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Exploration of mosses in urban-bogor habitats: Species identification, diversity and uniformity

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ABSTRACT

This research focuses on the exploration of moss in the Bogor urban habitat, to explore the identification of moss types, measuring the level of diversity, and assessing the level of uniformity in the context of the urban environment. Data collection at the research location was divided into 3 stations with different environmental parameters. The method used in this research was an exploratory survey using the belt transect technique. The sampling method is purposive sampling with the help of a quadratic plot. The results of this research found 20 moss species identified on the green belt of Jalan Pajajaran, Bogor with a diversity index for the three stations respectively, namely 2.45; 2.02; and 1.78 which is classified into the medium category, and the uniformity index for the three stations respectively is 0.835; 0.814; 0.811 which is classified as high. These results show that the moss found can live by adapting to environmental factors in urban areas such as fluctuating temperature, humidity, and light intensity.

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INTRODUCTION

Bogor City is one of the most active cities in Indonesia. Based on the results of the 2021 Global Traffic Scorecard study, Bogor City is ranked 5th nationally and 821st in the world in terms of congestion level. One of the main roads in Bogor City which is most famous for its density of activity is Jalan Pajajaran. Jalan Pajajaran is known as a "primary arterial" road in Bogor City which has buildings with high activity (Wulanraini & Jaya, 2008; Jaya, 2021). The activities of a city will greatly impact the environmental quality of that city which can cause environmental problems, such as air pollution. One way that can be done to reduce the negative impact of high city activity is by opening urban Green Open Space (GOS) (Ali et al ., 2021; Isrowati et al., 2023).

Green Open Space (GOS) is an elongated area or path that can be used more openly as a place for natural or deliberately planted plants to grow. Urban GOS is an area of open space in an

urban area that is usually covered with plants and vegetation so that it can become an urban habitat that has ecological, socio-cultural, and economic functions. GOS as an urban habitat has a function in the ecological field, namely, it can reduce air pollution, improve air quality, improve groundwater quality, prevent flooding, and reduce city temperatures (Hendriani, 2016; Isrowati et al., 2023).

Forms of urban open space that have ecological functions include green belts, urban green belts, urban forests, botanical gardens, river borders, etc. (Hendriani, 2016; Ali et al., 2021). The form of green open space applied on Jalan Pajajaran is a green belt on the side of the road which functions as one of the public facilities of Bogor City with seating, trees, ornamental plants, and rocks. Plants that can live in this habitat include yard plants, trees, ferns, and moss (Bryophyta) (Viasari & Osly, 2017; Putrika et al., 2017).

One of the plants found on the Jalan Pajajaran green belt is the bryophyte group. Mosses can be classified into a group of lower plants with a transitional form from plants that have thallus to cormus plants (Maharani et al., 2017; Endang et al., 2020; Eman et al ., 2022). Moss can be identified by looking at several morphological characteristics of its body. As representatives of lower plants, mosses have a very important role in the ecosystem as markers of biodiversity and indicators of environmental health. Through morphological analysis, the adaptation and response of moss to environmental changes, such as air pollution and climate change, can be identified. In addition, a deeper understanding of the morphological characteristics of mosses also supports biodiversity mapping, making it an important tool in natural resource conservation efforts. Moss has the morphological characteristic of having a thallus, where this moss is a plant that cannot be differentiated between roots and stems, and does not have true leaves (Rahman & Pujiastuti, 2018; Endang et al., 2020).

Moss plants can be found in places that tend to be humid, so most of them are easy to find in tropical rainforests. Moss grows on a medium which is usually called a substrate. There are various kinds of substrates where moss grows, which are tree areas, river banks, new surfaces, and even the surface layer of soil. Apart from being a medium for attaching moss, the substrate functions as a medium for absorbing nutrients. The abundant substrate in an area can be one of the factors that can determine the diversity and uniformity of moss types. Not only that, the diversity and uniformity of moss types in an area can be determined by microclimatic conditions such as light intensity, air humidity, environmental temperature, and available vegetation (Ristanto et al., 2021; Eman et al ., 2022)

The nature of being very dependent on nature makes moss a plant that is sensitive to environmental changes, one of which is an indicator of air pollution. When air quality in the environment decreases, some moss species disappear due to increasing concentrations of pollutants in the air. The abilities possessed by moss can indicate that the diversity of moss in an area can be a bioindicator of air quality in that area. Environmental factors are related to the diversity of moss in tropical urban areas such as the Jakarta area which is characterized by adaptation and diversity of moss in the polluted category compared to highland areas (Putrika et al., 2023). Moss can indicate air pollution, especially pollutant gases caused by motorized vehicles. The pollutants produced will fly freely in the air which can inhibit the growth of moss (Wijayanti, 2013; Isrowati et al., 2023).

Analysis of moss diversity in urban areas is needed to determine the ability of moss to live in urban areas. There is still minimal discussion regarding moss in urban areas, especially in the city of Bogor. Similar research was conducted by Isrowati et al., (2023) regarding moss in green open spaces carried out at the Udayana GOS with the results of the discovery of 5 species of moss. Another research was conducted by Fastansidan & Wulansari (2021) regarding moss in the urban area of Bogor at the Cibinong Ecopark with the results finding 30 identified species. This shows that the level of moss diversity is caused by the influence of environmental factors in the area.

Based on the background that has been described, studies on mosses in urban habitats need to be carried out. This research aims to explore moss in urban habitats in Bogor with a focus on identifying the types of moss that exist, measuring the level of moss diversity, and evaluating the level of uniformity of moss distribution in the Bogor urban area. It is hoped that this will contribute to increasing understanding of moss diversity and the impact of high urban activity on the environment and plants. The research location for the Pajajaran Street green belt in Bogor was chosen because of its status as one of the GOS in Bogor City which is expected to be able to represent well the condition of the urban habitat in the city.

RESEARCH METHODS

Research Design

This research was conducted on November 11 2023 along the green belt of Jalan Pajajaran Bogor as shown in Figure 1.

Figure 1. Research Location in Green Open Space Jalan Pajajaran, Bogor

The location for the green lane on Jalan Pajajaran Bogor was chosen using purposive sampling because Jalan Pajajaran is the busiest highway in Bogor City because it is the city center and center of trade and services (Jaya, 2021). Meanwhile, the green belt is a damp area on Jalan Pajajaran which supports the growth of moss in urban habitats. The length of the observation route is around 503 meters with a path width of around 5 meters. The research method applied in this research is an exploratory survey method, which involves collecting and exploring information on populations and samples that have been determined through exploration of the research environment. Data collection was carried out by making direct observations of the moss along the green belt, with a focus on identifying the morphology and distribution of the moss substrate. To support the analysis, environmental parameters such as air humidity, light intensity, and temperature were measured.

Population and Samples

Sampling was carried out using a purposive sampling technique, which involves selecting samples with certain considerations, such as the number of mosses on each plot and factors that have the potential to influence diversity, such as humidity, temperature, and light intensity. The sampling technique in this research was carried out using a belt transect at several predetermined observation points along the green route of Jalan Pajajaran, Bogor. Moss sampling was carried out randomly to cover variations that might occur at the research location. Apart from that, data collection also used quadratic plots measuring 1 m x 1 m which were distributed at three research stations. Determining the division of research stations is based on differences in environmental parameter conditions in the form of humidity and light intensity which causes differences in characteristics at each station.

Instruments

Tools and materials used in the research include: Global Positioning System (GPS), hygrometer, luxmeter, camera, stationery, rope, plastic sampling, brown envelope, cutter, 70% alcohol, and moss identification book.

Procedures

The research began with selecting a location along the green belt of Jalan Pajajaran, Bogor, where observation points were determined based on environmental variations. Three station points were determined with each track length of around 167 m. Square plots measuring 1 m x 1 m were created which were spread out at three stations along the observation route with details of 1 plot for each meter so that there were 167 plots at each station as seen in the illustration in Figure 2.

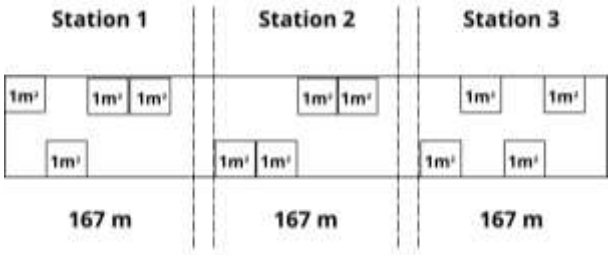

Figure 2. Illustration of technic sampling

Determination of plot placement is carried out with the following considerations: the presence of the type of moss and the amount of moss at the plot placement location. After the plot placement is complete, morphological identification is carried out and the type of moss found is determined. The types of moss present in the plots were documented and environmental parameters, such as air humidity, light intensity, and temperature, were measured during observations. Some of the mosses found were sampled by taking samples from the substrate and then used as a dry herbarium for further identification.

Data Analysis

In this study, the data obtained was analyzed descriptively qualitatively by looking at the morphological characteristics of each type of moss found during the research. Apart from that, the data was also analyzed descriptively quantitatively using the Shannon Wiener Diversity Index formula and the Uniformity Index formula. Shannon Wiener Species Diversity Index, calculated using the formula:

$$H' = -\Sigma pi\ In\ pi \text{ where, } pi = ni/N$$

Diversity index formula with the information that H' represents the diversity index; pi as the ratio between the number of individuals and the total number of individuals; ln for natural logarithm; ni states the number of individuals of each type; and N for total individuals. Meanwhile, the Species Uniformity Index is calculated using the formula:

$$E = H'/\ln S$$

The description of the species uniformity formula consists of E representing the species uniformity index, H' as the species diversity index; S for several types; and ln for natural logarithms. In Table 1, the criteria or categories for calculating species diversity and species uniformity are listed. Data analysis techniques include all the analysis needed to address the problem or research aims.

Table 1. Categorization of Species Diversity and Uniformity Index

	Index Value	Category
Diversity	H' < 1	low diversity
	1< H' <3	moderate diversity
	H' > 3	high diversity
Uniformity	0 < E ≤ 0.4	little uniformity, depressed community
	0.4 < E ≤ 0.6	moderate uniformity, unstable community
	0.6 < E ≤ 1	high uniformity, stable community

RESULTS

The exploration and observation of bryophytes on Jalan Pajajaran found a total of 20 identified species that spread across three observation stations. The division of observation stations is based on the results of different environmental parameters. Table 2 has found 19 identified moss species that are distributed in different substrates. Environmental factors at the station I have a temperature of 32°C with a humidity level of 61% and a measured light intensity of 1013 lx.

Table 2. Species of Bryophytes in Station I

No.	Species	Number found	Substrate
1.	*Fissidens perpusillus*	20	soil and stone
2.	*Fissidens taxifolius*	2	Stone
3.	*Fissidens zollingeri*	1	Stone
4.	*Fissidens obtusifolius*	3	Stone
5.	*Hypnum cupressiforme*	18	Wood
6.	*Mnium hornum*	17	Soil
7.	*Mnium stellare*	8	Soil
8.	*Marchantia emarginata*	3	Stone
9.	*Marchantia polymorpha*	3	soil and stone
10.	*Fontinalis antipyretica*	9	Stone
11.	*Serpoleskea confervoides*	11	soil and stone
12.	*Octoblepharum albidum*	2	Wood
13.	*Leucobryum sanctum*	2	Wood
14.	*Lejeunea sp.*	9	Stone
15.	*Neckera complanate*	2	Wood
16.	*Funaria hygrometrica*	1	Stone
17.	*Sematophyllum tristiculum*	2	Stone
18.	*Myrothecium microcarpum*	1	Soil
19.	*Pogonatum cirratum*	30	Stone
	Total	**144**	

Based on table 3 has found 12 moss species identified from station II. *Fissidens taxifolius* is the moss species that dominates station II. The temperature in station II was recorded at 32°C with a humidity level of 58%. The light intensity of station II is 3537 lx. These parameters influence the discovery of moss type.

Table 3. Species of Bryophytes in Station II

No.	Species	Number found	Substrate
1.	*Sematophyllum tristiculum*	4	Stone
2.	*Fissidens zollingeri*	3	Soil
3.	*Fissidens taxifolius*	38	Soil
4.	*Fissidens obtusifolius*	18	Soil
5.	*Fissidens perpusillus*	10	soil and stone
6.	*Octoblepharum albidum*	4	Wood
7.	*Serpoleskea confervoides*	12	Stone
8.	*Mnium hornum*	2	Soil
9.	*Marchantia emarginata*	4	Stone
10.	*Marchantia polymorpha*	6	soil and stone
11.	*Funaria hygrometrica*	2	Stone
12.	*Neckera complanata*	3	Wood
	Total	**106**	

Station III presented in table 4 data found 9 identified species. The environmental factors in station III have temperature 32°C with humidity of 53%. The light intensity at station III is higher than the other station about 4975 lx.

Table 4. Species of Bryophytes in Station III

No.	Species	Number found	Substrate
1.	*Serpoleskea confervoides*	15	Stone
2.	*Pogonatum cirratum*	2	Stone
3.	*Fissidens perpusillus*	12	Soil
4.	*Mnium hornum*	10	Soil
5.	*Neckera complanata*	2	Wood
6.	*Marchantia emarginata*	4	Stone
7.	*Fontinalis antipyretica*	4	Stone
8.	*Myrothecium microcarpum*	2	Soil
9.	*Amblystegium serpens*	1	Wood
	Total	52	

In Table 5, the results of calculating the diversity index (H') and uniformity (E) of bryophytes at the three stations on Jalan Pajajaran are presented. Calculation of diversity index values uses the Shannon-Wiener index formula.

Table 5. Diversity Index Value (H') and Uniformity Index (E) of Bryophytes in Urban-Bogor

Station	Number of Species	Diversity Index (H')	Uniformity Index (E)
I	144	2,4592	0,8352
II	106	2,0233	0,8142
III	52	1,7830	0,8115

The moss diversity and uniformity index in Station I was higher than in Station II and Station III. The diversity of moss in the Green Open Space of Jalan Pajajaran has medium diversity criteria. The results of the moss uniformity index showed high uniformity criteria with a stable community distribution at each observation station.

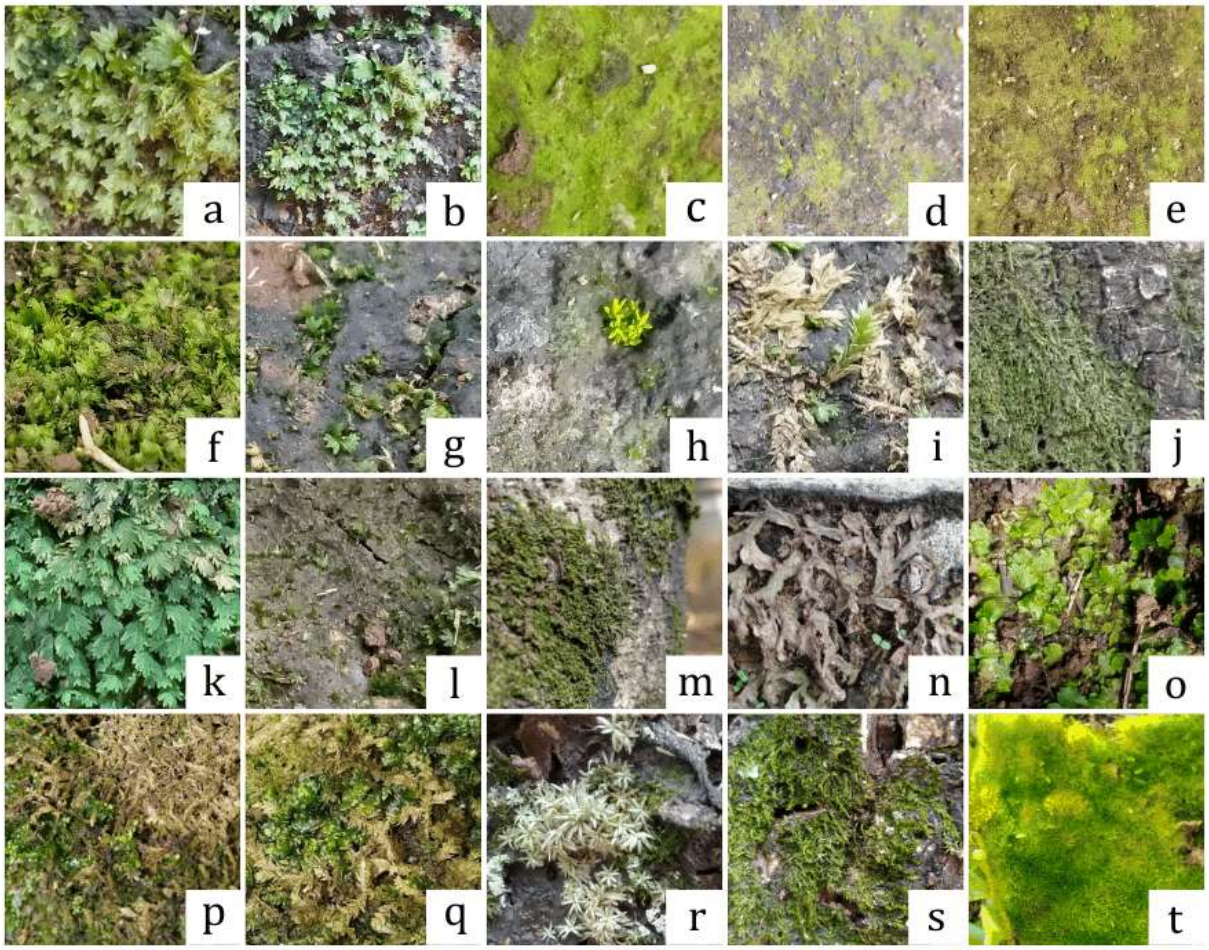

Figure 3. Species of Bryophytes in Urban-Bogor Region. (a) *Fissidens perpusillus*, (b) *Serpoleskea confervoides*, (c) *Pogonatum cirratum*, (d) *Lejeuna* sp., (e) *Sematophyllum tristiculum*, (f) *Fissidens taxifolius*, (g) *Fissidens obtusifolius*, (h) *Funaria hygrometrica*, (i) *Myrothecium microcarpum*, (j) *Neckera complanata*, (k) *Mnium hornum*, (l) *Fissidens zollingeri*, (m) *Hypnum cupressiforme*, (n) *Marchantia emarginata*, (o) *Marchantia polymorpha*, (p) *Mnium stellare*, (q) *Fontinalis antipyretica*, (r) *Octoblepharum albidum*, (s) *Leucobryum sanctum*, (t) *Amblystegium serpens*.

DISCUSSION

Characteristic of Canopy in Observation Station

The research uses data collection with stations divided into three at the research site. Station points are based on physical environmental characteristics, especially the amount of shade at the research location. The green route on Jalan Pajajaran with a length of approximately 503 meters has different shades along the road. This research using the belt transect technique divides three stations with each station being 167 meters long. The plants found in the green belt have various heights and widths in terms of tree height and shade area. Station I was observed to have very shady tree cover; several large and tall trees were found on the edge of the green route. The presence of tall buildings near Station I also hinders sunlight from shining towards Station I. This results in less light intensity coming in under the shade and station I being shadier. Station II has several tall

and large trees quite far away. The shade of the trees at station II is quite far apart and there are gaps for light to enter. This results in the light intensity at station II being greater than station I. In contrast to stations I and II, the light intensity entering station III is less due to the shade of trees and is not as extensive as the other two stations. The trees are quite far apart and there are parts of the green belt without being touched by tree shade.

Differences in shade in an area can cause differences in the physical environmental characteristics of that area. Shade has the function of lowering the air temperature, because the intensity of light hitting the area becomes lower, thereby increasing the humidity in the area. Other research also states that shade can function to optimize lighting for shaded plants so that the plants will not experience damage or death due to excess light. Therefore, it can be said that shade is the optimal way to regulate sunlight intensity, optimal light intensity will influence the productivity of a plant (Anni, 2013; Manullang, 2021; Sakiroh, 2021).

The optimal light intensity for several types of plants is different. Light intensity can affect temperature and humidity. Several plants can live optimally under direct sunlight, some plants grow and require shade or lower light intensity in the growth process, one of which is moss. Most plants can live in damp places, so if a place has a shade with low light intensity, that place will have higher humidity and will be an optimal place for moss to grow. So you can find more types of moss in places with more shade (Wati, 2016; Suryani, 2023).

Morphology Identification of Moss Species

The number of moss species found and identified on the green belt on Jalan Pajajaran Bogor consists of 20 species as depicted in Figure 3. (a) *Fissidens perpusillus*, this moss was found at all three stations a total of 42 discoveries. This indicates that this moss is one of the moss species that dominates in the area. *Fissidens perpusillus* is found in abundance, mostly attached to soil and rock substrates. The characteristics of moss when found are that it has a wide, segmented thallus, light yellowish green in color. (b) *Serpoleskea confervoides*, this moss was found at all three stations a total of 38 discoveries. This indicates that this moss is one of the species of moss that is quite abundant in the area. *Serpoleskea confervoides* isfound to be slightly dark green in color and attached to soil and rock substrates. The characteristic of moss when it is found is that it has a fairly large and dense thallus, the thallus is faintly serrated at the end. (c) *Pogonatum cirratum,* was found at two stations, namely station 1 and station 3, a total of 32 discoveries. This indicates that this moss species dominates in this area. *Pogonatum cirratum* is characterized by a very dense and smooth upright thallus that is bright yellowish green in color. (d) *Lejeuna* sp., this moss was found only at station 1 with a total of 9 discoveries. This moss is attached to the rock substrate. *Lejeuna* sp. It is characterized by a thallus that looks smooth and thin and has a greenish, slightly yellowish color. (e) *Sematophyllum tristiculum*, found at stations 1 and 2 for a total of 6 discoveries. This moss is found attached to rock substrates. *Sematophyllum tristiculum* is found with a slightly dry thallus that is yellow to greenish yellow in color.

Next, (f) *Fissidens taxifolius*, this moss was found at stations 1 and 2 a total of 40 number species. This shows that this moss is one of the mosses that dominates in this area. *Fissidens taxifolius* attaches to rock and soil substrates and is characterized by a thick, jagged-edged thallus that is fresh to dark green in color. (g) *Fissidens obtusifolius*, found at stations 1 and 2 for a total of 21 number mosses. This moss is found attached to the soil substrate. *Fissidens obtusifolius* is characterized by its thallus having a long and wide diameter, the tip of the thallus being serrated with a dark green to fresh green color. (h) *Funaria hygrometrica*, this moss was found at stations 1 and 2 a total of 3 discoveries. This shows that this species is relatively few in this area. This moss is found attached to rock substrates. *Funaria hygrometrica* is characterized by a long thallus in clusters of bright yellowish green color. (i) *Myrothecium microcarpum*, at stations 1 and 3 has found 3 number mosses. This moss attaches to the soil substrate. *Myrothecium microcarpum* is

one of the few mosses in this area. This moss is characterized by a long thallus that is stacked and has a pointed, yellowish green tip. (j) *Neckera complanata*, this moss was found at stations 1 and 3 a total of 4 number mosses. This moss attaches to the wood substrate. *Neckera complanata* is found characterized by its long, densely packed, slightly dry thallus which is pale dark green in color.

Furthermore, (k) *Mnium hornum*, this moss was found at the three stations a total of 29 discoveries. This moss attaches to the soil substrate. *Mnium hornum* is characterized by an erect thallus that spreads densely in dark green with a tapered tip. (l) *Fissidens zollingeri*, found at stations 1 and 2 with a total of 4 mosses. This moss attaches to soil and rocks. *Fissidens zollingeri* is characterized by its thallus being rather wide and the serrated tip is pale yellowish green. (m) *Hypnum cupressiforme*, found at station 1 18 discoveries. This moss attaches to the wood substrate. *Hypnum cupressiforme* has the characteristic that its thallus is long, small, and dense, dark green in color. (n) *Marchantia emarginata*, found at stations 1 and 2 with a total of 7 number mosses. This moss is found on stone substrates. *Marchantia emarginata* has the characteristic that its thallus spreads to form long and wide sheets with a brownish color when dry. (o) *Marchantia polymorpha*, found at stations 1 and 2 a total of 9 mosses. This moss is found attached to soil and rock substrates. *Marchantia polymorpha* is characterized by a bright yellowish green thallus in the form of a rather wide sheet and rounded edges.

Next, (p) *Mnium stellare*, was found at station 1 with a total of 8 discoveries. This moss is attached to the soil substrate. *Mnium stellare* is characterized by its slender and long thallus which is dark green and slightly brownish. (q) *Fontinalis antipyretica*, found at stations 1 and 3 a total of 13 discoveries. This moss is found attached to rock substrates. *Fontinalis antipyretica* is characterized by an elongated, dense, and rather wide thallus that is green and partly brownish. (r) *Octoblepharum albidum*, found at stations 1 and 2 for a total of 6 mosses. This moss attaches to the wood substrate. This moss is characterized by a star-shaped thallus that is pale green and whitish in color. (s) *Leucobryum sanctum*, found at station 1 with a total of 2 discoveries. This moss is attached to the wood substrate. This moss is characterized by its small, long, spreading thallus that is green to dark green. (t) *Amblystegium serpens*, this moss was found at station 3 discoveries. This moss is attached to a wood substrate which is characterized by its small, dense, and smooth thallus, fresh green to yellowish green in color.

All mosses found during the research were in the gametophyte phase, which is the dominant phase that occurs in mosses. In general, the morphological characteristics of urban moss include a body size that is not too large. Some moss was also found in a condition that was starting to turn black, dry, and pale in color. This occurs due to adaptation to environmental factors in urban areas in their growth and development.

Bryophytes Diversity

Based on the research results in Table 5, it can be seen that the moss diversity index (H') value along the Jalan Pajajaran green belt at all stations ranges between 1 and 3 which is included in the medium category. The research stations with the highest to lowest Diversity Index values were station I (2.4592), station II (2.0233), and station III (1.7830), respectively. This is influenced by differences in environmental factors such as temperature, light intensity, and air humidity at each station (So seen & Kurnia, 2021; Ristanto et al., 2021; Endang et al. 2020). Moss grows optimally at temperatures of 15-25°C, but this plant can adapt to live at temperatures of 40-50°C and will grow optimally at a humidity of more than 50%, which is around 85%-98% (Putri et al., 2019; Maharani et al., 2017). Mosses have different levels of adaptation and propagation phases, this is influenced by the level of intensity of sunlight they receive (So seen & Kurnia, 2021; Putrika, 2017).

Bryophytes Uniformity

The research results show that the value of the moss type uniformity index (E) at the three stations is around 0.8, where this value is classified as high (Table 5). The research stations with the highest to lowest Species Uniformity Index respectively are Station I (0.8352), Station II (0.8142), and Station III (0.8115). A high species uniformity index can reflect the dominance of species that are more resistant to environmental stress and able to adapt to rapid changes in urban conditions (Sujetoviene & Galinyte, 2016).

Species that can tolerate environmental stressors, such as air pollution and temperature fluctuations, have a competitive advantage in surviving and thriving in dynamic urban environments (Bhatt et al., 2022). High uniformity may indicate that some moss species dominate urban landscapes and can withstand environmental challenges better than other species. This phenomenon is thought to be related to the specific adaptive properties of some types of moss to survive in the face of rapidly changing environmental conditions (Grdovic & Stevanovic, 2006).

Relation of Species Identification, Diversity, and Uniformity of Bryophytes

Identification of moss types is the initial stage in characterizing moss communities along the green belt of Jalan Pajajaran, Bogor. This process involves identifying and documenting the various moss species found in the region. This variable is the basis for measuring moss diversity, which includes the number of species in the urban habitat (Bhatt et al., 2022). Moss diversity reflects the variety and abundance of species in a community (Fojcik & Stebel, 2014). Meanwhile, moss uniformity refers to how evenly distributed the number of individuals of the various species is (Julinova & Beckovsky, 2019).

The relationship between these variables is that the higher the identification of moss types, the more accurate our understanding of the diversity of species at the research location. This identification forms the basis for measuring moss diversity, which can reveal the level of variation and complexity of moss ecosystems in urban habitats. Meanwhile, the uniformity of moss can provide further insight into the extent to which certain species dominate or distribute themselves evenly throughout the region.

Research Limitations

In this research there are several limitations, especially related to the coverage of the urban area along Jalan Pajajaran, Bogor (with coordinate points between -6,595, 106,804 and -6,600, 106,805). Although this area was chosen because of its relevance to the urban habitat context, this research does not fully represent the complexity of the urban environment in Bogor City. These regional limitations may affect the generalization of research findings regarding the condition of mosses in urban habitats in general.

CONCLUSION

Green Open Space (RTH) as an urban habitat has an ecological function to reduce environmental problems in cities with the presence of plants that grow with human help and grow by themselves due to environmental factors. One of the plants that can adapt to urban environments, especially in green belts, is moss. The presence of moss can be used as an environmental indicator due to the diversity of moss types and the uniformity of types in urban areas. The results of research on Jalan Pajajaran, Bogor found that there were 20 species of moss consisting of leaf moss and liverworts. The diversity index of the three observation stations in sequence is 2.45; 2.02 ; 1.78 so it is classified as medium criteria. The uniformity index obtained at three observation stations was 0.8, which is included in the criteria for high uniformity and an even distribution of moss types along the green belt. Moss in urban areas adapts to environmental

factors such as temperature, humidity, and light intensity so that the morphological characteristics of the moss found will adapt to these factors. Based on this research, it is necessary to carry out further research related to a wider coverage of the research area so that it is more representative of the overall condition of moss in urban Bogor habitats. Apart from that, further research can be carried out regarding the comparison of the morphological characteristics of moss in urban habitats with moss in habitats where it is more likely that the moss will grow optimally, such as humid highland areas in the mountains. This will provide a deeper understanding of the influence of environmental impacts on moss growth in an area.

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