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Diversity of epiphytic bryophytes in Medan City Parks, North Sumatra, Indonesia and its potential as lead (Pb) bio-accumulators

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Abstract. *Siregar ES, Pasaribu N, Lubis AF. 2023. Diversity of epiphytic bryophytes in Medan City Parks, North Sumatra, Indonesia and its potential as lead (Pb) bio-accumulators. Biodiversitas 24: 3214-3221.* The information on the diversity of epiphytic bryophytes in the metropolitan area, particularly Medan City, North Sumatra, Indonesia has been limited. Therefore, this study aimed to conduct an inventory of the diversity of epiphytic bryophytes in Medan City parks as well as to assess their potential as lead (Pb) bioaccumulators. Three sampling sites, namely Ahmad Yani Park, Beringin Park, and Medan Zoo, were selected based on their pollution levels from high to low, respectively. Five plots with dimensions of 25×25 m were placed at each site and five representative host trees were selected in each plot. Lead (Pb) bioaccumulation of bryophyte samples is determined using the atomic absorption spectroscopy (AAS) method at the Plant Research Center Laboratory, Medan. The Pb-bioaccumulation capacity of each species from different sites was compared through two-way ANOVA. The results showed eight species, namely four liverworts (Marchantiophyta): *Cololejeunea lanciloba* Steph., *Lejeunea cocoes* Mitt., *Lopholejeunea eulopha* (Taylor) Schiffn., and *Lopholejeunea subfusca* (Nees) Schiffn., as well as 4 Mosses (Bryophyta): *Calymperes tenerum* C.Müller, *Meiothecium microcarpum* Mitten, *Octoblepharum albidum* Hedwig and *Vesicularia dubyana* Brotherus. *Vesicularia dubyana* was the dominant species at Beringin Park and Medan Zoo, while *C. tenerum* was dominant at Ahmad Yani Park. The biodiversity of epiphytic bryophytes in this study was categorized as moderate level (1≤H'≤3). The highest Important Values Index (IVI) of epiphytic bryophytes in this study was obtained for *V. dubyana* at 131.80. The highest Pb bioaccumulation was observed in *O. albidum* at 87.5 mg/kg, followed by *V. dubyana* at 66.6 mg/kg. This study provided information on the ecological contribution of epiphytic bryophytes as Pb bioaccumulators in urban areas. *Vesicularia dubyana* and *O. albidum* can be recommended as biomonitoring agents in the future.

Keywords: Bioindicators, liverworts, mosses, urban area

INTRODUCTION

Bryophytes (liverworts, mosses, hornworts), are cosmopolitan, have a wide range and can be found in almost every habitat, particularly in high-humidity areas. They can also flourish on different substrates, including the soil surface, rocks, rotten logs, tree trunks, and living leaves. Epiphytic bryophytes prefer rough tree trunk surfaces, which inhibit precipitation to provide water and nutrients for their growth (Gairola et al. 2014).

Furthermore, because of their sensitivity to environmental changes and lack of cuticles, bryophytes can be utilized as indicators of air pollution and heavy metal accumulation (Gairola et al. 2014; Yushin et al. 2020). These plants have the ability to absorb pollutants directly through the entire body surface, which are stored in their cells. The presence of bryophytes in urban areas is beneficial to human health because they are considered potential natural air filters. They have the capacity to store air components in excess of their physiological requirements as well as polluting compounds in low concentrations (Anđi et al. 2015; Donovan et al. 2016).

Bryophytes can accumulate heavy metals from the air 4 to 51 times greater than vascular plants (Jiang et al. 2018). The main sources of lead (Pb) are the combustion of lead gasoline, waste incineration, and industry (Koz and Cevik 2014). Leads are also produced from various anthropogenic sources such as Pb mining and smelting, car traffic, burning of municipal wastes and so on. Lead (Pb) in the air can be accumulated by several species of bryophytes, so they are quite commonly used as biomonitors of air pollution, and indicators to evaluate atmospheric conditions in urban areas (Ávila-Pérez et al. 2019; Mao et al. 2022). Accumulation and retention of pollutants can help in the interpretation of heavy metal emission patterns (Govindapyari et al. 2010; Abulude et al. 2021). In addition to the chemical properties of bryophytes, their diversity such as species abundance, has been used to evaluate atmospheric conditions in urban areas (Oishi and Hiura 2017).

The sensitivity of epiphytic bryophytes to environmental changes can be determined from differences in composition, abundance, and distribution. Furthermore, they are extremely vulnerable to forest clearing, which causes their population decline as well as the extinction of some species. Natural forests have a more diverse epiphytic bryophyte composition and a greater number of species than plantations or unnatural forests. In urban areas, an air purity index and a low diversity index were determined based on the abundance and frequency of the plants (Yan et al. 2013; Perwati et al. 2015).

Research on the diversity of bryophytes in urban areas and their ability to absorb lead has been carried out in several areas worldwide, such as: in India (Vats et al. 2010), Canada (Cowden et al. 2015), Poland (Fojcik et al. 2015), China (Li et al. 2014; Jiang et al. 2020), Russia (Yushin et al. 2020). In Indonesia, several studies of bryophytes diversity in urban areas were done by Putrika et al. (2017), Khujjah and Ekowati (2018), Nasuha et al. (2021), and Tsabituddinillah et al. (2023). However, none of them had examined the potential of bryophytes as a metal bioaccumulator. A number of studies have been carried out on bryophytes in natural forests of North Sumatra, Indonesia by Siregar and Pasaribu (2019), Siregar et al. (2017, 2018, 2020, 2021), but their presence in urban areas is still neglected. The existence of epiphytic bryophytes in urban areas is necessary because they act as an indicator of air pollution. They also have the potential to absorb pollutants, such as Pb, but no study has been carried out related to this topic in Sumatra, especially North Sumatra. Medan, as the capital of the North Sumatra province, has several city parks with various species of trees, which are mostly overgrown with bryophytes. These trees provide potential alternative habitats for epiphytic bryophytes from the high rate of forest destruction and enhanced conservation of urban biodiversity (Zhao et al. 2021; Załnierz et al. 2022). The species of trees favored by the bryophytes as hosts are also unknown, which is important for selecting species as good epiphytic hosts. The trees planted are expected to serve as hosts for epiphytic bryophytes, along with providing greenery and shade. Therefore, this study aims to investigate the diversity of epiphytic bryophytes in Medan City Parks, as well as their ability to accumulate Pb. This research is expected to provide information about epiphytic bryophytes that can absorb lead (Pb), which is used to reduce air pollution in Medan City.

MATERIALS AND METHODS

Study area

This study was conducted from June to October 2021. The locations were in the three sites, namely Ahmad Yani Park, Beringin Parks and Medan Zoo, as shown in Figure 1. Beringin Park is located on Jl. Teuku Cik Ditiro, Medan Polonia District, with an area of 1.2 ha and ± 3.1 km from the city center. Furthermore, Ahmad Yani Park is located on Jl. Sudirman and Jl. Imam Bonjol, Medan City, with an area of 2 ha and 2.4 km from the city center. Medan Zoo is located on Jl. Bunga Rampe IV, Simalingkar B, Medan Tuntungan District with an area of 30 ha and ±17.4 km from the city center (Subarudi et al. 2014).

Collection of plant

At each study site, five plots size 25×25 m^2 were established using a purposive method (Figure 1). Epiphytic bryophytes were then sampled on five selected trees per plot (Figure 2) to obtain a total of 75, and the inclusion criteria include >10 cm diameter breast-high. Subsequently, samples were collected using four mini-subplots of 15×15 cm^2 (Figure 2) which were placed in different directions following the four cardinal directions (east, west, north, south) between 0 and 2 m height on each tree trunk (Putrika et al. 2017).

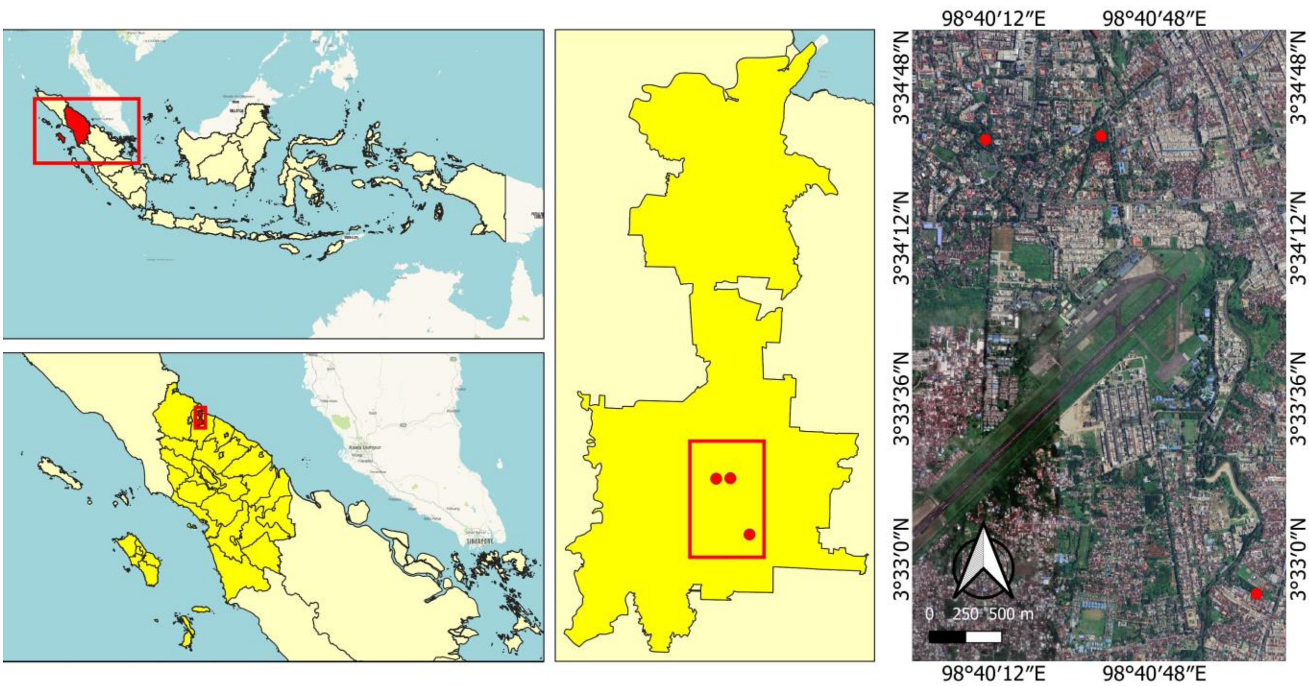

Figure 1. Map of study sites in Medan, North Sumatra, Indonesia and layout of the sampling plots

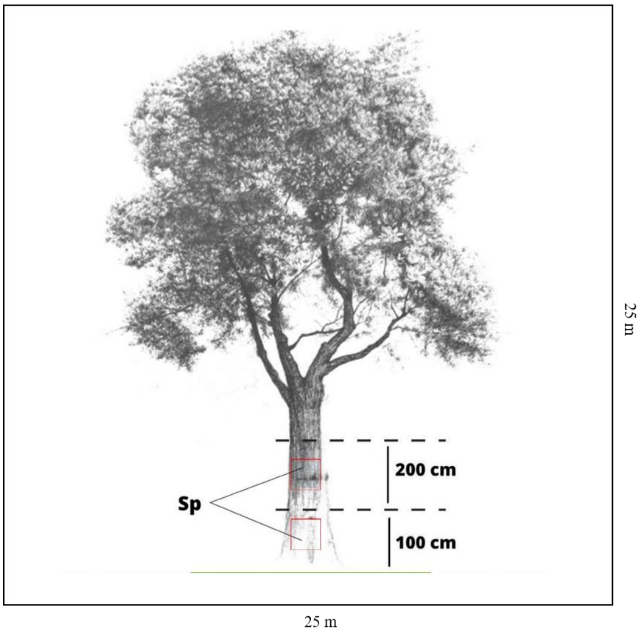

Figure 2. The layout of the sampling plots on one selected tree, Sp=sub plot (15×15 cm^2)

All species of bryophytes within the mini subplots were collected and placed in paper bags for identification at the Plant Systematic Laboratory, Biology Department, Faculty of Mathematics and Sciences, Universitas Sumatera Utara, Medan, North Sumatra, Indonesia. Some information about the sample collection in the study sites was noted, such as collection time, location, collector's name, host trees species, type of host trees bark (smooth or rough), and abiotic factors such as temperature, humidity, and light intensity (Susilo et al. 2022). Abiotic factors measurements were carried out once at a similar time at each study site. At least 10 g fresh weight of each bryophyte species per site was collected for analysis of the Pb content. If the sample is less than 10 g, the results of the Pb content analysis are less accurate in the study.

Lead (Pb) analysis

All samples of bryophyte were cleaned from other components, and dried at ambient air temperature for 48 h, and milled to a fine powder. The dry samples were mineralized using 69-70% nitric acid Baker Instra-Analyzed for trace metals analysis (Ochota and Stebel 2013). Lead content in the samples was measured once, due to the small amount of material. Lead (Pb) concentrations in the bryophyte cells were determined at the Institute for Industrial Research and Standardization of Medan North Sumatra, using Perkin Elmer 3110 Atomic Absorption Spectrophotometry (AAS) Shimadzu AA 7000 at a specific wavelength of 283.3 nm.

Data analysis

Morphological characters of the samples (plant width, branching, leaf shape, leaf base, leaf margin etc.) were observed using a compound microscope (Olympus CX23) with 40×, 100× and 400× magnifications. Identification was carried out using several identification references, such as Eddy (1988), Gradstein (2011), and other bryophyte publications. Determination of the scientific name was based on the Tropicos website: https://www.tropicos.org/home.

Species composition was obtained from all samples identified at each study site. Their relative abundance and frequency were also recorded to calculate the importance value index (IVI). The importance value index was used to determine the dominant species in the study site. Furthermore, the Diversity Index of species was calculated using the Shannon-Wiener diversity index (Shannon and Wiener 1963).

The Pb-bioaccumulation capacity of each species in different sites was compared through two-way analysis of variance (ANOVA), considering city parks and bryophyte species as factors. The ANOVAs was performed using the Minitab ver. 17.0 program with significant differences at the 0.05 level followed by a post-hoc test using Tukey's Honestly Significant Difference (Tukey’s HSD) test for multiple comparisons among epiphytic bryophyte species.

RESULTS AND DISCUSSION

Composition and Diversity of Epiphytic Bryophytes

This study documented a total of 8 epiphytic bryophytes species from Medan City Parks, namely four liverworts (Marchantiophyta): *Cololejeunea lanciloba* Steph., *Lejeunea cocoes* Mitt., *Lopholejeunea eulopha* (Taylor) Schiffn., *Lopholejeunea subfusca* (Nees) Schiffn. and 4 mosses (Bryophyta): *Calymperes tenerum* C.Müller, *Meiothecium microcarpum* Mitten, *Octoblepharum albidum* Hedwig, *Vesicularia dubyana* Brotherus. The community assemblage was the highest species richness in Beringin Park, with six species, followed by Ahmad Yani Park and Medan Zoo, with five species, as shown in Table 1.

Only one family of liverworts was observed at the study locations, namely Lejeuneaceae. This is because its members often favor open vegetation or disturbed habitats, such as gardens and roadsides, and can thrive anywhere from lowlands to highlands. Lejeuneaceae is also the largest family of liverworts, with a vast number of species and a wide range of distribution. Most of the members were epiphytes on the trunks, branches, twigs, and leaves (Lee and Gradstein 2013; Siregar et al. 2017, 2020). In Medan Zoo, the liverworts were less than the member of mosses. This may be caused by the impact of the random selection of sample tree species, which affects the species found, which might not contain all species in a single study area.

Three epiphytic bryophytes species, namely *Lejeunea cocoes* (Lejeuneaceae: Marchantiophyta), *O. albidum* (Calymperaceae: Bryophyta), and *V. dubyana* (Hypnaceae: Bryophyta), were obtained in all sampling sites. The three species are tolerant to dry conditions or low water content, and they are similar to others found on tree trunks in open habitats. This high tolerance supports its high colonization in a habitat. According to Maciel-Silva et al. (2013), the successful colonization of *O. albidum* is due to the abundance of both asexual structures production (gemmae and protonema/buds at the leaf tips) and sporophytes. The species is widely distributed in tropical forests, dry forests, tropical savannas and coastal habitats in north-eastern Brazil. Previous studies revealed that *O. albidum* inhabits other urban areas in Indonesia, such as parking areas (Khujjah and Ekowati 2018), schoolyards (Aripulis 2019), and riparian vegetation (Roziaty et al. 2019). The number of epiphytic bryophytes species obtained in this study was lower compared to Putrika et al. (2017), who reported 36 species in the urban forest and the main road of the University of Indonesia's campus, Depok West Java, Indonesia. The varying numbers of mosses can be linked to the differences in vegetation density, host tree species, and microclimates. There are others, and some obvious ones are the tree's age, the distance of the host tree to forests, other abiotic factors, and sampling methods.

Table 1 shows that the Important Values Index (IVI) of epiphytic bryophytes at Beringin Park ranged from 2.58 to 131.80. The highest value was obtained for *V. dubyana* at 131.80, while *C. lanciloba* had the lowest of 2.58. The IVIs in Ahmad Yani Park ranged from 2.85 to 93.16, where *C. tenerum* has the highest at 93.16 and *L. cocoes* has the lowest at 2.85. The IVIs recorded in Medan Zoo ranged from 8.4 to 58.90, where *V. dubyana* has the highest at 58.90, which has little difference from the value of *C. tenerum* at 57.80 and *L. cocoes* has the lowest at 8.40. In Beringin Park and Medan Zoo, *V. dubyana* existed as the dominant species, as indicated by the high IVI in both sites. The species *V. dubyana* has a high adaptation to habitats and can live in water, as well as in terrestrial (Šuňovská et al. 2015). *Calymperes tenerum* was the dominant species in Ahmad Yani Park, but was not found at Beringin Park. The high IVI value of the species may be due to the extensive cover in the plot as well as the dense population. Putrika et al. (2017) stated that species *C. tenerum* dominates on the roadside of the University of Indonesia campus.

Diversity Index Value

The diversity value at Ahmad Yani Park is 1.18, Beringin Park is 1.02 and Medan Zoo is 1.54. The diversity index (H') value in the three study sites ranged from 1.02-1.54. Based on the index obtained in each park, the biodiversity of epiphytic bryophytes was categorized as moderate level (1≤H'≤3).

The Diversity Index of Medan Zoo Park is higher than the two other study sites. This presumably relates to their environmental factors, mainly their humidity, as shown in Table 2. The average humidity of Medan Zoo Park was higher (74.4%) than the two other parks (Ahmad Yani Park 61.6%, and Beringin Park 60.8%). The temperature is relatively the same value at the three locations, ranging from 31.2-33.5ºC. Light intensity showed varying values at each study site, the highest light intensity in Beringin Park at 142.2 cd, decreased at Ahmad Yani Park at 137.4 cd, and the lowest is Medan Zoo with a value of 125.6 cd.

The diversity of epiphytic bryophytes is strongly influenced by the surrounding environmental conditions and needs an important requirement to fulfill their life processes. Temperature, humidity, and light intensity are the important abiotic factors needed by bryophytes to grow and support their life. The growth of bryophytes is better in humid air conditions and cool to moderate temperatures (up to 25°C) (Glime 2017). Moreover, some bryophyte species may survive only in forests without human impact with optimum environmental factors. Based on Table 2, the air humidity was low, and the temperature was too high for epiphytic bryophytes. These two factors are not optimal conditions to support the existence of epiphytic bryophytes and cause their low diversity in Medan City Park.

Table 2. Abiotic factors measurement results in data from the study site

Location	Parameter		
	Humidity (%)	**Temperature (°C)**	**Light intensity (cd)**
Ahmad Yani Park	61.6	33.5	137.4
Beringin Park	60.8	32.6	142.2
Medan Zoo	74.4	31,2	125.6
Mean	65,6	32,43	135.1

Table 1. Species composition and Important Value Index of epiphytic bryophytes in City Parks, Medan, North Sumatra, Indonesia

Family	Species	Important Value Index		
		Beringin Park	**Ahmad Yani Park**	**Medan Zoo**
Lejeuneaceae	*Cololejeunea lanciloba* Steph.	2.58	-	-
	Lejeunea cocoes Mitt.	5.36	2.85	8.40
	Lopholejeunea eulopha (Taylor) Schiffn.	-	8.45	-
	Lopholejeunea subfusca (Nees) Schiffn.	40.73	-	-
Calymperaceae	*Calymperes tenerum* C.Müller	-	93.16	57.80
Hypnaceae	*Vesicularia dubyana* Brotherus	131.80	61.23	58.90
Calymperaceae	*Octoblepharum albidum* Hedwig	10.29	33.99	54.08
Sematophyllaceae	*Meiothecium microcarpum* Mitten	13.64	-	30.72

Note: (-) Not found

The species of host tree of epiphytic bryophyte

Fifteen species of host tree were documented as the growth substrate for epiphytic bryophytes in the Parks of Medan City, as shown in Table 3. Some species of bryophytes are restricted to specific host tree species, but others are found in more than one host tree. It would therefore some species can be found growing on more than one host tree and others prefer to occupy only one host tree. The most prevalent mosses were identified on two tree species, namely *Adenanthera pavonina* L. and *Swietenia mahagoni* (L.) Jacq., and each of them was colonized by six bryophytes species. *Pometia pinnata* J.R.Forst. & G.Forst. and *Roystonia regia* (Kunth) O.F.Cook were the second and third most prevalent trees associated with the bryophytes. Furthermore, *Mangifera indica* L., *Sandoricum koetjape* Merr., and *Terminalia catappa* L. were the least colonized by the bryophytes, each with only one species. *Mangifera indica,* which is the least colonized by the bryophytes, somewhat with high species diversity of epiphytic bryophytes, such as Ezukanma et al. (2019), in urban agroforests in Ibadan southwest Nigeria. This difference may be influenced by environmental factors such as temperature, humidity, and solar radiation.

Table 3. Species composition of host tree for epiphytic mosses in selected city parks, Medan City

Species	Bark structure	Occurrence of epiphytic bryophytes species		
		Beringin Park	**Ahmad Yani Park**	**Medan Zoo**
Adenanthera pavonina L.	Rough	*V. dubyana* *C. lanciloba* *L. cocoes* *L. subfusca*	-	*L. cocoes* *C. tenerum* *O. albdium*
Alstonia scholaris (L.) R.Br.	Rough	*M. microcarpum* *O. albidum*	-	*V. dubyana* *M. microcarpum*
Anthocephalus cadamba (Roxb.) Miq.	Rough	-	-	*C. tenerum* *O. albidum*
Areca catechu L.	Rough	-	*C. tenerum* *L. cocoes* *L. eulopha*	-
Cocos nucifera L.	Rough	-	*V. dubyana* *C. tenerum* *L. eulopha* *O. albdium*	-
*Filicium decipiens (*Wight & Arn.) Thwaites	Rough	*V. dubyana* *L. cocoes* *L. subfusca*	*C. tenerum*	-
Mangifera indica L.	Rough	*L. subfusca*	-	-
Mimusops elengi L.	Rough	*V. dubyana* *L. subfusca* *O. albidum*	-	-
Pometia pinnata J.R.Forst. & G.Forst.	Rough	*V. dubyana*	-	*L. cocoes* *V. dubyana* *C. tenerum* *M. microcarpum* *O. albidum*
Pterocarpus indicus Willd.	Rough	*V. dubyana*	-	*V. dubyana* *C. tenerum* *M. microcarpum* *O. albidum*
Roystonea regia (Kunth) O.F.Cook	Rough	*V. dubyana* *O. albidum*	*V. dubyana* *C. tenerum* *L. cocoes* *L. eulopha* *O. albidum*	*L. cocoes*
Sandoricum koetjape (Burm.f.) Merr.	Smooth	*V. dubyana*	-	-
Swietenia mahagoni (L.) Jacq.	Rough	*V. dubyana* *L. subfusca*	*V. dubyana* *C. tenerum* *L. cocoes* *L. eulopha* *O. albidum*	*V. dubyana*
Tectona grandis L.	Rough	-	-	*V. dubyana* *C. tenerum* *M. microcarpum* *O. albidum*
Terminalia catappa L.	Smooth	-	-	*V. dubyana*

Table 4. Lead (Pb) concentration in the tissue of epiphytic mosses

Species	Lead (Pb) concentration (mg/kg)		
	Beringin Park	Ahmad Yani Park	Medan Zoo
Cololejeunea lanciloba Steph.	–	–	–
Lejeunea cocoes Mitt	6.56[c]	5.03[d]	7.57[a]
Lopholejeunea eulopha (Taylor) Schiffn.	–	9.02[d]	–
Lopholejeunea subfusca (Nees) Schiffn.	0.02[d]	–	–
Vesicularia dubyana Brotherus	2.61[cd]	66.6[b]	5.65[ab]
Calymperes tenerum C.Müller	–	31.0[c]	6.28[b]
Meiothecium microcarpum Mitten	35.0[a]	–	7.23[ab]
Octoblepharum albidum Hedwig	21.1[b]	87.5[a]	6.93[ab]
Total	65.29	199.15	33.66

Note: *The numbers followed by letters in same column show no difference according to Tukey's HSD test at a rate of 5%

There were two types of bark texture in all three study sites, namely rough and smooth. Observation showed that the bryophytes prefer to occupy trees with rough bark rather than smooth ones. The rough bark may have trapped more dust and nutrients from the atmosphere that are readily dissolved by rainwater during rainfall and leached down the trunks where the epiphytic bryophytes occur (Glime 2017).

Vesicularia dubyana colonized 12 tree species as its host due to its rapid growth, wide dispersion, and high adaptability in the habitat. Its presence in all three observation sites across different trees indicated that it is cosmopolitan. *Cololejeunea lanciloba* is the only species that lives on a single host tree. It has a small population and was only found in Beringin Park, which indicates that its spread was limited.

Lead (Pb) accumulation

Lead content measured from each epiphytic bryophyte is shown in Table 4. *Octoblepharum albidum* was the highest Pb accumulator, followed by *V. dubyana*, particularly from Ahmad Yani Park. Lead (Pb) accumulated in the species of *O. albidum* ranged from 21.1 to 87.5 mg/kg, and in *V. dubyana* ranged from 2.61 to 66.6 mg/kg. The two species belong to the tolerant bryophytes species because they can be found throughout the study sites. *Octoblepharum albidum* and *V. dubyana* can be classified as resistant species because of their presence both in areas with highly polluted air and low polluted air. In the previous study by Šuňovská et al. (2015), the species *V. dubyana* can be used as a potential biosorbent for the removal of toxic metals or radionuclides from wastewaters or contaminated liquids.

Higher content of lead (Pb) was also displayed by *O. albidum*, which was collected from Lucknow city and Green Field School Rajajipuram India (with heavy traffic sites) in comparison to the samples collected from garden and monument sites (treated as control) (Misra and Tandon 2014, 2015). The species was able to survive in air-polluted habitats because of its ability to absorb heavy metals such as Pb, so also often used as a bio-indicator of air pollution. The large bioaccumulation is because the rate of air pollution in Ahmad Yani Park is higher than in other locations. Naturally, bryophytes also contain Pb, as reported by Ochota and Stebel (2013) in the natural forest of Białowieski National Park, the species *Hypnum cupressiforme* Hedwig contains 31.73 mg/kg Pb and *Brachythecium salebrosum* W.P.Schimper contains 18.77 mg/kg Pb. Their Pb content in the natural forest is lower than Katowice (an urbanized and industrialized area in Poland). Anthropogenic factors, such as motor vehicle emissions and the manufacturing industry, release pollutants into the air, which causes heavy metal deposition in the bryophyte tissues (Jiang et al. 2018). The other important factor for the variation of lead concentrations with respect to the Bryophyta species is the size of the leaf surface. The lead adsorption capacities of bryophytes also show variations with respect to the species (Koz and Cevik 2014). The leaves of the Bryophyta species found in this study were wider than the liverwort leaves. This is related to the higher accumulation of Pb in Bryophyta than in liverworts.

Bryophytes with the highest accumulation of Pb are here considered the most tolerant to air pollution because they are able to survive in the site with the highest pollutants level and absorb the Pb pollutants. These species can also be used as indicators of a contaminated environment, particularly Pb, which can be accumulated in their tissues. *Vesicularia dubyana* and *O. albidum* demonstrated high survivability and prolific growth in polluted environments. The presence of *O. albidum* and *V. dubyana* species at the parks was due to their high adaptability and their independence of specific tree species as growth substrates. Several species of bryophytes are sensitive to air pollutants, so they are rarely found in polluted areas. The tolerant species can be used as a bioindicator to detect the level of pollutants contained in the air especially.

In conclusion, a study of epiphytic bryophytes in three selected city parks in Medan found four species for each Marchantiophyta and Bryophyta. The result showed that 16 tree species could serve as hosts, where *A. pavonina* and *S. mahagoni* had the highest number of bryophyte species. The bryophytes species with the highest ability to absorb Pb was found to be *O. albidum*, followed by *V. dubyana*, and both were present at Ahmad Yani Park, Medan. Epiphytic bryophytes in Medan City Parks polluted with Pb served as potential heavy metal bioaccumulators. The highest Pb bioaccumulators were *V. dubyana* and *O. albidum*, which indicated their ecological potential as biomonitoring agents in the future. The city parks are not only for reforestation, they can also support considerable epiphytic bryophyte diversity. Because of the wide distribution and simplicity of sampling, the most prevalent species must be preserved, specifically the host tree to provide optimum growth for the epiphytic bryophyte diversity.

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