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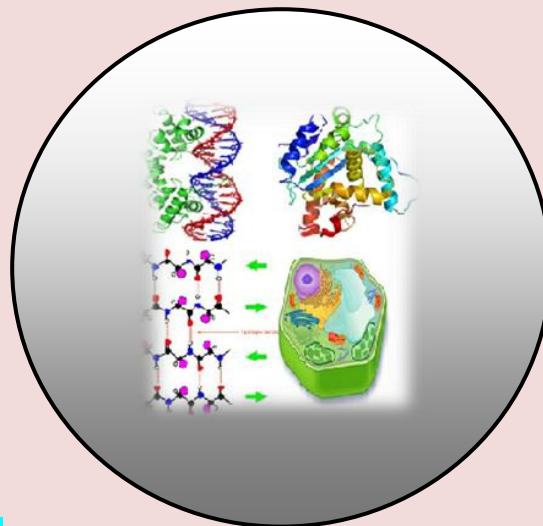
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RESEARCH PAPER

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## **Diversity of Fern Plants on the Track to Gitgit Waterfall, Sukasada, Buleleng**

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### **ABSTRACT**

*Study on the diversity of ferns has been carried out along the route to the Gitgit waterfall Sukasada Buleleng. The research was conducted in January-March 2019. The method used in this study was the line transects method, 2 meters wide and 3 sub-lanes with 243 meters each. So, the research area is 1,458 m<sup>2</sup> (2 m x 3 x 243 m). Identification of ferns based on leaf morphological characters, leaf arrangement on stems, stem shape and color, sporangium position. The results showed that in the Gitgit waterfall area, there were 22 species of ferns belonging to 13 genera and 10 families. The most dominant species found were from the Pteridaceae family. Four species of ferns were found relatively dominant based on their importance value on the track to the Gitgit Waterfall, namely *Adiantum philipense*, *Adiantum raddianum*, *Deparia petersenii* and *Pteris longipinnula*. Based on the moderate diversity index (Shanon-Wiener index 2.97) and the high evenness index (evenness index 0.96), the ecological condition of the track to Gitgit waterfall is good.*

**Keywords:** *Species Diversity, Ferns Species, Line Transect Method and Gitgit Waterfall Area.*

### **INTRODUCTION**

The fern is one of the groups of Indonesian flora which has a high diversity and wide distribution. Fern plants are vascular plants that do not have seeds (vascular seedless). The diversity of Pteridophyta species found in an area can be an indicator of the environmental conditions of the area. The existence of Pteridophyta, as an ecosystem component, can indicate whether the environment supports the life of an organism or not because it has a reciprocal relationship and is interdependent with its environment. The role of ferns as pioneer plants is very important, such as balancing the forest ecosystem, namely as a prevention of erosion, regulating water content and helping the process of decaying forest litter (Nazihah *et al.*, 2018, Arini and Kinho, 2012).

Indonesia contributes significantly to the diversity of ferns in the world. Of the 13,000 species of ferns estimated to exist in the world, around 2,197 species were identified in Indonesia (Elizabeth *et al.*, 2014). In Bali, there are 173 species of ferns (Girmansyah *et al.*, 2013). The Flora of Bali records 165 species of ferns in Bali (Van Balgooy and Widjaja, 2014).

In general, ferns plant well in humid habitats, in general the number of ferns in mountainous areas is more than in lowlands, this is due to high humidity, high water flow, fog, and even the amount of rainfall that affects its kind. In addition to differences in height, there are also differences in tree variation, so that tree variations will also affect abiotic factors which in turn affect the diversity of ferns (Surfiana *et al.*, 2018, Nazihah *et al.*, 2018).

Several studies on the diversity of ferns in Bali have been carried out. Darma *et al.* (2018), found 24 species of epiphytic ferns in the area of Mount Tapak and Lesung Bedugul Bali. Adjie and Lestari have identified around 72 species of ferns in Bali. Putra *et al.* (2016) identified 11 species of ferns in the Dasong Tourism Forest, Buleleng (Ginantra *et al.*, 2015) have also examined one species of fern that has never been reported to be found in Bali, namely the *Helminthostachys zeylanica*. The results of this study found this species in the Bajera area of Tabanan Regency (Sujarwo *et al.* 2014) in an ethnobotany study, reported that there were 4 species of Edible Ferns Used in Bali.

The Gitgit waterfall area is in the Sukasada district, Buleleng regency, Bali. This area is located at an altitude of about 700 m above sea level. The Sukasada district area, especially Gitgit-Buyan-Tamblingan, has a relatively cooler climate, higher humidity and higher rainfall than other Buleleng areas, which is around 105 mm / month. Rainfall occurs every month or throughout the year with almost no dry months. The Gitgit Waterfall area and its surroundings are plantation areas, including coffee, cocoa and clove plantations (Sukasada District in Numbers, 2020).

Habitat conditions on the path to the Gitgit waterfall are humid, water flow, trees in plantations and forests, so that it supports the growth of diversity of nails. Data on the diversity of ferns in the waterfall area is important to know, considering that the presence of ferns is one component of the ecosystem, it can indicate whether the environment supports the life of an organism or not because it has a reciprocal relationship and is interdependent with its environment. In addition, the use of the path to the waterfall for tourism can affect the existence of plants, including ferns. So the focus of this research is to determine the diversity of species of ferns along the tracking path to the Gitgit waterfall.

## **MATERIALS AND METHOD**

### **Study area and period**

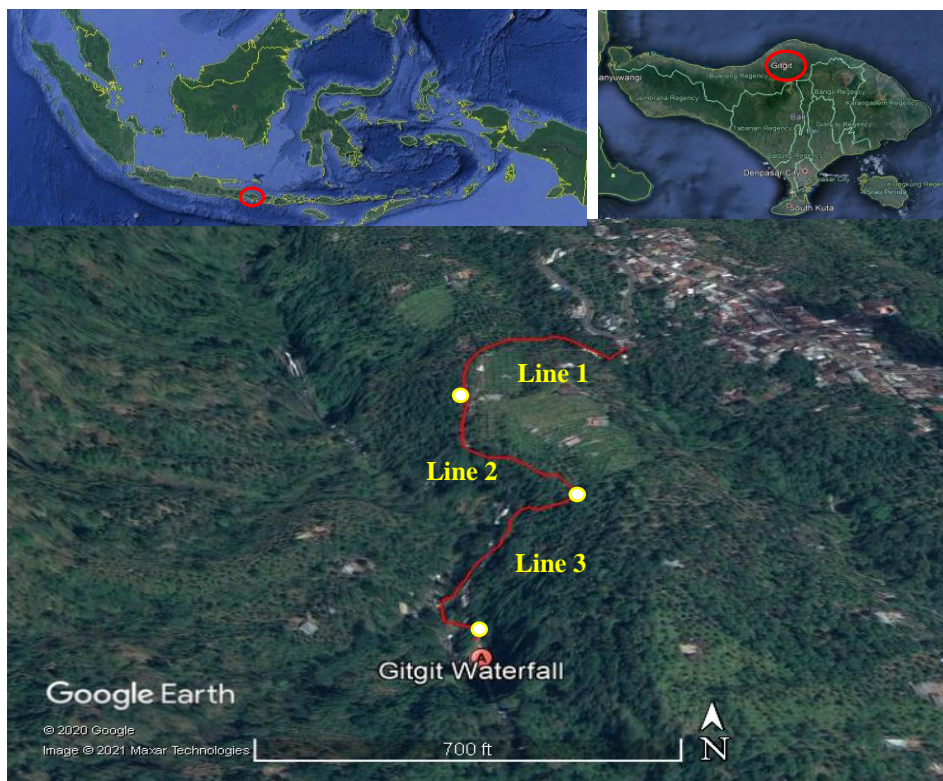
The research was carried out along the route to the Gitgit Waterfall, Sukasada District, Buleleng Regency, Bali, from January to March 2019. The length of the tracking path is 729 m, divided into 3 sub-lines (Figure 1). The research location is at coordinates 8°11'23.02"-8°11'23.30" S and 115°08'09.52"-115°08'05.83" E, altitude between 518-600 m above sea level. The path to the Gitgit waterfall is a plantation area, rice fields (Tea, Chocolate, Coffee) and rainforest.

### **Data collection technique**

The data was collected by using the line transect method (Stiling, 1996), 2 meters wide and 3 sub-lanes with a length of each lane is 243 meters. So, the research area is 1,458 m<sup>2</sup> (2 m x 3 x 243 m). The number of clumps of nails found in each lane is recorded (one clump of ferns is counted as one individual). Each species was photographed for identification. Identification of fern species based on leaf morphological characters, leaf arrangement on stems, shape and color of stems, position of sporangium, identification refers to Flora Indonesian, Fern of Bali (Adjie and Lestari, 2011).

### **Data analysis**

Data on the number of clumps and the presence of ferns in the 3 sub-lines along the tracking line were calculated to determine the importance value of each species. Furthermore, the importance value of fern species is based on the sum of the relative density and relative frequency of each species. The plant diversity index (H) uses the Shannon-Wiener index,  $H = -\sum (ni / N) \times \ln (ni / N)$ , which *ni* is the important value of the species-*i* and *N* is the total important value of all species. The evenness index is  $H / \ln S$ , where *S* is the number of species (Stiling, 1996).



**Figure 1. Map of fern plant study locations.**

## RESULTS AND DISCUSSION

The results of the research in the Gitgit waterfall area found 22 species of ferns, consisting of 13 genera and 10 families. The most dominant species from the Pteridaceae family were found, namely 6 species (Table 1). Four species of ferns are relatively dominant based on their importance on the path to the Gitgit waterfall, namely *Adiantum philipense*, *Adiantum raddianum*, *Deparia petersenii* and *Pteris longipinnula*. These species have a high frequency of presence along the line (on 3 lines). The four species grow on the ground, under the shade of other plants and around rocks where conditions are quite humid. *Cyathea latebrosa* tree species are not widely found, only a few individuals around the waterfall. *Pyrrosia lanceolata* species are epiphytic fern found by several individuals attached to cacao and *Zyzigium* plants in line 2 (the path through the plantation). Most of the species of ferns found in the Gitgit waterfall area are species of ferns that have been recorded in the fern of Bali by Adjie and Lestari (2011).

Environmental conditions in the Gitgit waterfall area, namely high soil moisture, high humidity, temperature range between 22-28 °C, light intensity that is not too high because of the shade that supports the growth of various types of nails (Imaniar *et al.* 2017) conducted research in the area of Kapas Biru Waterfall, Pronojiwo District, Lumajang Regency, stating that areas with high humidity (air humidity around 80 %), soil humidity at 50 %, the presence of shade so that light intensity is not too high, temperature range 21-27 °C is very supportive for the growth of species diversity of ferns. The condition of the Kapas Biru Lumajang waterfall area is somewhat similar to the conditions in the area leading to the Gitgit waterfall, so the richness of the species of ferns is also high.

**Table 1. Species diversity of ferns along the tracking path to Gitgit Waterfall.**

No.	Species	Family	Distribution of ferns in the tracking lines			Importance value
			Line 1	Line 2	Line 3	
1	<i>Adiantum concinnum</i>	Pteridaceae	-	√	√	10.53
2	<i>Adiantum philipense</i>	Pteridaceae	√	√	√	21.61
3	<i>Adiantum raddianum</i>	Pteridaceae	√	√	√	18.13
4	<i>Cyathea latebrosa</i>	Cyatheaceae	-	-	√	5.27
5	<i>Deparia petersenii</i>	Athyriaceae		√	√	14.02
6	<i>Diplazium esculentum</i>	Athyriaceae	-	√	√	9.37
7	<i>Dryopteris sparsa</i>	Dryopteridaceae	-	-	√	6.43
8	<i>Lygodium microphyllum</i>	Lygodiaceae	√	-	-	5.27
9	<i>Lygodium sp.</i>	Lygodiaceae	√	-	-	5.27
10	<i>Microlepia speluncae</i>	Dennstaedtiaceae	-	√	√	5.27
11	<i>Nephrolepis biserrata</i>	Lomariopsidaceae	√	√	√	5.27
12	<i>Nephrolepis exaltata</i>	Lomariopsidaceae	√	-	-	5.27
13	<i>Nephrolepis sp1.</i>	Lomariopsidaceae	√	-	-	5.27
14	<i>Pteridium sp.</i>	Dennstaedtiaceae	√	-	-	6.43
15	<i>Pteris biaurita</i>	Pteridaceae	-	√	√	11.70
16	<i>Pteris longipinnula</i>	Pteridaceae	-	√	√	15.80
17	<i>Pteris vittata</i>	Pteridaceae	√	-	-	11.70
18	<i>Pyrosia lanceolata</i>	Polypodiaceae	-	√	-	7.59
19	<i>Selaginella delicatula</i>	Selaginellaceae	-	√	√	11.70
20	<i>Selaginella plana</i>	Selaginellaceae	-	-	√	6.43
21	<i>Tectaria coadunata</i>	Tectariaceae	√	-	-	6.43
22	<i>Tectaria sp.</i>	Tectariaceae	√	√	-	5.27
<b>Diversity index (H)</b>						<b>2.97</b>
<b>Evenness index (E)</b>						<b>0,96</b>

Based on the Shannon-Wiener index, the diversity of ferns on the path to the Gitgit waterfall is in the medium category ( $H = 2.97$ ), the evenness index value is 0.96. This shows that the ecological condition of the tracking path to the Gitgit waterfall is still quite good. This is because 22 species of ferns were found in the research area of 1.458 m<sup>2</sup>, with a medium diversity index and a high evenness index.

The existence of different species of ferns with their respective morphological characteristics (Figure 2), namely the arrangement of the leaves, the layout of the leaves on the twigs, the shape of the leaves, the position of the sporangium, the color of the branches are very interesting to observe and become objects of environmental education for visitors to the Gitgit waterfall area. The diversity of species with their unique characteristics becomes the object of introduction to the richness of flora for visitors. The existence of ferns on the slope of the soil on the path to the Gitgit Waterfall is important in maintaining soil stability, because the root system is able to glue / hold the soil so that it is not easily eroded when the rainwater is high (Rizky *et al.* 2018) stated that ferns have a high ecological value as understorey, which plays a role in the formation of nutrients from the resulting litter, as soil cover and prevents soil erosion.



*Adiantum concinnum*



*Adiantum philippense*



*Adiantum raddianum*



*Deparia paterseii*



*Diplazium esculentum*



*Dryopteris sparsa*



*Lygodium microphyllum*



*Lygodium sp.*



*Microlepia speluncae*



**Figure 2. Species of ferns in the tracking path Gitgit Waterfall, Sukasada, Buleleng.**

## **CONCLUSION**

In the Gitgit waterfall area, 22 species of ferns were found, including 13 genera and 10 families. The most dominant species found were from the Pteridaceae family. The ecological conditions of the path to the Gitgit Waterfall are classified as good, based on a moderate diversity index (Shanon-Wiener index 2.97) and a high species evenness index (evenness index 0.96).

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