

Diversity, Evenness, and Abundance of Epiphytic Ferns in The Area Around Villa Silma, Cilember Sub-District, Bogor Regency



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ABSTRACT

This research aimed to find out the diversity, evenness, and distribution abundance of epiphytic ferns scattered in the area around Villa Silma, Cilember District, Bogor Regency. This research used a purposive sampling method by taking samples as the data determined by determining the characteristics of the epiphytic ferns found. Collecting data in this research exploratively by exploring all epiphytic ferns found in the area and observations on the morphology of epiphytic ferns. Data were analyzed through the diversity index using the Shannon-Wiener index, distribution of abundance using the Margalef index, and evenness index using based on the value of the Shannon-Wiener species diversity index. The research results obtained that three species of epiphytic ferns were found in the area around Villa Silma, namely *Asplenium nidus* L., *Asplenium adiantum-nigrum* L., and *Pyrrosia piloselloides* (L.) M.G. Price with different numbers of individuals. The diversity index of epiphytic fern is 0.7 which indicates the level of diversity in the area is low. Then, The distribution of abundance and evenness epiphytic ferns is 0.6 which indicates that there are epiphytic ferns dominant in the area and the number of individuals in each species is unevenly distributed. The most abundant fern epiphytic was found is *Asplenium nidus* L. with 84 individuals. This because the environment allows it to spread and grow the spores of this epiphytic fern plant properly.

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INTRODUCTION

Indonesia has a lot of flora and fauna diversity. There are 40,000 species of flora growing in the world and 30,000 of them live in Indonesia. About 26% have been cultivated and the remaining 74% are still growing wild in forests (Hidayat, 2006; Sukarsa, 2011). One of the diversity of flora in Indonesia is ferns. The fern is one of the plant groups that can be found in almost every region in Indonesia. This plant is a transition between plants with calluses and worms, so that it can be clearly distinguished on three parts of this plant, namely roots, stems and leaves (Irawati *et al.*, 2012; Mardiasutik, 2010; Steenis *et al.*, 2013; Tjitrosoepomo, 2014).

Ferns have important benefits in tropical rainforest communities and structures and play a role in nutrient circulation. Ferns that live epiphytes by attaching to other plants and do not take up nutrients or water in the plants they live on. Epiphytic size varies from small (micro epiphyte) and large (macro epiphyte) and some also live in colonies (Irawati *et al.*, 2012; Sujalu, 2007).

According to Irawati *et al.* (2012) stated that epiphytic ferns are one of the unique groups of ferns that live attached to the surface of the host tree without damaging them. Epiphytic ferns use the host tree as a place to obtain certain environmental conditions while nutrients and water are obtained from deposits around the surface of the host tree. Epiphytic ferns have a stature that is not much different from other ferns, has a vegetative structure in the form of a clump of leaves called ental, the leaves are usually thick because they store water reserves, sometimes chlorophyll, and soft roots. The generative structure is in the form of spores stored in a collection of the sporangium. This fern has beneficial value for everyday human life. The useful value of epiphytic ferns is not only to learn media that can be researched and studied, but the useful value of epiphytic ferns can also be used as ornamental plants, medicines, crafts, and food, such as deer horn nails (*Platyserium bifurcatum*), bird's nest nails (*Asplenium* sp.), and supplier (*Adiantum* sp.) (Irawati *et al.*, 2012; Romaidi *et al.*, 2012; Sujalu, 2007; Tjitrosoepomo, 2014).

Epiphytic nails have an important ecological role which has a function as a litter mixer for nutrient formation, a producer in the food chain, and a habitat for several animals (Romaidi *et al.*, 2012; Sujalu, 2007; Suraida *et al.*, 2013). The aim of this research was to find out the diversity, evenness, and abundance of epiphytic ferns scattered in the area around Villa Silma, Cilember District, Bogor Regency.

METHODS

This research was used as a purposive sampling method by taking samples as the data determined by the epiphytic ferns found. Retrieval of data by tracing the area around Villa Silma and noting all epiphytic ferns found along with their numbers. Then, documented by taking photos of epiphytic ferns using a digital camera. The species of ferns that have been found are identified using a fern identification book. Collecting data in this research exploratively by exploring all epiphytic ferns found in the area and observations on the morphology of epiphytic ferns. Then, the data were analyzed through the diversity index using Shannon-Wiener index, the abundance index using Margalef index, and the evenness index using based on the value of Shannon-Wiener species diversity index with the following formula below:

Diversity index (Shannon-Wiener)

$$H' = - \sum P_i \ln P_i \text{ where } P_i = \frac{n_i}{N}$$

Where,

n_i = The number of individuals for each species of fern

N = The total number of all species of ferns

H' = Diversity index Shannon-Wiener

P_i = n_i/N

Abundance index (Margalef index)

$$D_{mg} = \frac{(S - 1)}{\ln N}$$

Where,

D_{Mg} = Margalef abundance index

S = The Number of species of fern

N = Total individual ferns in the sample

Evenness index

$$E'_1 = \frac{H'}{H \max}$$

Where,

E'_1 = Evenness index

H' = Diversity index Shannon-Wiener

$H \max$ = $\ln S$

S = The Number of Species of fern

RESULTS AND DISCUSSIONS

There are three species of epiphytic ferns found in the area around Villa Silma, namely *Asplenium nidus* L., *Asplenium adiantum-nigrum* L., and *Pyrrosia piloselloides* (L.) M.G. Price can be seen in Figure 1. The number of each species of epiphytic ferns is different and the most epiphytic ferns are 84 in *Asplenium nidus* L., while other epiphytic ferns are found in *Asplenium adiantum-nigrum* L. and *Pyrrosia piloselloides* (L.) MG Price found as many as 13 and 10 individuals, so the number of individual species of epiphytic ferns found was 107 which can be seen in Table 1.

According to Hasanah *et al.* (2021) stated that families with a high number of species were recorded in Polypodiaceae and Aspleniaceae. The Polypodiaceae family is the most abundant epiphytic fern growing on the host trees. This family is one of the richest in epiphytic fern species in the Cibodas Botanical Gardens, Bogor Botanical Gardens, and Mexico (Nasution and Junaidi, 2017; Praptosuwiryo *et al.*, 2019; Nurza and Andriyani, 2021; Jiménez-López *et al.*, 2020). Aspleniaceae and Polypodiaceae were recorded as dominant families in the Kolli Hills of the Eastern Ghats, India (Sureshkumar, 2020). These two families are a group of ferns with the highest species abundance in the world. Many Aspleniaceae, especially those of the genus *Asplenium*, grow as epiphytes and are distributed throughout the world. The majority of this family is in the tropics and southern climates. In addition, Polypodiaceae is also a family that is widely found and spread in almost all tropical and sub-tropical areas (Hasanah *et al.*, 2021).

Table 1. Exploration results of epiphytic ferns in the Villa Silma area

Family	Genus	Species	Number of Species
Aspleniaceae	<i>Asplenium</i>	<i>Asplenium nidus</i> L.	84
		<i>Asplenium adiantum-nigrum</i> L.	13
Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i> (L.) M.G. Price	10
Total			107

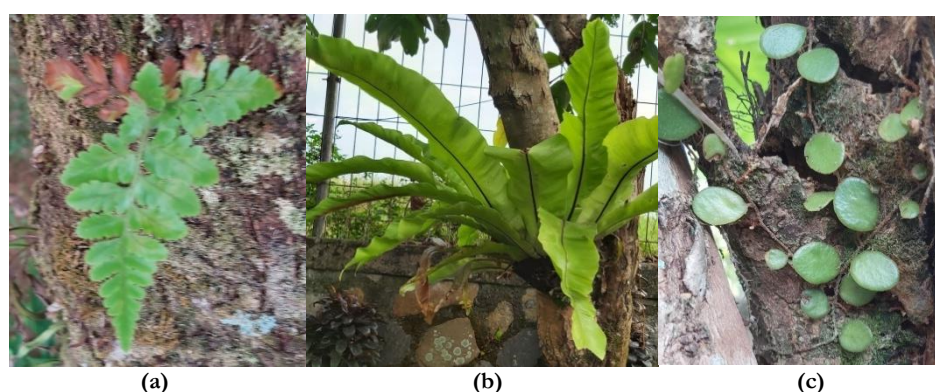


Figure 1. (a) *Asplenium adiantum-nigrum* L., (b) *Asplenium nidus* L., and (c) *Pyrrosia piloselloides* (L.) M.G. Price

In table 2, the diversity index for epiphytic ferns is 0.7 which indicates the level of diversity in the area is low. This is because of the species of epiphytic ferns that can grow and found in the presence of a few species. According to Nahlunnisa *et al.* (2016) stated that increasing the number of species is not always responded to by adding an index value. This is a high number of species but not proportional to the number of individuals that will result in a lower value (Irawati *et al.*, 2012; Magrach *et al.*, 2014; Mucunguzi, 2007; Praptosuwiryo *et al.*, 2019; Rahmad dan Akomolafe, 2018; Suraida dan Amriyanto, 2013). Diversity can decrease or increase depending on the presence of species in an area. Diversity can affect the evenness of epiphytic ferns in urban regions because there are species that dominate. This species is *Asplenium nidus*. *Asplenium nidus* is found in urban regions (Rahmad and Akomolafe, 2018; Böhnert *et al.*, 2016). In addition, the lower diversity index value is caused by anthropogenic disturbance. Cutting down trees for agriculture may be a factor in the low diversity of epiphytic ferns. This activity is evidence that forest fragmentation and habitat conversion affect the diversity of epiphytic ferns in the ecosystem (Stireman *et al.*, 2014; Zambrano *et al.*, 2019).

Table 2. Diversity, evenness, and abundance of epiphytic ferns

Parameters	Index Value
Shannon-Wiener index (H')	0,7
Margalef index (D_{mg})	0,6
Evenness index (E'_1)	0,6

The abundance of epiphytic ferns in the area around Villa Silma is 0.6. This shows that the species of epiphytic ferns are not evenly abundant and only one species of epiphytic ferns is abundant with a large number of individuals (Table 1). One species of epiphytic fern is *Asplenium nidus* L. Then, this species can be abundant because the environment that allows it to spread and grow the spores of this epiphytic fern plant properly. The value of the abundance of ferns is per the number of species found. The number of species found is directly proportional to the abundance value of plant species with the Margalef index and the low abundance of epiphytic ferns as well because the environment may very well reflect the abiotic response. The lack of suitable hosts for colonization also limits the distribution of epiphytic ferns (Rahmad dan Akomolafe, 2018; Suis *et al.*, 2021; Cicuzza *et al.*, 2020; Eskov *et al.*, 2020). In addition, according to Böhnert *et al.* (2016) stated that the abundance and diversity of high epiphytic ferns with total species richness and floristic composition have differences between forest communities and plantation areas. Rubber plantation areas have a lower abundance and diversity of epiphytic ferns than oil palm plantations. Rubber agroforestry is very diverse and is a sanctuary rich in epiphytic fern species. Rubber agroforestry is currently in the process of rapid conversion to rubber and

oil palm monocultures, so it is likely to be shared with some of the remaining forests. According to Cano-Mangaoang *et al.* (2020) stated that the abundance of epiphytic ferns in an area can be attributed to the clearing of other vegetation, thereby providing more sunlight for light-tolerant species. In addition, the higher availability of host plants for attachment is also a factor for epiphytic ferns.

The evenness of epiphytic ferns is 0.6 which indicates that there are epiphytic ferns dominate in the area and the number of individuals in each species is not evenly distributed. This is per the results of observations in table 1 which shows that there is a dominant species of epiphytic ferns, namely *Asplenium nidus* L. with 84 individuals. The low evenness value is due to the existence of species that have a high number of individuals or dominant species, and the number of individuals in each species is uneven. The low species evenness index can be related to the low number of ferns (Magrach *et al.*, 2014; Nahlunnisa *et al.*, 2016; Lestari *et al.*, 2020; Aros-Mualin *et al.*, 2021). The unevenness of epiphytic spikes in this area due to the ability to survive in this environment can support tolerance to only one species so that dominant species appear in this area. Almost all host plants in this area are covered with epiphytic ferns in the Aspleniaceae family, especially the *Asplenium* genus (Taylor *et al.*, 2021; Aros-Mualin *et al.*, 2021).

CONCLUSIONS

Three species of epiphytic ferns were found with different numbers of individuals. The diversity, evenness, and abundance distribution of epiphytic ferns in this area is low and uneven, but the number of individuals found is high. The species of epiphytic fern that is most found in this area is *Asplenium nidus* L. because of the capabilities that highly to survive in that area.

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