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Dry Season Bryophytes in Cangar Hotspring-Batu, East Java, Indonesia

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ABSTRACT

Tropical forests in Indonesia are spread all over the region, one of them in East Java. The component of forest structure in East java can be found from the basic layer in the floor until the highest layer in the canopy. The forest floor can be full of bryophytes, one of the most influential components in the forest ecosystem. This research aims to know what kind of bryophytes are during the dry season in Cangar hotspring-Batu , East Java, which is the most popular tourist hotspot in this forest. This study was conducted in October 2019. The sampling uses the transect method and we analyzed by Importance Value Index and ordination analysis. The microclimate is measured by Luxmeter and Thermometer. We found 7 families including 13 species of bryophytes. From the analysis, we calculate that the highest Importance Value Index is of *Vesicularia dubyana* and the lowest is of *Trichosteleum* sp. A special area in this research also found that *Philonotis hastata* and *Riccia fluitans* dominate the bottom of river hotspring in Cangar.

***Key words**: Bryophytes, Dry season, Cangar, East Java*

Introduction

Biodiversity, the variety of life on Earth in all its forms, covers herbs, animals, mushrooms, and microorganisms and a variety of genetic material of ecological system (Hendry Baiquni , 2007). Biodiversity in Indonesia has a lot of value including ecological value, economic value, and socio-cultural value. It is estimated 30% of plants and 90% of animals in Indonesia have not finished with complete and scientifically documented. One of them is bryophytes.

Bryophytes are one of the groups of plants of the biodiversity that has been researched. Bryophytes are often found in places humid and wet, for example in the woods, and live attached to the substrate, various among other things such as ground in the jungle, stone, peat, the bark of the tree, and others (Gembong, 2005). Bryophytes did not have roots, true stems, and leaves (Afiatry, 2012). Indonesia has more or less 1500 varieties of Bryophytes, most of which live in the forest.

The forest which is a natural resource has undergone many changes and is extremely vulnerable to damage. The forest is the main vegetation and one of the very important natural resources. Forest can be described as a lung of the world, have a crucial function as our oxygen resources than algae in the marine. Forest is also placed where the animals and other living things do the live habits in all of the components and structure of the forest.

Tropical forests in Indonesia are spread all over the region, one of them in East Java. The component of forest structure in East java can be found from the

basic layer in the floor until the highest layer in the canopy. The forest floor can be full of bryophytes, one of the most influential components in the forest ecosystem. However, one of the functions of the forest is tourism. The tourism forest is a forest product that is intended specifically for training and maintenance to the interests of the development of science, and education (Karden,2003). Otherwise, this information about Bryophytes is new in one of the most destined forests in East Java, Cangar Hotspring, Batu. Hence, this research aims to know what kind of bryophytes grow during the dry season in Cangar Hotspring-Batu, East java

Methodology

Data Collection

The bryophytes data collection was conducted in October 2019 during the dry season in Cangar hotspring. The sampling uses the transect method. We used 3 sampling point which is all around in Cangar hotspring hotspot. The transect methods are done by 3 plots for each transect. The bryophytes were collected in samples to do identification in the laboratory and preserve in bottle samples alive. The microclimate is measured by Luxmeter and Thermometer.

Data Analyze

The data were analyzed by Importance Value Index and ordination analysis. Ordination analyses was done by Principal Canonical Analysis (PCA) and Redundancy analysis (RDA) using Canoco for Windows 4.5

Results and Discussion

Dry Season Bryophytes in Cangar Hotspring- Batu, East Java

The result shows that we found 7 families including 13 species of bryophytes. Each species come from 3 transects in the research area. This information can be seen see in Table 1.

From Table 1, we know that the dominance of bryophytes in Cangar Hotspring are taken by *Vesicularia dubyana*, although the frequency of the bryophytes taken by *Vesicularia dubyana* and *Philonotis hastata*. The dominant species also indicate that the species have the highest Importance Value Index. Bryophytes are known to be affected by their substrate (Klavina, 2015). For example substrates with a rough surface are good places for moss growth, while substrates with smooth and slippery surfaces do not provide a place for moss growth (Windradi, 2014). In this dry season, *Vesicularia dubyana* found the highest abundance, in all transects already found with the highest dominance in each plot. It can be assumed that *Vesicularia dubyana* has the best adaptation through out the dry season. Which is related to the substrate of the bryophytes in Cangar, mostly with the dry bark tree. Following the species with the high IVI value, are *Philonotis hastata* and *Plagiomnium medium*. *Philonotis hastata* is one of the common bryophytes, but in this dry season, Philonotis also found especially at the bottom of the river. Whereas the *Plagiomnium medium*, found in the dry bark of the tree. The lowest IVI value is of *Trichosteleum* sp. This species was only found in transect one in only 1 plot, this means, this species didn't spread around the area. This species is also found in very dry characteristics. The identification of this species is done by 1 week after the sampling and takes to acclimation the species in the humid microclimate in the laboratory.

Distribution of Dry Season Bryophytes in Cangar Hotspring- Batu, East Java

Distribution of species of bryophytes analyzed by Ordination analysis using Canoco for Windows 4.5. As a result of DCA eigenvalues <3, we use Principal Canonical Analysis (PCA) (linear model) and the correlation between the distribution and the microclimate using Redundancy analysis (RDA). From this analysis, we know that species of the bryophytes have different preference to the area where this research is done. The result of the PCA can be seen in picture 1 below.

Based on Figure 2. It can be assumed that unit sampling 1, only found *Meiothecium microcarpum (mm), Riccia lamellose (rl), Leucobryum candidum(lc), Leucobryum aduncum(la), Tricosteleum sp.(t). Unit sampling 2 only found Marchantia paleacea(mpa), Marchantia polymorpha(mpo), Riccia fluitan(rf). Unit sampling 3 only found Dicranum scoparium(ds).* The analysis of the distribution study here is based on the transect. From here, we know that unit sampling 1 has the most abundant species of bryophytes in Cangar. The habitat in-unit sampling 1 (transect 1) can be described as a primary forest, which has a lot of trees. All of the bryophytes in-unit sampling 1

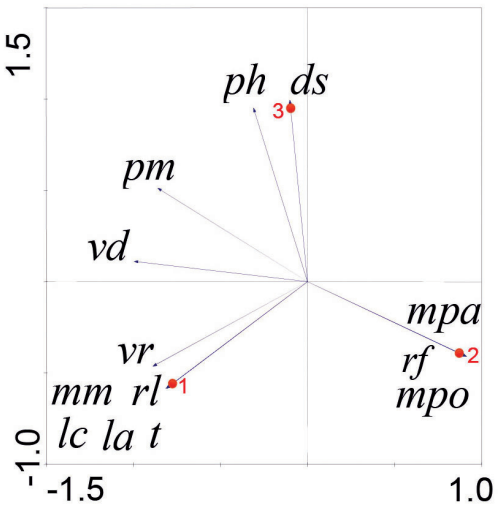

Fig. 2. Principal Canonical Analysis of Distribution of Bryophytes in Cangar hotspring-Batu, East Java

were found in the tree although the bark was already dry by the dry season.

The canopy of the tree can be assumed to help the humidity for the bryophytes still can be adapt by the species, so the species of the bryophytes didn't get the direct sunlight. Unit sampling 1 also found that the bryophytes have a connection with the lichen which is also found near the plot or in the plot. Unit sampling 3, which have the lowest abundance of the species can be described as a secondary forest which has the transect made by human for tourism but already closed due to safety. In this area, we found that most of the bryophytes are already in the dry characteristic. The color of the leaves turns yellow due to direct sunlight. The canopy in here is not close to unit sampling 1. This also can be the reason, the abundance of the species of bryophytes and also the other related species such as lichen are very low. In 1 transect, we only found 1 small group of lichen.

The distribution of the species can be influenced by environmental factors. Here, we measure 2 microclimates are temperature and light penetration. In real measure, we assume that the light penetration has an opposite mechanism toward temperature. The analysis of the influence of environmental factors through the distribution of bryophytes done by RDA. From the conditional effects of Redundancy Analysis of the Environmental factor toward the distribution of bryophytes in Cangar hotspring-Batu, East Java the variable of Light penetration have P-value 0. 824 and Temperature with P-value 1.000.

From here we know that P value<0.01indicate that environmental variables such as light penetration and temperature didn't influence significantly bryophytes distribution during the dry season. As bryophytes can survive on bare rock, they can initiate soil formation in any barren terrain of the land. They can maintain the soil moisture and also help in the recycling of the nutrients in forest vegetation. Apart from this, there are a few economically important bryophytes such as the peat moss.

The special area in this research (Unit sampling 2, plot 2) also found that *Philonotis hastata* and *Riccia fluitans* dominate the bottom of river hotspring in Cangar. *Philonotis hastata*, the test plant extracts showed potential antimicrobial activity against *Staphylococcus aureus*, *Aspergillus flavus*, and *Candida*

Table 1.Importance Value Index of the Dry Season Bryophytes in Cangar hotspring - Batu, East Java

No	Family	Species	D	Dr (%)	F	Fr (%)	IVI
1	Marchantiaceae	*Marchantia paleacea*	0.06	7.44	0.07	3.57	11.01
2	Marchantiaceae	*Marchantia polymorpha*	0.01	1.86	0.07	3.57	5.43
3	Bartramiaceae	*Philonotis hastata*	0.08	10.70	0.36	17.86	28.55
4	Dicranaceae	*leucobryum candidum*	0.09	12.09	0.14	7.14	19.24
5	Dicranaceae	*leucobryum aduncum*	0.05	6.51	0.07	3.57	10.08
6	Dicranaceae	*Dicranum scoparium*	0.02	2.79	0.07	3.57	6.36
7	Hypnaceae	*Vesicularia dubyana*	0.19	25.12	0.36	17.86	42.97
8	Hypnaceae	*Vesicularia reticulata*	0.05	6.98	0.29	14.29	21.26
9	Mniaceae	*Plagiomnium medium*	0.11	13.95	0.29	14.29	28.24
10	Ricciaceae	*Riccia fluitans*	0.04	4.65	0.07	3.57	8.22
11	Ricciaceae	*Riccia lamellosa*	0.03	3.72	0.07	3.57	7.29
12	Sematophyllaceae	*Meiothecium microcarpum*	0.03	3.72	0.07	3.57	7.29
13	Sematophyllaceae	*Trichosteleum* sp.	0.00	0.47	0.07	3.57	4.04
	TOTAL		0.77	100.00	2.00	100.00	200.00

albicans(Makinde *et al.,* 2018).This study showed that *Philonotis hastata* has alkaloids, cardiac glycosides, flavonoids, and saponins as part of its chemical constituents. Generally, bryophytes have been reported to serve as a source for a wide variety of chemical compounds that are known to have numerous potentials. *Riccia fluitans*, whose common name is floating crystalwort, is an aquatic floating plant of the liverwort. It can be found floating in ponds and often forms thick mats on and under the water surface.

Conclusion

The research found 7 families including 13 species of bryophytes. From the analysis, we calculate that the highest Importance Value Index is of *Vesicularia dubyana* and the lowest is *Trichosteleum* sp. A special finding in this research is that *Philonotis hastata* and *Riccia fluitans* dominate the bottom of river hotspring in Cangar.

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