

Diversity of terrestrial ferns (*Pteridophytes*) in Ciliwung Telaga Warna Puncak Bogor tea estate in West Java

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Abstract. Very few research has been done on the diversity of terrestrial ferns (Pteridophyta) in the Ciliwung Telaga Warna Puncak tea garden in Bogor, West Java. This research aims to understand the diversity of ferns and species of ferns found in the tea plantation area of Ciliwung, Telaga Warna Puncak, Bogor, West Java, by examining ecological indices in the form of important value index and diversity index. Objects collected in the observation were all types of ferns in the Ciliwung Telaga Warna Puncak tea plantation area, Bogor, West Java through line transect techniques (transect sampling) and rectangular sampling which were placed randomly in the census zone (sampling square). The data obtained were processed quantitatively with Microsoft Excel. From the research conducted in the Ciliwung Telaga Warna tea plantation area, 18 species were found. The highest index of important value for ferns was *Selaginella* sp, at 92.98% and the lowest was *Lycopodiella cernua* with an INP value of 1.15%. The value of H' (Species Diversity) obtained in the Ciliwung Telaga Warna Puncak tea plantation area with 4 transects and 100 plots was 1.425, indicating that the species diversity on a transect was moderate.

1. Introduction

Indonesia is a country with high biodiversity, one of which is ferns. Ferns are spherical cormophytes that live anywhere (cosmopolitan). The abundance and distribution of ferns is very high, especially in the tropics. This is particularly true for ferns *Cyathea* Sp which has a very big role in balancing forest ecosystems, including as an erosion prevention (Elsifa, Arisandy, & Harmoko, 2019).

Diversity is the variation found in different types or species of living things in the same genus (Aneva, I, et.al., 2020). Even though they are in the same genus, these living things have different characteristics (Soilhi, H. et.al., 2020). This is in accordance with Odum and Eugene (1993). A community is said to have low species diversity if there are only certain species in the community. Meanwhile, a community which consists of various types of species is said to be a community that has a level of species diversity that describes the variety of plant species from a community which is influenced by the number of species and the relative abundance of each species (Hammond, ME & Pokorný, R., 2020; Sulaiman Shah, S., et.al., 2020).

Research on ferns has been carried out to date, such as research on the diversity of ferns (*Pteridophyta*) in the *Muara Sungai Peniti Mangrove, Segedong District, Pontianak Regency* by Ceri, Lovadi, & Linda (2014), *Diversity of Nail Plants (Pteridophyta) in Kenali Forest Park Jambi City* by XX, *Diversity of Nail Plants (Pteridophyta) in the Selo Hiking Route of the Mount Merbabu National Park, Central Java* by Astuti et al. (2017). Nonetheless, no research has been conducted on the



diversity of ferns (*Pteridophyta*) terrestrial in the Ciliwung Telaga Warna Puncak tea garden area in Bogor, West Java.

This research is expected to research the diversity of ferns and species of ferns found in the Ciliwung Telaga Warna Puncak tea garden area in Bogor, West Java by examining ecological indices in the form of important value index and diversity index.

2. Methodology

Research Scope

The research was conducted in the Ciliwung Telaga Warna Puncak tea plantation area in May - July 2019 by sampling all ferns found in the tea garden. The tools and materials used to conduct the research were a 2x2 meter quadrant, a rope, a mattress strap, a plastic bag, a digital camera, stationery, as well as the Flora of Malaya identification book. The research method in collecting data was the transect method with 2x2 meter plotting. The method used in the preparation of the report was quantitative descriptive method, in which the data was analyzed by calculating the index of importance and diversity.

Research Procedure

Research procedures are written in paragraph form. Sentences were written in detail using good language that is to understand. The research procedure which consisted of several stages was written separately using subtitles. The research procedure was not written in numbering but in paragraph form.

Data Collection and Data Analysis

Data collection was carried out directly by visiting the research site at the Ciliwung Telaga Warna Puncak tea garden area in Bogor, West Java. In the study of the diversity of ferns in the Ciliwung Telaga Warna Puncak tea garden area in Bogor, West Java, primary data and supporting data were collected. Primary data was the number of each type of fern contained in the square (Carvajal-Hernández, et.al., 2018). These data were used to determine the index value of species diversity. Meanwhile, the supporting data collected included light intensity, air temperature, humidity, wind speed, and altitude.

The data analysis was processed quantitatively with Microsoft Excel. The data from the measurement results in the field were then analyzed to obtain the Importance Value Index (INP) of each plant species. INP was obtained based on the sum of the parameters Relative Density (KR), Relative Frequency (FR), and Relative Dominance (DR), which was generated from field data analysis (Indriyanto, 2006; Mueller-Dombois & Ellenberg, 2016). The level of species diversity was measured using the Shannon-Wiener diversity index (H') (Fachrul, 2007). The amount of the Diversity Index according to Shannon-wiener is defined as follows.

- a. The value of $H' > 3$ indicates that species diversity on a transect is high.
- b. The value of $H' \leq 3$ indicates that the diversity of species on a transect is moderate.
- c. The value of $H' < 1$ indicates that the diversity of species in a transect is low.

3. Result and Discussion

The data obtained from the study showed that the highest index of importance for ferns was *Selaginella* sp, at 92.98% and the lowest was *Lycopodiella cernua*, with an IVI value of 1.15%. Moreover, the Diversity Index Value obtained in the Ciliwung Telaga Warna Puncak tea garden area in Bogor, West Java was 1,425, indicating that species diversity on a transect is moderate.

Index Results of the Important Value of Terrestrial Nail Plants in the Ciliwung Telaga Warna Puncak tea garden area in Bogor, West Java.

The dominant species in a plant community usually has the highest IVI among other species. In addition, the amount of the IVI value also indicates the extent of the species' influence in a plant community.

Table 1. Index of the Importance of Terrestrial Ferns in the Ciliwung Telaga Warna Puncak tea garden area in Bogor, West Java.

No	Species	FR (%)	KR (%)	DR (%)	INP (%)
1	<i>Angiopteris evecta</i>	3,57	0,87	0,97	5,41
2	<i>Asplenium nidus</i>	0,51	0,12	6,30	6,93
3	<i>Blechnum orientale</i>	1,53	0,37	0,58	2,48
4	<i>Christella dentata</i>	34,69	41,14	0,95	76,78
5	<i>Cyathea contaminans</i>	3,57	1,61	2,22	7,40
6	<i>Cyathea junghuhniana</i>	19,39	20,45	21,8	61,60
7	<i>Dicranopteris linearis</i>	3,06	1,36	15,2	19,58
8	<i>Diplazium sp</i>	1,02	0,37	0,18	1,58
9	<i>Gleichenia laevigata</i>	0,51	0,25	0,66	1,41
10	<i>Goniophlebium verrucosum</i>	1,02	0,25	0,53	1,80
11	<i>Histiopteris incisa</i>	1,02	0,25	0,13	1,40
12	<i>Lycopodiella cernua</i>	0,51	0,37	0,26	1,15
13	<i>Microlepia sp</i>	1,53	0,49	1,14	3,16
14	<i>Nephrolepis cordifolia</i>	0,51	0,49	5,05	6,05
15	<i>Nephrolepis davallioides</i>	0,51	0,12	4,33	4,96
16	<i>Odontosoria Chinensis</i>	1,02	0,25	1,98	3,25
17	<i>Pteris longipinnula</i>	0,51	0,25	1,31	2,06
18	<i>Selaginella sp</i>	25,51	30,98	36,5	92,98
	Σ	99,99	99,99	99,9	299,98

The importance value index (INP) was obtained from the sum of the relative frequency, relative density and relative dominance. The highest index of important value for ferns was the species *Selaginella sp*, at 92.98% followed by *Christella dentata*, *Cyathea junghuhniana*, *Dicranopteris linearis*, *Cyathea contaminans*, *Asplenium nidus*, *Nephrolepis cordifolia*, *Angiopteris evecta*, and the lowest was the species *Lycopodiella cernua*, with an INP value of 1.15% and followed respectively by the species *Histiopteris incisa*, *Gleichenia laevigata*, *Diplazium sp*, *Goniophlebium verrucosum*, *Pteris longipinnula*, *Blechnum orientale*, *Microlepia sp*, *Odontosoria chinensis*, *Nephrolepis davallioides*.

Diversity Index Calculation Results

The calculation of the diversity index value (H'), ferns in the Ciliwung Telaga Warna Puncak tea garden area in Bogor, West Java shows that the level of species diversity was measured using the Shannon-Wiener diversity index (H') (Fachrul, 2007).

Table 2. Diversity Index (H') of Nail Plants in the Ciliwung Telaga Warna Tea Plantation

Species	Number	Diversity Index (H')
<i>Angiopteris evecta</i>	7	-0,041179547
<i>Asplenium nidus</i>	1	-0,008294081
<i>Blechnum orientale</i>	3	-0,020798184
<i>Christella dentate</i>	332	-0,365401051
<i>Cyathea contaminans</i>	13	-0,066504171
<i>Cyathea junghuhniana</i>	165	-0,32455688
<i>Dicranopteris linearis</i>	11	-0,058549829
<i>Diplazium sp.</i>	3	-0,020798184
<i>Gleichenia laevigata</i>	2	-0,014870326
<i>Goniophlebium verrucosum</i>	2	-0,014870326
<i>Histiopteris incise</i>	2	-0,014870326
<i>Lycopodiella cernua</i>	3	-0,020798184
<i>Microlepia sp.</i>	4	-0,026304978
<i>Nephrolepis cordifolia</i>	4	-0,026304978
<i>Nephrolepis davallioides</i>	1	-0,0082940081
<i>Odontosoria chinensis</i>	2	-0,014870326
<i>Pteris longipinnula</i>	2	-0,014870326
<i>Selaginella sp.</i>	250	-0,363030592
Total	807	1,425166369

The diversity of ferns can be analyzed using species diversity (H'). The H' value obtained from the Ciliwung Telaga Warna Puncak tea garden area in Bogor, West Java with 4 transects and 100 plots is 1.425 indicating that the species diversity on a transect is moderate.

Based on the research carried out, there are two classes of ferns; namely the Filicinae class which consists of 12 families with 16 species, and the Lycopodinae class which consists of 2 families with 2 species. This makes the total species found in the Ciliwung Telaga Warna Puncak tea garden area in Bogor, West Java, is 18 species. In this study, 4 stations were made with different observation locations, such as the distance between one station and another. The physical factors at station 1 included an altitude of 1,545 - 1,504 masl with a temperature of 24.4°C - 26.3°C, 60.5% - 61.0% humidity, and 0.0 m/second wind speed. As for the light intensity found at station one is 1484 lux, 1149 lux, and 1622 lux. At station 1, more types of ferns were found due to the location that is closer to the forest. Meanwhile the types of nails that are prevalent at station 1 were *Cristella dentata* and *Cyathea junghuhniana*.

At station 2, the dominant ferns were *Cristella dentata* and at station 2 there were many plots that has no ferns because there were a lot of weeds covering the soil surface as well as physical factors that affect the presence of ferns, including its height which reaches 1,448 - 1,451 masl, 30.4 ° C - 31.8 ° C air temperature, 47.9% -52.5% humidity, 0.0 m / sec wind speed, and 9900 lux -17100 lux light intensity.

At station 3, the most common ferns found were the types of *Selaginella* sp and *Cyathea junghuhniana*. This is because at station 3, besides being located close to the forest, there is also a flow of water. Moreover, due to safety measures that were carried out in the location, only nail tillers were discovered. At station 3, it was found 1 type of *Asplenium nidus* with a large size. The physical factors of station 3 include an altitude of 1,448 - 1,479 mdpl, 28.3°C - 30.0°C temperature, 49,0% - 56.7% humidity, 0.0 m/sec wind speed, and 2420 lux - 4580 lux light intensity.

At station 4, the types of nails found were *Nephrolepis cordifolia* and *Dicranopteris linearis*. This is because these fern species can live even in dry soil conditions. The physical factors found at station 4 are an altitude of 1,455 - 1466 mdpl, 29.3°C - 30.2°C temperature, 48.8% - 52.6% humidity, 0.0 wind speed, and 3370 lux - 4640 lux light intensity. At station 4, there were many plots with no nails and species found was very little.

4. Conclusion

Based on the research conducted in the Ciliwung Telaga Warna Puncak tea garden area in Bogor, West Java, it was concluded that there were 18 types of ferns from 2 classes (Filicinae, Lycopodinae). The diversity index of ferns in the Ciliwung Telaga Warna Puncak tea garden area in Bogor, West Java is in the medium category (1,425). The Importance Value Index with the highest percentage was found in the *Selaginella* sp species, namely 92.98% and the lowest percentage was found in the *Lycopodiella cernua* species, namely 1.14%.

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