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DIVERSITY OF FERNS (PTERIDOPHYTA) WITH DIFFERENT VEGETATION IN FOREST AREAS BUKUM VILLAGE, SIBOLANGIT SUB-DISTRICT

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ABSTRAK

Tumbuhan paku atau Pteridophyta adalah tumbuhan dari divisi Cryptogamae yang dapat dibedakan dengan jelas antara akar, daun dan batang. Tumbuhan paku memiliki kepentingan ekologis yang besar yaitu sebagai tumbuhan bawah yang berkontribusi pada kelangsungan ekosistem hutan dalam jangka panjang dengan mencampur serasah tanah, sebagai vegetasi penutup tanah, sebagai produsen dalam rantai makanan dan sebagai salah satu tumbuhan pionir dalam suksesi ekosistem hutan. Tujuan dari penelitian ini untuk mengetahui jenis-jenis, indeks keanekaragaman dan pola sebaran tumbuhan paku berdasarkan vegetasi yang berbeda di Kawasan Hutan Desa Bukum Kecamatan Sibolangit Sumatera Utara. Metode yang digunakan pada penelitian adalah metode survey eksploratif dengan teknik pengambilan sampel secara *purposive sampling.* Adapun hasil dari penelitian ini ialah terdapat 39 jenis yang ditemukan di Kawasan Hutan Desa Bukum, 21 jenis pada vegetasi Kawasan Aliran Sungai, 16 jenis pada vegetasi Kebun Kopi, dan 14 jenis pada vegetasi Hutan Primer. Indeks keanekaragaman pada vegetasi Kawasan Aliran Sungai sebesar 2.32 , pada vegetasi Kebun Kopi sebesar 2.02 dan pada vegetasi Hutan Primer sebesar 1.86. Berdasarkan hasil indeks keanekaragaman tersebut menunjukkan bahwa keanekaragaman tumbuhan paku pada kawasan Hutan Desa Bukum tergolong sedang sehingga dikatakan komunitasnya stabil. Indeks Morisita pada vegetasi Aliran Sungai sebesar 1.43, pada vegetasi Kebun Kopi sebesar 2.13 dan pada vegetasi Hutan Primer 2.05. Hasil indeks Morisita dari masing-masing vegetasi tersebut menunjukkan bahwa pola sebaran tumbuhan paku pada Kawasan Hutan Desa Bukum berkelompok karena kondisi lingkungan yang diperlukan oleh tumbuhan paku tidak seragam.

Kata Kunci: Desa Bukum, Pola Sebaran, Tumbuhan Paku, dan Vegetasi.

ABSTRACT

Ferns or Pteridophyta are lower plants from the Cryptogamae division, which can be distinguished between roots, leaves, and stems. Ferns have great ecological

importance, namely as understory plants that contribute to the long-term sustainability of forest ecosystems by mixing soil litter, as ground cover vegetation, as producers in the food chain, and as one of the pioneer plants in the succession of forest ecosystems. This study aims to determine the species, diversity index, and distribution pattern of ferns based on different vegetation in the Forest Area of Bukum Village, Sibolangit District, North Sumatra. The method used in this research is an exploratory survey method with a purposive sampling technique. The results of this study were 39 species found in the Forest Area of Bukum Village, 21 species in the watershed vegetation, 16 species in the Coffee Garden vegetation, and 14 species in the Primary Forest vegetation. The diversity index in the watershed vegetation is 2.32, the coffee plantation is 2.02, and the primary forest is 1.86. Based on the results of the diversity index, it shows that the diversity of ferns in the Forest area of Bukum Village is classified as moderate so the community is said to be stable. The Morisita index on the river flow vegetation is 1.43, the coffee garden vegetation is 2.13, and the primary forest vegetation is 2.05. The results of the Morisita index from each vegetation indicate that the distribution pattern of ferns in the Forest Area of Bukum Village is grouped because the environmental conditions required by ferns are not uniform.

Keywords: Bukum Village, Distribution Patterns, Ferns, and Vegetation.

INTRODUCTION

Pteridophyta is a transitional plant between thallus plants and cormus plants, which means it already has roots, leaves, and stems as the three main components of its body [1]. Ferns have great ecological importance, namely as understory plants that contribute to the long-term sustainability of forest ecosystems by mixing soil litter, as ground cover vegetation, as producers in the food chain, and as one of the pioneer plants in the succession of forest ecosystems. Ferns are also used as culinary ingredients, traditional medicines, and ornamental plants [2].

The distribution of ferns is extensive and can be found in various places by their habitat. The presence of sunlight and rainfall will affect the abundance of plant species in a particular area. According to Loveless (1999), it is known that the total number of ferns in the world is around ± 10,000 species, and 3,000 of them grow in Indonesia [3]. According to Wee (2005), 65% of all species can be found in tropical rainforests [4].

Bukum Village Forest Area is one of the tropical forest areas in North Sumatra. Bukum Village is one of the

villages of Sibolangit District, Deli Serdang Regency, North Sumatra, with an area of about 10.01 km2 and an altitude of approximately 900 m above sea level with slope-shaped land contours. With a geographical location of 3°14'13.23' North latitude and 98°33'59.79' East longitude [5].

The Bukum Forest area is mainly a hilly area drained by several rivers and not far from community settlements. In addition, there is also a reasonably large area of land where the land is used by the community as a place to grow crops and is used for rice fields and coffee plantations [6]. Based on observations that have been made in the Bukum Village Forest Area, there are several different vegetation as a place to grow ferns, starting from the community plantation area (coffee plantation), which is not far from residential areas, the Bukum River flow area which is in secondary forest, and primary forest which is still natural and has not experienced damage caused by humans.

RESEARCH METHODS

Time and Place of Research

This field research was conducted from January 2022 to February 2022 in the Bukum Village Forest Area, Sibolangit District, Deli Serdang Regency, North Sumatra.

Research Tools and Materials

The tools and materials used in this research are newsprint, stationery, meter, raffia rope, plastic, plant scissors, sacks, label paper, stapler, observation sheet, test board, digital camera, hanging label, white duct tape, Global Positioning System or GPS, pack, soil tester, thermo-hygrometer, soil thermometer, 70% alcohol and all ferns (Pteridophyta) found in the Bukum Village Forest Area.

Methods and Data Collection Techniques

This research was conducted directly at the research site to obtain the information that would be needed, and this method is also called the exploratory survey method [7]. Sampling of ferns using the Purposive sampling method by selecting samples of ferns that can represent a population as a research location [8].

Sampling was divided into three locations, namely the Bukum River Watershed Area, the Community Coffee Plantation Area, and the Primary Forest

Area. Sample using the plot/quadrat method measuring 5m×5m totaling 30 plots using three transects. Each location consists of 1 transect with 10 observation plots facing each other with a transect length of 65m, and the distance between plots is 10m.

Environmental parameters measured in this study were air temperature and air humidity using a thermohygrometer, soil moisture and soil pH using a soil tester, soil temperature using a soil thermometer, and altitude and coordinate points using a GPS (Global Positioning System).

Samples found in the field from three different locations were preserved by placing them in plastic bags after wrapping them in newspaper and applying alcohol. The preserved specimens were identified in the laboratory using various guidebooks.

Data Analysis

The results of the data obtained were analyzed using the following formula:

1. Density

Absolute Density (KM)

$$KM = \frac{\sum \text{individual species in the sample}}{\text{sample plot area}}$$

Relative Density (KR)

$$KR = \frac{\text{species density}}{\text{density of all species}} \times 100\%$$

2. Frequency

Absolute Frequency (FM)

$$FM = \frac{\sum \text{plot of the discovery of species}}{\sum \text{all plot}}$$

Relative Frequency (FR)

$$FR = \frac{\text{frequency species}}{\text{frequency of all species}} \times 100\%$$

3. Index of Importance (INP)

INP = KR (Relative Density) + FR (Relative Frequency)

4. Diversity Index (H')

The diversity formula is calculated using the Shannon-Wienner theory, which aims to see a community's level of order and irregularity in a particular area.

H’ = -∑(ni/n) In (ni/n) [9].

5. Distribution Pattern

The distribution pattern of ferns is calculated using the Morisita index formula, which is as follows:

$$Id = n\frac{\sum x^2 - \sum x}{(\sum x)^2 - \sum x}$$ [10].

Descriptions:

Id : Morisita spread index

n : Number of plots

$\sum x$: Number of individuals of a species per plot

$\sum x^2$: Sum of squares of individuals of a species per plot

RESULTS AND DISCUSSION

Types of Pteridophyta in Bukum Village Forest Area

From the results of research that has been carried out on three different vegetation in the Bukum Village Forest Area with a total of 30 plots, 39 species of ferns (Pteridophyta) were found with a total of 811 individuals. There are 14 families of ferns, where the Polypodiaceae family is the most common family with eight species, and the Blechnaceae, Davalliaceae, Dryopteridaceae, Hymenophyllaceae, Marattiaceae, Nephrolepidaceae families are the least number of species, namely one species each.

Table 1. Pteridophyta Species based on Different Vegetation in the Bukum Village Forest Area

No.	Family	Types of Pteridophyta	River flow	Coffee farm	Primary forest	∑ ind
1	Aspleniaceae	*Asplenium caudatum*	-	2	-	2
2		*Asplenium glaucophyllum*	2	-	-	2
3		*Asplenium nidus*	-	7	-	7
4		*Asplenium tenerum*	1	-	-	1
5	Athyriaceae	*Diplazium bantamense*	1	-	85	86
6		*Diplazium cordifolium*	1	-	-	1
7		*Diplazium crenatoserratum*	-	-	12	12
8		*Diplazium dilatatum*	-	-	4	4
9		*Diplazium esculentum*	-	19	-	19
10		*Diplazium sorzgonense*	2	-	-	2
11	Blechnaceae	*Blechnum orientale*	-	4	-	4
12	Chyatheaceae	*Cyathea recommutata*	-	-	5	5
13		*Cyathea spinulosa*	17	2	-	19
14		*Pityrogramma calomelanos*	2	2	-	4
15	Davalliaceae	*Davallia divaricata*	4	5	3	12
16	Dryopteridaceae	*Athyrium dilatatum*	-	-	23	23
17	Hymenophyllaceae	*Hymenophyllum wilsonii*	17	-	11	28
18	Marattiaceae	*Angiopteris angustifolia*	11	-	-	11
19	Nephrolepidaceae	*Nephrolepis biserrata*	-	12	-	12
20	Polypodiaceae	*Belvisia revolute*	6	83	1	90
21		*Drymoglossum piloselloides*	-	3	-	3
22		*Drynaria rigidula*	-	3	-	3

No.	Family	Types of Pteridophyta	River flow	Coffee farm	Primary forest	∑ ind
23		*Goniophlebium* sp.	-	16	-	16
24		*Goniophlebium subauriculatum*	-	-	2	2
25		*Phymatosorus longissima*	1	-	-	1
26		*Phymatosorus scolopendria*	6	-	-	6
27		*Polypodiaceae* sp.	20	-	-	20
28	Pteridaceae	*Adiantum latifolium*	-	1	5	6
29		*Pteris fauriei*	-	-	11	11
30		*Vittaria elongata*	-	9	-	9
31	Selaginellaceae	*Selaginella doederleinii*	3	-	-	3
32		*Selaginella intermedia*	2	-	76	78
33		*Selaginella plana*	4	-	4	4
34		*Selaginella stipulata*	83	-	-	83
35	Tectariaceae	*Tectaria incisa*	34	3	99	136
36		*Tectaria* sp.	2	-	2	2
37	Thelypteridaceae	*Cyclosorus polycarpus*	26	-	-	26
38		*Cyclosorus interruptus*	28	-	-	28
39		*Thelypteris interrupta*	-	30	-	30
	Total		**271**	**201**	**339**	**811**

Based on Table 1. it is known that there are differences in the number of fern species in each vegetation. River flow vegetation produces the highest number of fern species, namely 21 species, with 271 individuals, compared to coffee plantation vegetation and primary forest. This happens because the river flow vegetation has a condition that is always wet, with the highest air humidity of 99%. Following the opinion of Tjitrosoepomo et al. (1983), which argues that ferns generally grow in protected and humid areas in various habitats, some of these fern species can grow in open spaces. They can thrive in temperate regions [11]. The type of fern (Pteridophyta) with the highest number of individuals in the stream vegetation is Selaginella stipulata, with as many as 83 individuals, and the kind of fern with the lowest number of individuals are Diplazium cordifolium, Diplazium bantamense, Phymatosorus longissium,

and Asplenium tenerum which each amounted to one individual.

Based on Table 1. It can be seen that coffee plantation vegetation produces the least number of individuals, namely 201 individuals. This happens because the coffee plantation vegetation is in an open place with reasonably high light intensity and is not shaded by trees, producing the lowest environmental factors. This vegetation is also not spared from the activities of the people of Bukum Village. This is in accordance with the opinion of Handayani and Sugiarti (2019). The soil structure is a place to grow ferns, and as a medium for vegetation growth, if affected by human activity, it will act the existence of ferns (Pteridophyta) [12]. The type of fern (Pteridophyta) with the highest number of individuals in this vegetation is Belvisia revoluta, with a total of 83 individuals, and Adiantum latifolium is a type of fern with the least individuals in coffee plantation vegetation, with a capacity of one individual.

Based on Table 1. it is known that there are 14 species of Pteridophyta with ten families in the Primary Forest Area. The total number of individuals in this vegetation is 339 individuals. Primary Forest vegetation has the highest number of individuals and fewer species than River Flow vegetation and Coffee Plantations. This happens because Primary Forest vegetation has a higher altitude than river flow vegetation and coffee plantation vegetation, namely 1,011 meters above sea level. According to Anwar et al. (1984), if the size of a mountainous area increases, plants will experience a decrease in species abundance accompanied by an increase in the number of individuals [13]. Tectaria incisa is a fern species with the most significant number of individuals in the Primary Forest Area, with 99 individuals. Belvisia revolute is a fern species with the smallest number of individuals, namely one individual.

Diversity Index (H') of Ferns (Pteridophyta)

According to Fachrul (2007), diversity is a parameter used in measuring the stability of plant communities. The higher the value of the diversity index (H') in an area, the community in that area is said to be stable [14]. The results of the calculation of the species diversity index (H') using the Shannon-Wienner

formula of fern species in 3 different vegetation are presented in the table below. The results of the calculation of the species diversity index (H') using the Shannon-Wienner formula of fern species in 3 different vegetation are presented in the table below.

Table 2. Diversity Index (H') of Ferns

Vegetation	Diversity Index (H')
Watershed Area	2.32
Coffee Plantation	2.02
Primary Forest	1.86

Based on Table 2. above there is a comparison of the diversity index value (H') of the three vegetations that are not too different, where the diversity index value (H') in the Watershed vegetation is 2.32, Coffee Plantation 2.02 and in Primary Forest 1.86. Overall, each vegetation's diversity index (H') of ferns is classified as moderate. The diversity index (H') is said to be moderate because it is by the provisions of the Shannon-Wienner diversity index, which defines that if H'<1 then the diversity of a plant is said to be low or negligible, if 3≤ H'≤1 then the variety of a plant is said to be moderate, and if 3> H' then the diversity of a plant is said to be high [14].

The fern species diversity index is classified as average because the Bukum Village Forest Area has moderate complexity, so the interaction is also not too high or too low among the ferns. The number of plant species and environmental conditions determine a plant species' high and low diversity. In addition, the high and low value of the diversity index is caused by the even distribution of species. This is emphasized by Hardjosuwarno (1990), who argues that diversity is the abundance of species weighted by the evenness of the species [12].

Distribution Pattern of Pteridophyta

To determine the distribution pattern of ferns found in Bukum Village Forest Based on Different Vegetation is

calculated using the Morisita Index formula (Id). The results of the calculation of the Morisita Index of ferns found in 3 different vegetation are in Table 3. below.

Table 3. Morisita Index Value of Ferns in the Forest Area of Bukum Village

Vegetation	Morisita Index (Id)
Watershed Area	1.43
Coffee Plantation	2.13
Primary Forest	2.05

Based on the table above, it can be seen that the distribution pattern of ferns in the Watershed vegetation is 1.43, Coffee Plantation 2.13, and Primary Forest 2.05. Each vegetation has a Morisita Index value >1, which means the distribution pattern is grouped. This is by the criteria for dispersal patterns according to Krebs (1985), where if Id < 1 means uniform dispersal patterns, if Id =1 random or random dispersal patterns, and if Id >1, then the dispersal pattern is grouped [15].

Generally, the pattern of group distribution in a particular population is a distribution that often occurs in nature. This is in accordance with the results of research on the third vegetation that produces a pattern of distribution of ferns (Pteridophyta) in groups. Group distribution patterns indicate that the presence of a plant can show the same type of plant in a forest ecosystem. Individuals of a plant will try to find a place to grow with environmental conditions that suit their needs. An individual fern is also more likely to live together therefore, the pattern of distribution of ferns in groups occurs because the Bukum Village Forest area has different or non-uniform environmental conditions, so the type of fern will grow in groups in an area that is suitable for its life needs only. Ecological factors affecting the group distribution pattern are light intensity, temperature, and humidity obtained according to where the fern grows. In accordance with the statement of Haruna et al. (2022) which says that the spread in groups (clumped) occurs due to the sources of nutrients needed by a

plant is not uniform or not spread evenly [16].

CONCLUSIONS

Based on the results of the research that has been carried out, it can be concluded:

1. The types of ferns (Pteridophyta) in the Watershed vegetation were 21 species with a total number of individuals of 271; in the Coffee Plantation vegetation, there were 16 species of ferns (Pteridophyta) with an unlimited number of individuals 201, while in the Primary Forest vegetation, there were 14 species of plants with a total number of individuals of 339.
2. The diversity of fern species (Pteridophyta) in the Bukum Village Forest Area in each vegetation is categorized as moderate, where in the Watershed vegetation H' is 2.32, in the Coffee Plantation H' is 2.02 and in the Primary Forest, H' is 1.86.
3. The distribution pattern of ferns (Pteridophyta) in the Bukum Village Forest Area in each vegetation is said to be grouped because it has a Morisita Index value of >1, whereas in the vegetation of the Id River Flow Area (Morisita Index) of 1.43, in the Id Coffee plantation vegetation of 2.13, and the Id Primary Forest vegetation of 2.05.

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