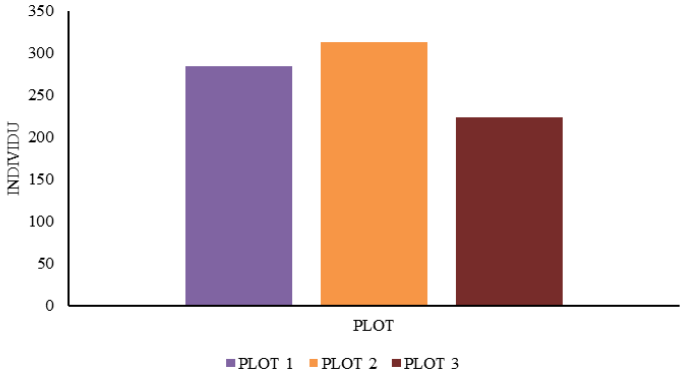

Figure 4. comparison of the real presence of total individual in each observation plot

This grouping indicates differences in the species composition of undergrowth between plots. The first and third plots are located far apart, so there probably needs to be more resemblance. Nevertheless, in the second and third plots, the locations are very close together. So, the species present and likely to dominate the two areas are similar, such as *C. cinereum*, *C. dactylon*, *K. brevifolia*, *M. pudica*, *P. tetraphyllum*, *S. dulcis*, *S. obtusifolia*, *S. acuta*, *S. nodiflora*, *U. pumila*, and *U. lobata*. This condition is probably due to several species dominating each observation plot.

In the first observation plot, the species with the dominant presence (**Kesalahan! Sumber referensi tidak ditemukan.**) was *L. nummularia*, with as many as 57 individuals (ID = 0.03890). In contrast, the least numerous in this plot were *C. minima*, *C. esculenta*, *G. sepium*, *T. pentandra*, and *U. lobata*, each containing only one species (ID = 0.00001). While in the second observation plot, the dominant species was *S. obtusifolia,* with 162 individuals (ID = 0.26788). At the same time, the species with at least two individuals were *S. acuta* (ID = 0.000004). Finally, the third observation plot was dominated by *C. dactylon* with 120 individuals (ID = 0.28193) and *C. mucunoides*, *S. acuta*, and *Z. elegans* with as many as one individual (ID = 0.00002). Species *L. nummularia*, *S. obtusifolia*, and *C. dactylon* dominated the three observation plots due to damaged or disturbed research sites. The lack of tall trees is also a factor. In addition, because the soil in the study area is mostly clay, waterlogging occurs very often. However, the three species are classified as low (ID < 0.5) when referring to the dominance index criteria. Dominance can be said to describe the level of species cover in an area (Gunawan, Basuni, Indrawan, Prasetyo, & Soedjito, 2011). Abiotic factors influence species that dominate an ecosystem. Generally, the species of vegetation that dominates an area has a major influence on the formation of the characteristics of the habitats that make up the landscape (Paga, 2020).

Regarding the evenness index (**Kesalahan! Sumber referensi tidak ditemukan.**) or species from the three observation plots, only *S. nodiflora* had a moderate evenness ($0.6 \leq e \leq 0.4$) in the second observation plot. Meanwhile, species with low evenness ($e < 0.4$) were *C. dactylon* and *S. tora* in the third observation plot and *S. obtusifolia* in the second observation plot. For the diversity index (**Kesalahan! Sumber referensi tidak ditemukan.**), all the observation

ISSN 2443-1230 (print)
ISSN 2460-6804(online)
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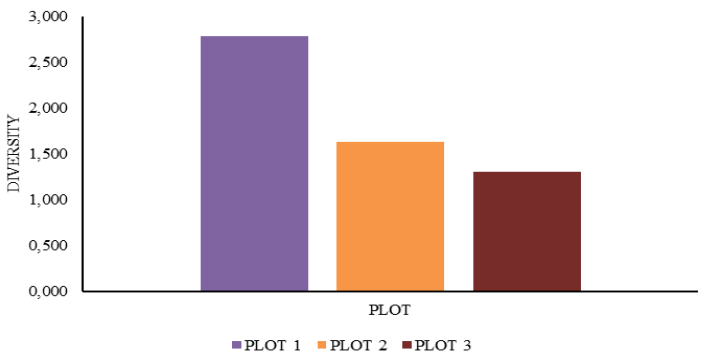
plots are classified as moderate ($1 \leq H' \leq$ 3). The presence of almost all species in at least two different sample plots is the cause of moderate diversity.

According to Odum (1959) the community diversity level is supported by many or at least the constituent species. Therefore, diversity will be high if it is composed of many species. Otherwise, it will be low if it is composed of a few species. Furthermore, Odum (1975) said that the community is identical to the stability of its ecosystem. It is also related to the diversity of species that comprise the ecosystem. If the diversity is high, then the condition of the ecosystem tends to be stable. If the environment is disturbed, then the condition of diversity will be moderate. However, if the environment is polluted, the diversity will be low.

Table 1. Comparison of evenness index and species dominance in each observation plot

No	Species	Evenness			Dominance		
		Plot 1	Plot 2	Plot 3	Plot 1	Plot 2	Plot 3
1	*A. compressus*[b]	1.27	0.397	-	0.00100	0.0380	-
2	*A. hispidus*	2.01	-	-	0.00020	-	-
3	*A. Lavenia*	2.01	-	-	0.00020	-	-
4	*A. pintoi*	1.43	-	-	0.00061	-	-
5	*A. sessilis*	0.86	-	-	0.00838	-	-
6	*B. pyramidatum*	0.96	-	-	0.00402	-	-
7	*C. cinereum*[c]	-	0.910	1.186	-	0.0004	0.0002
8	*C. dactylon*[a]	1.73	0.680	0.272	0.00031	0.0012	0.2870
9	*C. fuscus*	4.02	-	-	0.00005	-	-
10	*C. odorata*[b]	0.86	0.602	-	0.00838	0.0023	-
11	*D. ciliaris*	0.76	-	-	0.01886	-	-
12	*D. triflorum*	1.73	-	-	0.00031	-	-
13	*G. soja*	2.01	-	-	0.00020	-	-
14	*H. sabdariffa*	-	-	1.879	-	-	0.0001
15	*K. brevifolia*[c]	-	0.636	0.940	-	0.0017	0.0003
16	*K. monocephala*	1.43	-	-	0.00061	-	-
17	*K. nemoralis*	1.27	-	-	0.00100	-	-
18	*L. hyssopifolia*	2.54	-	-	0.00011	-	-
19	*L. nummularia*	0.69	-	-	0.04028	-	-
20	*M. charantia*	2.01	-	-	0.00020	-	-
21	*M. esculenta*	1.73	-	-	0.00031	-	-
22	*M. perrenis L*	4.02	-	-	0.00005	-	-
23	*M. pudica*[a]	1.43	1.485	1.186	0.00061	0.0001	0.0002
24	*O. basilum*	2.01	-	-	0.00020	-	-
25	*P. tetraphyllum*[c]	-	1.177	1.186	-	0.0002	0.0002
26	*P. urinaria*	1.73	-	-	0.00031	-	-
27	*R. scabra*	2.01	-	-	0.00020	-	-
28	*S. acuta*[b]	1.73	2.353	-	0.00031	0.0000	-
29	*S. dulcis*[c]	-	0.910	1.186	-	0.0004	0.0002
30	*S. nodiflora*[c]	-	0.520	1.186	-	0.0054	0.0002
31	*S. obtusifolia*[c]	-	0.321	0.809	-	0.2679	0.0005
32	*S. tora*[d]	1.01	-	0.302	0.00317	-	0.1121
33	*U. lobata*[c]	-	1.485	1.879	-	0.0001	0.0001
34	*U. pumila*[c]	-	1.177	0.940	-	0.0002	0.0003
35	*V. cinerea L.*	1.43	-	-	0.00061	-	-

[a] species presents in each observation plot
[b] species present in the first and second observation plots
[c] species present in the second and third observation plots
[d] species present in the first and third observation plots



ISSN 2443-1230 (print)
ISSN 2460-6804(online)
DOI: https://doi.org/10.24114/jbio.v10i1.40387

Figure 5. comparison of species diversity in each observation plot

ISSN 2443-1230 (print)
ISSN 2460-6804(online)
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Conclusions

Based on the study results, it can be concluded that the location of the greenhouse construction of the Department of Biology at UIN Alauddin Makassar has abundant undergrowth. There were several species present at each observation point, namely *A. compressus*, *A. hispidus, A. Lavenia, A. pintoi, A. sessilis, B. pyramidatum, C. cinereum, C. dactylon, C. fuscus, C. odorata , D. ciliaris, D. triflorum, G. soja, H. sabdariffa, K. brevifolia, K. monocephala, K. nemoralis, L. hyssopifolia, L. nummularia, M. charantia, M. esculenta, M. perrenis L, M. pudica, O. basilum, P. tetraphyllum, P. urinaria, R. scabra, S. acuta, S. dulcis, S. nodiflora, S. obtusifolia, S. tora, U. lobata, U. pumila, and V cinerea L*. Nine of these are invasive species. This condition indicates that the understory species in the research area are abundant and dominated by *L. Nummularia*, *S. obtusifolia*, and *C. dactylon*. The community similarity index shows a figure of 12%, which means the categories are not the same. The species diversity index shows that the three observation plots are moderate. Regarding the evenness, only *S. nodiflora* had a moderate evenness ($0.6 \leq e \leq 0.4$). Meanwhile, species with low evenness ($e < 0.4$) were *C. dactylon*, *S. tora*, and *S. obtusifolia*.

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