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DIVERSITY OF FERNS (PTERIDOPHYTA) IN THE SEVERAL MOUNTAINS OF WEST JAVA

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Abstract

The diversity of ferns (Pteridophyta) in the five mountainous in West Java (Mt. of Patuha, Papandayan, Tangkuban Perahu, Pangrango, and Guntur) has not been widely reported. The aim of this research was to obtain data on diversity and similarity of fern species in the five mountains in West Java. This research was conducted by exploring and descriptive analysis method. Comparison of species diversity among all reseach field were calculated by the index of species similarity according to Sorenson. The diversity of ferns in Mt. Patuha, Papandayan, Tangkuban Perahu, Pangrango, and Guntur were 27, 14, 26, 40 and 5 species, respectively. The total number of ferns species in five locations are 83 species from 25 families. Comparison of species diversity among fileds based on the Sorenson similarity index is low (<50%), except between the Mt. Patuha and Mt. Papandayan areas is high (> 50%).

Keywords: *Ferns, Biodiversity, Analytical Descriptions, Sorenson's Similarity Index*

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INTRODUCTION

A fern is one species of interesting flora in Indonesia. The number of this species in the world is estimated there are 10,000 species, and about 22% or 2,197 species in Indonesia. A total of 515 species of this plant were found in Java Island (Wahyuningsih, Murniningtyas, & Effendy S, 2016).

The ferns have a distinctive form of young leaves, shaped like a loop of rope (krozier; ental), which is not found in other plants. In addition, all of these species produce spores that form in sporangium (Yusuf, 2010a); (Nasution dkk, 2018); (Tjitrosoepomo, 2009); (Arini, D. I. D. and Kinho, 2012); (Prastyo, W.R., Heddy, S., 2015). Ferns are grouped into *cryptogamae* that have vessels and prefer to grow in moist areas; therefore about 65% are found in tropical rainforest areas (Hietz, 2010).. According to previous paper (Kessler, 2010), in general, species of ferns grow abundantly in mountainous areas compared to the lowlands.

The ferns have a role both ecologically and economically. Ecologically, the existence of ferns acts as a producer in a food chain and components in the nitrogen cycle. Meanwhile economically, fern has the potential for trade commodities because

of its role as an ornamental plant, medicinal plants, vegetables, and as a protector of seedlings (Vijayakanth & Sathis, 2016);(Richardson, 2010); (Lee, 2011); (Vijayakanth, P. & Sathis, 2016);(Pranita, H. S., Mahanal, S. and Sari, 2017).

The research on various aspects of ferns in several regions in Indonesia has been carried out before, including about distribution of ferns Mt. of Selamat (Widhiastuti, 2006), the relationship of several species of ferns of the Polypodiaceae family (Nurchayati, 2010) and ex situ and in situ efforts at Kebun Raya Cibodas (Nasution, 2015).. In contrast to previous studies, this study examines the existence of ferns in five mountains in West Java (Mt. Patuha, Mt. Tangkuban Perahu, MT. Papandayan, Mt. Pangrango, and Mt. Guntur). These mountains were chosen as a research field, due to the lack of publicity about the existence and diversity of ferns in the area. Aim of this study is rationalize a relationship between diversity and the similarity of ferns in this region which is expressed by the similarity index.

MATERIALS AND METHODS

The samples of ferns were collected by cruise methods, i.e. samples were taken

along the road leading to the top of the mountains (\pm 5 km long and 2 m wide by the road). The ferns were taken from several different growing places including above ground level, in crevices of rocks or attached to tall plant stems. For identification purposes, all parts of nail plants such as roots, stems, and leaves, both fertile and sterile leaves are taken.

Data analysis

The identification process was carried out in the Plant Taxonomy Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences - UNPAD by referring to the identification key book, namely, i.e.

- ferns of Malaysia in Colours (Piggot, 1988).
- Tree Ferns (Braggins, J. E., Mark, 2004).
- Ferns Growner's Manual (Hoshizaki, B. J., 2001);
- Fern Ecology (Mehltreter, K., Walker, L. R. and Sharpe, 2010);
- Fern Classification (Smith, A.R., K.M. Pryer, 2008).

The identification data was then analyzed qualitatively. Comparison of

species diversity of ferns in five research locations, calculated by the similarity index according to Sorensen, with the following formula: $S = 2C/A+B$

Where:

S = Sorensen Similarity Index

A = Number of species in the sample at location A

B = Number of species in the sample at location B

C = Number of species found at locations A and B

RESULTS AND DISCUSSION

Ferns Diversity

The total number of ferns that were collected from all research field was 83 species from 25 families. There are differences in the number of species and families of ferns in each field, namely 27 species of 17 families on Mt. of Patuha, 14 species of 9 families on Mt. of Papandayan, 40 species of 19 families on Mt. of Gede Pangrango, 15 species of 9 families on Mt. of Guntur, and 26 species from 13 families in Mt. of Tangkuban Perahu. Diversity of Ferns in the all research field is shown in Table 1.

Table 1. Diversity of Ferns in the five research locations

NO	FAMILY	SPECIES	RESEARCH FIELD				
			L1	L2	L3	L4	L5
1	Adiantaceae	<i>Adiantum capillus veneris</i>	v		v		
2	Aspidiaceae	<i>Arachnoides hasseltii</i>					v
3		<i>Arachnoides haniffi</i>	v			v	
4		<i>Heterogonium pinnatum</i> (Copel.) Holtt			v		

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5		<i>Heterogonium sagenoides</i>				v
6		<i>Tectaria angulata</i> (Willd.) Copel				v
7		<i>Tectaria melanocaula</i>				v
8		<i>Tectaria crenata</i>				v
9	Aspleniaceae	<i>Asplenium belangeri</i>				v
10		<i>Asplenium caudatum</i> Forst.				v
11		<i>Asplenium macrophyllum</i>				v
12		<i>Asplenium nidus</i>	v	v		
13		<i>Asplenium salignum</i> Bl.				v
14		<i>Asplenium tenerum</i> Forst				v
15		<i>Asplenium thunbergii</i> Kunze				v
16		<i>Asplenium unilaterale</i> Lam.				v
17	Athyriaceae	<i>Diplazium accedens</i> Bl.				v
18		<i>Diplazium asperum</i>				v
19		<i>Diplazium cordifolium</i>				v
20	Blechnaceae	<i>Blechnum finlaysonianum</i> Hook. & Grev				v
21		<i>Blechnum vestitum</i>	v	v		v
22		<i>Brainea insignis</i>	v			
23		<i>Stenochlaena palustris</i>		v		
24	Cibotiaceae	<i>Cibotium baromei</i>				v
25	Cyatheaceae	<i>Cyathea contaminans</i>	v	v	v	v
26		<i>Cyathea dealbata</i>	v	v		
27		<i>Cyathea hymenodes</i>	v			
28		<i>Cyathea latebrosa</i>				v
29	Davaliaceae	<i>Davallia trichomanoides</i>	v	v		
30		<i>Microlepia spiluncar</i>				v
31	Dennstaedtiaceae	<i>Histiopteris incisa</i>	v	v		v
32	Dycsoniaceae	<i>Diksonia blumei</i>	v			
33	Gleicheniaceae	<i>Dicranopteris linearis</i> (Burm.)				v
34		<i>Glichenia linearis</i>	v	v		v
35		<i>Glichenia truncata</i>	v	v		
36	Grammitidaceae	<i>Ctenopteris obliquata</i>	v			v
37		<i>Scleroglossum pusillum</i>				v
38	Hemionitidaceae	<i>Syngamma wallichii</i>				v
39	Hymenophyllaceae	<i>Hymenophyllum</i> sp.				v
40	Hypolepidaceae	<i>Hypolepis beddomei</i>	v			v
41		<i>Hypolepis bivalvis</i>				v
42		<i>Hypolepis broksiae</i>				v
43		<i>Pteridium aquilinum</i> (L.) Kuhn		v	v	v
44	Lindsaeaceae	<i>Sphenomeris chinensis</i>	v			
45	Lomariopsidaceae	<i>Lommagrama parkensis</i>				v
46		<i>Elaphloglossum califolium</i>				v
47	Lycopodiaceae	<i>Lycopodium cernuum</i>	v			v

48		<i>Lycopodium clavatum</i>	v	v	v				
49	Marattiaceae	<i>Angiopteris evecta</i> (Forst.) Hoffm			v	v			
50	Nephrolepidaceae	<i>Nephrolepis biserata</i>					v		
51		<i>Nephrolepis davallioides</i> (Sw.) Kunze			v				
52		<i>Nephrolepis dicksonioides</i>			v				
53		<i>Nephrolepis falcata</i>					v		
54		<i>Nephrolepis radicans</i>					v		
55		<i>Neprolevis tuberosa</i>		v	v				
56	Polypodiaceae	<i>Belvisia revoluta</i>	v	v	v		v		
57		<i>Dipteris conjugata</i> Reinw.			v				
58		<i>Drynaria sparsisora</i>			v				
59		<i>Goniophlebium percisifolium</i> (Desv.) Presl			v		v		
60		<i>Goniophlebium verrucosum</i>					v		
61		<i>Microsorium heterocarpum</i>			v				
62		<i>Microsorium zippelii</i>			v		v		
63		<i>Phymatosorus nigrescens</i>	v						
64		<i>Pityrogramma chrysophylla</i>		v		v			
65		<i>Pityrogramma calomelanos</i>				v			
66		<i>Pyrosia lanceolate</i>	v						
67		<i>Pyrrosia angustata</i>					v		
68		<i>Selliguea feei</i>	v	v					
69	Pteridaceae	<i>Pteris bicuriata</i>					v		
70		<i>Pteris longipinnula</i> Wall. Ex Agardh			v				
71		<i>Pteris mentensioides</i>	v						
72		<i>Pteris tripitata</i>			v	v			
73	Selaginellaceae	<i>Selaginella flagellate</i>	v		v				
74		<i>Selaginella</i> sp.			v				
75	Thelypteridaceae	<i>Chingia sakayensis</i>	v						
76		<i>Christella arida</i>	v			v			
77		<i>Cyclosorus subpubescens</i>					v		
78		<i>Mesophlebion trichocladium</i>	v						
79		<i>Pneumatopteris callosa</i>				v			
80		<i>Sphaerostephanos</i> sp.			v				
81		<i>Thelypteris brunea</i>					v		
82	Vittariaceae	<i>Antrophyum callifolium</i> Bl.			v				
83		<i>Monogramma trichoidea</i> J. Sm.			v				
		<i>Jumlah</i>	25	83	27	14	40	15	26

Where:

L1: Mt.of Patuha

L2: Mt.of Papandayan

L3: Mt.of Gede Pangrango

L4: Mt.of Guntur

L5: Mt.of Tangkuban Perahu

Based on Table 1, Polypodiaceae is the family with the most number of species, i.e as many as 13 species, followed

by Aspleniaceae (8 species), Aspidiaceae and Thelypteridiaceae (7 species), and Nephrolepidaceae (6 species). Similar results were reported in a previous paper (Zhang Xianchun, Lu Shugang, 2013) which states that Polypodiaceae is one of the largest ferns families in China. This is very possible because polypodiaceae is the most diverse and abundant type of vascular plant group in tropical and subtropical forests.

Polypodiaceae members mostly have epiphytic properties. The shape of the leaves of ferns is wide, with various distinctive shapes. Because of its morphology, this ferns are widely used as ornamental plants in parks and rooms, such as “ekor tupai” (*Drynaria*) and “paku tanduk rusa” (*Platycterium*) (Zhang Xianchun, Lu Shugang, 2013).

Species diversity based on the nature of life

Type of epiphytic ferns

Based on Table 1, *Belvisia revoluta* is the most widely spread epiphytic fern species, found in 4 locations namely Mt. of Patuha (L1), Mt. of Papandayan (L2), Mt. of Gede Pangrango (L3), and Mt. of Tangkuban Perahu (L5). This species of ferns lives attached to other plants by not taking nutrients or water from the plants

they are traveling with. Other epiphytic ferns found were *Drynaria sparsisora*, *Pyrosia lanceolate*, *Pyrosia angustata*, and from the Aspleniaceae family of 8 species. Some examples of epiphytic ferns images found can be seen in figures (Fig 1(a), (b), and (c)).

Aspleniaceae is a member of a family of ferns (Pteridophyta) of the “paku sejati” (Filicales) order. Its members are characterized by relatively rigid entals, rather thick leaves, sori located on the underside of leaf blades and hidden behind “folds” which are right on the veins of pinnate leaves (Zhang Xianchun, Lu Shugang, 2013); (Hoshizaki, B. J., 2001).

The number of species found from the family Aspleniaceae is 8 species, 6 species originating from Mt. Gede Pangrango. “Paku sarang burung” (*Aplenium nidus*) is the species with the most number of individuals found.

Type of terrestrial ferns

The number of species of terrestrial ferns found at the study site was 70 species from 23 families. Polypodiaceae family is the family with the most number of species; the most interesting species is the *Pityrogramma* genus. This genus is found in Mt. of Papandayan and Mt. Guntur. The regional names of these

species of ferns are “paku perak” (*Pityrogramma callomelanos*) (Fig 1.(d)) and “paku emas” (*Pityrogramma chrysophylla*) (Fig. 1(e)). This species of ferns is very suitable for ornamental plants (Sastrapradja S, Afriastini JJ, Darnaedi D, 1979). The Aspidiaceae family was also found at the study site, from the Pteridophyta group and the order of "paku sejati" (Filicales). This family represents all the ferns commonly found in the forest (Yusuf, 2010b). From this family, 7 species are found which come from 3 genera, namely *Arachnoides*, *Heterogonium*, and *Tectaria*.

The *tectaria* genus was only found all at Mt. of Gede Pangrango, not found in

other research locations. *Tectaria crenata* is the most recognized species of the genus *Tectaria*, in the regional language known as "paku kikir". *Tectaria crenata* (Fig. 1(f)) is one of the ferns that grow in the highlands, up to a height of 1500 m. These ferns are widely distributed in Malaysia, Indonesia to Polynesia (Sastrapradja S, Afriastini JJ, Darnaedi D, 1979); (Yusuf, 2010b).. The young leaves are used for several purposes, such as vegetables, Gonorrhoe disease drugs after being mixed with *Pleomele angustifolia* (Arini, D. I. D. and Kinho, 2012).

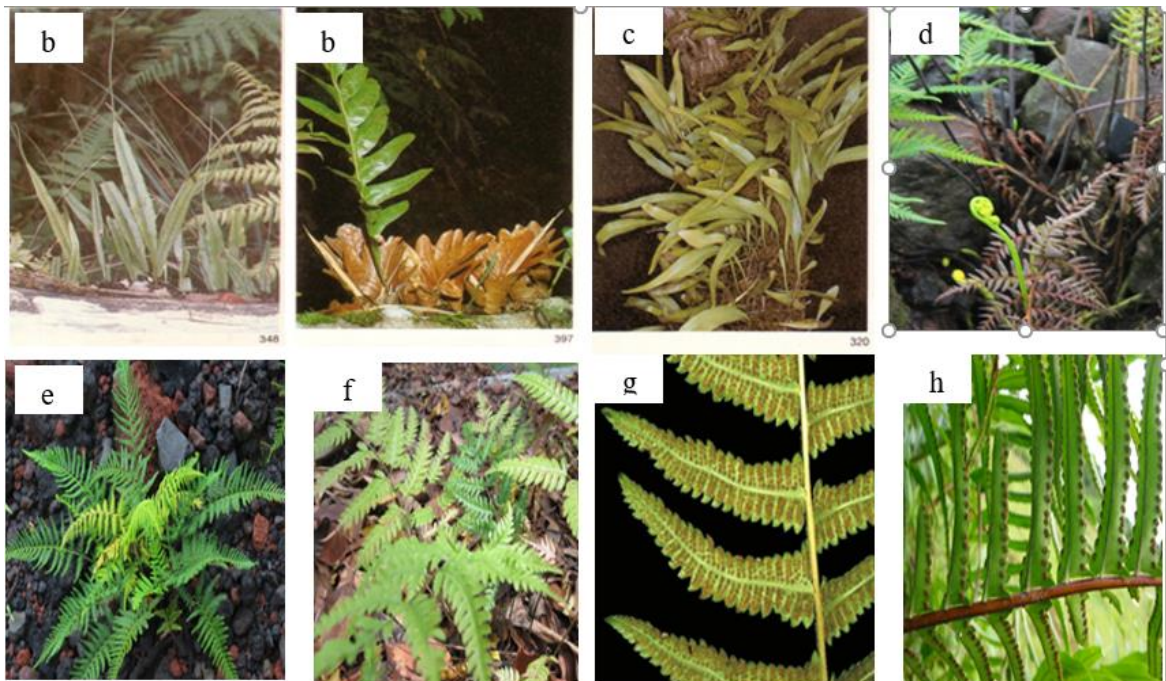


Fig 1. Morphology of the species of ferns found at the study site (a) *Belvisia revoluta* (b) *Drynaria sparsisora* (c) *Pyrosea lanceolata* (d) *Pityrogramma callomelanos* (e) *Pityrogramma chrysophylla* (f) *Tectaria crenata* (g) *Christella arida* and (h) *Nephrolepis* sp.

Thelypteridaceae are classified as "paku sejati" (Tjitrosoepomo, 2009). At the research field, this family consists of 7 species of ferns, 3 species found in Mt. Patuha, namely *Chingia sakayensis*, *Christella arida* and *Mesophlebion trichocladium*, while *Christella arida* (Fig. 1.(g)) found at Mt. Patuha and at Mt. Thunder. Mt. Guntur.

Nephrolepidaceae are classified as "paku sejati" (Filicales). This family has terrestrial, lithophytic or epiphytic characteristics in plants (Tjitrosoepomo, 2009). At the research field, found 6 species and 1 genus ferns from this family, with distribution of 3 species in Mt. Gede Pangrango namely *Nephrolepis davallioides* (Sw.) Kunze, *Nephrolepis dicksonioides* and *Nephrolepis tuberosa*. Other species, namely *Nephrolepis biserata*, *Nephrolepis falcata* and *Nephrolepis radicans* found at Mt. Guntur.

Nephrolepis falcata is often also called "cecerenean ferns" (sunda),

multiplying rapidly, hence is often used for ground cover ornamental plants. Ferns of this species type are widespread in Malaysia, Siam, Indochina to Australia, commonly found in lowland forests to the mountains. (Piggot, 1988); (Sastrapradja S, Afriastini JJ, Darnaedi D, 1979); (Tjitrosoepomo, 2009); (Mehltreter, K., Walker, L. R. and Sharpe, 2010).

Comparison of species diversity at the research field

Comparison of species diversity in all study locations is shown in Table 2. Species similarity among all regions compared is expressed by the Sorenson similarity index. The similarity index value is divided into two criteria, if the index value > 50%, it means that the similarity of species is high and if the index value < 50% means the similarity of species is low.

Table 2. Similarity Index Value for Ferns in the Research Field

Research Field	L1	L2	L3	L4	L5
L1		111%	32%	11%	38%
L2			24%	7%	43%
L3				12%	38%
L4					0 %
L5					

Similarities of plant species in the Mt. Patuha (L1) and Mt. Papandayan (L2) is high. But overall, the comparison of

species similarity among mountains has a low species similarity (IS < 50%). Even the similarity of ferns between the Mt. Guntur

(L4) and Mt. Tangkuban Perahu (L5) is zero (IS = 0%), this means that there is no single type of ferns between the mountains.

CONCLUSION

Based on the results of research and discussion, it can be concluded as follows: The diversity of ferns in the study site is different in each mountain. The total number of ferns that have been found in the study site totals 83 species from 25 families. Polypodiaceae is the family with the highest number of species. Comparison of species diversity at the study site is low (<50%), except between the Mt. Patuha (L1) with Mt. Papandayan (L2) (> 50%).

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