IBJ
Indonesian Biodiversity Journal
http://ejurnal.unima.ac.id/index.php/ibj

indonesian.biodivers.j.
Vol. 6, No. 3, December 2025
ISSN : 2722-2659

LICHEN DIVERSITY IN KEBUN RAYA BANUA, BANJARBARU CITY, SOUTH KALIMANTAN PROVINCE

Alifia Puspita Sari*[1], Opik Prasetyo[1] , Muhammad Abdi Gusti[1]

[1]Faculty of Teacher Training and Education, Lambung Mangkurat University, Indonesia.

**Corresponding author: 2310119120008@mhs.ulm.ac.id*

Received: November 05th, 2025 *Accepted: February 25th, 2026*

Abstract

Lichen are pioneer organisms resulting from symbiosis between mycobionts (fungi) and photobionts (algae or cyanobacteria) that play an important role in maintaining ecosystem balance. This study aims to determine the diversity of lichen species in the Kebun Raya Banua, Banjarbaru City, South Kalimantan Province and to analyze the environmental factors that influence their existence. The study was conducted using an exploratory survey method with a purposive sampling technique at three observation stations, and diversity analysis was calculated using the Shannon–Wiener Index (H'). The results showed that 7 lichen species belonging to 6 families were found, namely *Cryptothecia striata*, *Graphis scripta*, *Diorygma sticticum*, *Dirinaria applanata*, *Phlyctis argena*, *Lepraria* sp., and *Bacidia* sp., with a total of 110 colonies and a diversity index value of $\hat{H}$ = 1.8233 which is included in the moderate diversity category. These values indicate that environmental conditions in the Kebun Raya Banua are still quite stable and support the growth of various types of lichen, with temperature, humidity, soil pH, and light intensity as important factors influencing variations in diversity between observation stations.

Key words: diversity index, environmental factors, Kebun Raya Banua, Lichen, South Kalimantan

INTRODUCTION

Indonesia is the country with the second-highest terrestrial biodiversity in the world. Biodiversity or biological diversity is a term used to describe the diversity of living things on Earth, from lower to higher organisms (Suryana & Antara, 2021). The high level of biodiversity in Indonesia is influenced by the diversity of ecosystems spread across various regions, such as peat forests in Kalimantan and savannas in East Nusa Tenggara (Kamaluddin *et al*., 2022). These diverse environmental conditions create unique habitats for organisms, including lichen, which play a vital role as bioindicators of environmental quality. Lichen have long been a subject of research in Indonesia, but most studies are limited to exploring species and their distribution in a few regions (Ghazali *et al*., 2021).

Lichens are composite symbiotic organisms formed through a mutualistic association between a fungal partner (mycobiont) and a photosynthetic partner known as the phycobiont, which may consist of green algae or cyanobacteria (Grimm *et al*., 2021). In this symbiosis, the mycobiont provides structural support, protection, and the ability to absorb water and minerals from the surrounding environment, while

indonesian.biodivers.j.
Vol. 6, No. 3, December 2025
ISSN : 2722-2659

the phycobiont performs photosynthesis and supplies organic nutrients necessary for the survival of the lichen thallus (Benita *et al*., 2025). This mutualistic relationship enables lichens to persist in a wide range of habitats, including environments with limited nutrients and extreme conditions. Lichens typically grow attached to various natural substrates, such as tree bark, rocks, and soil, where the substrate functions as a stable surface that supports their growth and physiological processes (Ghazali *et al*., 2021).

Research on lichen in Indonesia remains very limited, both in terms of the number of studies and their coverage. Most lichen-related research in Indonesia is concentrated on the islands of Java and Sumatra, while other regions, such as Kalimantan, have received minimal study (Muvidha, 2020) Research conducted in Banjarbaru City, South Kalimantan, showed that the number of lichen colonies found in the Banjarbaru Arboretum area was relatively low, indicating that data on lichen species and diversity in this area is still limited and requires further study (Yuliani *et al*., 2021). This condition reflects that lichen research in Indonesia is not evenly distributed and still does not adequately describe the ecological aspects of lichen in various regions, especially in South Kalimantan, so further studies are needed to enrich local biodiversity data (Sonia *et al*., 2024).

Based on these conditions, the lack of data on lichen diversity in the Kebun Raya Banua, Banjarbaru City, South Kalimantan Province, became the basis for this research. This study aims to identify the diversity of lichen species and analyze environmental factors that influence their distribution patterns. The results are expected to contribute to the provision of baseline data on lichen biodiversity in South Kalimantan, while also supporting conservation efforts and sustainable environmental management.

RESEARCH METHODS

This study employed an exploratory field survey method using a purposive sampling technique. The exploratory approach was conducted through direct field investigation to explore lichen diversity by systematically observing natural substrates, including tree trunks, rocks, and other hard surfaces at selected observation sites. The exploration focused on locating, recording, and identifying lichen colonies based on their macroscopic morphological characteristics, such as thallus type, color, and growth form. Purposive sampling was used to intentionally determine sampling locations based on specific considerations, including the presence of lichen on various substrates and variations in environmental conditions such as temperature, soil moisture, soil pH, humidity, sunlight intensity, and wind speed (Thomas, 2022).

The research activities were carried out in September – October 2025 in the Kebun Raya Banua, Banjarbaru City, South Kalimantan Province. Sampling locations were determined based on several points representing the entire research area and taking into account the presence of lichen at each location. The stations were divided into three stations, as shown in Figure 1.

indonesian.biodivers.j.
Vol. 6, No. 3, December 2025
ISSN : 2722-2659

Figure 1. Research Location Map

Station 1 (entrance gate to Kebun Raya Banua)

The observation site is located adjacent to the Kebun Raya Banua entrance. It features a greenhouse for ex-situ plant conservation, with dense canopy cover creating a shaded, cool environment conducive to specific undergrowth species.

Station 2 (Kebun Raya Banua Reservoir)

The observation site is situated in the reservoir area of Kebun Raya Banua. Vegetation in this location is distributed with relatively wide spacing, forming an open canopy structure that permits higher light penetration and produces a brighter and more exposed microenvironment

Station 3 (garden canteen)

The observation site is situated near the Kebun Raya Banua canteen, with relatively dense vegetation forming a closed canopy structure. This condition limits sunlight penetration and creates a more shaded and humid microenvironment.

The tools used in this study included a Global Positioning System (GPS) to determine the coordinates of sampling stations, a smartphone camera for documentation, a ruler for direct measurement of lichen samples, stationery for data recording, a thermometer for measuring ambient temperature, a soil tester for soil moisture and pH, a hygrometer for relative humidity, and a 4-in-1 multifunction environmental

indonesian.biodivers.j.
Vol. 6, No. 3, December 2025
ISSN : 2722-2659

measuring instrument for assessing wind speed and light intensity.

Sampling was conducted using a purposive sampling technique in the Kebun Raya Banua, Banjarbaru City, South Kalimantan Province. Samples were taken from three predetermined observation stations. At each location, lichen samples were observed by observing the substrates on which they grow, such as rocks, tree bark, and soil. Once found, the lichen samples were recorded and analyzed to determine their species based on morphology and scientific classification.

Data analysis was performed by dividing the data into categories. Macroscopic observations, such as the shape, condition, and color of the lichen thallus, were conducted to determine the lichen species, and then compared with the literature. Lichen diversity at the three stations was determined using the Shannon-Wiener diversity index (Sun & Ren, 2021).

$$\hat{H} = -\sum_{t=1}^{s} (pi)(\ln pi)$$

Information:

$\hat{H}$ = Shannon-Wiener diversity index

S = Total number of species found

p_i= Proportion of individuals of the i-th species, with the formula: $p_i = n_i / N$

n_i = Number of individuals of the i-th species

N = Total number of individuals of all species

ln = Natural logarithm (base e)

Table 1. Shannon–Wiener Diversity Index Value Criteria

Value of $\hat{H}$	Diversity Category
$\hat{H} \leq 1$	Low
$1 < \hat{H} \leq 3$	Moderate
$\hat{H} > 3$	Tall

(Nolan & Callan, 2006)

RESULTS AND DISCUSSION

Lichen Diversity Index

Based on the research conducted in the Kebun Raya Banua, Banjarbaru City, South Kalimantan Province, a total of seven lichen species belonging to six families were recorded, with a total of 110 colonies observed. The results of the Shannon–Wiener diversity index calculation for the study area are presented in Table 2.

indonesian.biodivers.j.
Vol. 6, No. 3, December 2025
ISSN : 2722-2659

Table 2. Lichen Diversity Index at All Observation Stations.

Family	Spesies	Station			∑ Colony	Ĥ
		I	II	III		
Arthoniaceae	*Cryptothecia striata*	+	-	+	21	0,3161
Graphidaceae	*Graphis scripta*	+	+	-	12	0,2417
Graphidaceae	*Diorygma sticticum*	+	+	-	14	0,2624
Caliciaceae	*Dirinaria Applanata*	-	+	+	9	0,2048
Phlyctidaceae	*Phylctis argena**	+	+	+	32	0,3592
Stereocaulaceae	*Lepraria* sp**	-	-	+	6	0,1587
Ramalinaceae	Bacidia sp.	+	-	+	16	0,2804
Jumlah		6	4	5	110	1,8233

Information:

* : the highest score

** : lowest value

\+ : There are species

\- : No species found

Based on the calculation results, the Shannon-Wiener diversity index (Ĥ) value is 1.8233, which is included in the moderate diversity category (1 < Ĥ ≤ 3). This value indicates that the diversity of lichen species at the research site is classified as moderate, with colony structures still dominated by certain species, such as *Phylctis argena,* while other species have relatively fewer colonies.

Environmental Factors

Environmental factors are important factors influencing lichen growth. Measurements were taken at three points, with each point being replicated three times. The results of these environmental factor measurements are presented in Table 3.

Table 3. Environmental Parameter Measurement Results

No	Tool Name	Measured Parameters	Average			Range
			Point 1	Point 2	Point 3	
1	Thermometer	Measuring Environmental Temperature	31.6 °C	34.43 °C	34.6 °C	30.9 - 35
2	Soil Tester	Measuring Soil Moisture	5.67%	2.33%	3.33%	1 - 8
		Measuring Soil pH	5.7	6.37	6.07	5.1 - 6.9
3	Hygrometer	Measuring Environmental Humidity	71.93%	64.37%	59.97%	57.4 - 74.2
4	4 in 1 parameters	Sunlight Intensity	Min. 3,282 Lux	Min. 5,153.33 Lux	Min. 3508.67 Lux	1366 - >20000

No	Tool Name	Measured Parameters	Average			Range
			Point 1	Point 2	Point 3	
			Max. 9086.67 Lux	Max. 15,090 Lux	Max. 9,673.33 Lux	
		Measuring Wind Speed	Min. 0.0 m/s Max. 1.1 m/s	Min. 0.0 m/s Max. 1.13 m/s	Min. 0.0 m/s Max. 1.0 m/s	0.0 > 1.4

Source: processed from primary data

Classification and Characteristics of Lichen in Kebun Raya Banua, Banjarbaru

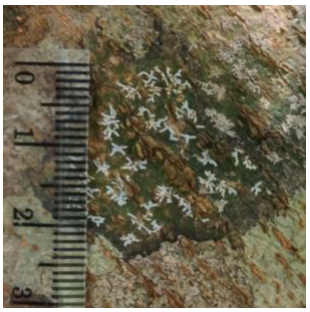
In the Kebun Raya Banua, seven lichen species belonging to six families were recorded, with a total of 110 colonies. Station 1 showed the highest species richness (six species), followed by Station 3 (five species) and Station 2 (four species). The lichen community was dominated by *Phlyctis argena* with the highest colony abundance (32 colonies). In terms of thallus type, crustose lichens accounted for approximately 86% of the identified species, while foliose lichens represented about 14%, and fruticose lichens were not observed (Table 4).

The predominance of crustose thalli indicates a higher adaptability of lichen species to local environmental conditions, as this thallus type is known for its strong substrate attachment and greater tolerance to environmental stressors, including microclimatic variation and moderate levels of air pollution. Conversely, the limited presence of foliose lichens suggests higher sensitivity to environmental disturbance at the study site (Suniyanti *et al*., 2022)

Table 4. Results of Lichen Identification in the Kebun Raya Banua, Banjarbaru City, South Kalimantan Province

No.	Species	Classification	Characteristics	Observation Photos
1.	*Cryptothecia striata*	Kingdom: Fungi Division: Ascomycota Class: Lecanormycetes Order: Arthoniales Family: Arthoniaceae Genus: *Crytothecia* Species: *Crytothecia striata*	Diameter: 4 cm Color: grayish white green Substrate: KBP Thallus type: crustose	

indonesian.biodivers.j.
Vol. 6, No. 3, December 2025
ISSN : 2722-2659

No.	Species	Classification	Characteristics	Observation Photos
2.	*Graphis scripta*	Kingdom: Fungi Division: Ascomycota Class: Lecanormycetes Order: Ostropales Family: Graphidaceae Genus: *Graphis* Species: *Graphis scripta*	Diameter: 3.5 cm Color: white with branched black Appthecia Substrate: KBPThallus type: crustose	
3.	*Diorygma sticticum*	Kingdom: Fungi Division: Ascomycota Class: Lecanoromycetes Order: Graphidales Family: Graphidaceae Genus: *Diorygma* Species: *Diorygma sticticum*	Diameter: 2.3 cm Color: Grayish white Substrate: KBP Thallus type: crustose	
4.	*Dirinaria Applanata*	Kingdom: Fungi Division: Ascomycota Class: Lecanormycetes Order: Teloschistales Family: Caliciaceae Genus: *Dirinaria* Species: *Dirinaria Applanata*	Diameter: 1.3 cm Color: greenish white Substrate: KBP Thallus type: foliose	
5.	*Phylctis argena*	Kingdom: Fungi Division: Ascomycota Class: Lecanormycota Order: Gyalectales Family: Phlyctidaceae Genus: *Phylctis* Species: *Phylctis argena*	Diameter: 8 cm Color: creamy white Substrate: KBP Thallus type: crustose	
6.	*Lepraria sp.*	Kingdom: Fungi Division: Ascomycota Class: Lecanoromycetes Order: Lecanorales Family: Stereocaulaceae Genus: *Lepraria*	Diameter: 8 cm Color: grayish green Substrate: KBP Thallus type: crustose	

indonesian.biodivers.j.
Vol. 6, No. 3, December 2025
ISSN : 2722-2659

No.	Species	Classification	Characteristics	Observation Photos
7.	*Bacidia* sp.	Species: *Lepraria* sp. Kingdom: Fungi Division: Ascomycota Class: Lecanoromycetes Order: Lecanorales Family: Ramalinaceae Genus: *Bacidia* Species: *Bacidia* sp.	Diameter: 2.3 cm Color: Light green Substrate: KBP Thallus type: crustose	

Description: KBP (Tree Bark); KAP (Tree Root Bark).

Discussion

The Shannon–Wiener diversity index (H' = 1.8233) indicates that lichen diversity in the Kebun Raya Banua is classified as moderate. This value indicates that the environment at the research site is still quite stable and able to support the growth of several lichen species, although it has not yet reached a high level of diversity (Rimanda, 2024). A moderate diversity index (1 < H' ≤ 3) indicates a fairly diverse and relatively stable lichen colony, influenced by environmental factors. This condition indicates that the Kebun Raya Banua ecosystem still supports the growth of various types of epiphytic lichen that utilize tree bark as their primary substrate. Variation between stations is caused by differences in microenvironmental conditions that affect the lichen's ability to adapt to abiotic factors (Anggraini *et al*., 2021).

Observed environmental factors, including temperature, humidity, soil pH, light intensity, and wind speed, play a significant role in determining lichen distribution patterns. Temperatures at the study site ranged from 31–34°C with air humidity of 59–72%. The combination of these two factors influences lichen thallus growth, as high humidity indicates the availability of atmospheric water vapor, which is essential for symbiont metabolism and photosynthesis (Puspitasari & Roziaty, 2022). Light intensity also influences lichen abundance. In areas with low light intensity, such as Station 1, the number of colonies tends to be lower, while in areas with higher light levels, the number of colonies increases. Symbiotic algae require sufficient light for photosynthesis, which is the primary energy source for lichen growth and development (Laelasari, 2021).

The recorded light intensity values showed a relatively wide range (1366 to >20,000 lux), reflecting differences in vegetation density, canopy cover, and spatial openness among observation stations. Station 2, located near the reservoir area, exhibited higher light intensity due to more open vegetation structure, allowing greater solar radiation to reach the substrate surface. In contrast, Stations 1 and 3 were characterized by denser canopy cover, which reduced light penetration and resulted in lower light intensity values. Such microenvironmental variation in light availability is common in botanical garden ecosystems and plays an important role in influencing lichen distribution, as sufficient light is required by photobionts for photosynthesis (Widodo *et al*., 2023).

indonesian.biodivers.j.
Vol. 6, No. 3, December 2025
ISSN : 2722-2659

Soil pH ranging from 5.7 to 6.37 significantly influences lichen colony development. A pH close to neutral tends to support healthy and optimal host vegetation growth, providing a stable and conducive stem surface for epiphytic lichen development. This condition is consistent with previous findings showing that stable soil pH and moisture play an important role in maintaining host vegetation productivity and the presence of symbiotic microorganisms that contribute to the lichen ecosystem (Benita *et al*., 2025). High soil moisture also supports lichen growth, as it increases the availability of water necessary for lichen metabolism and colony development (Widodo *et al*., 2023).

The *Phlyctis argena* species was the most dominant species with the highest number of colonies among all the species found. Suharno *et al.* (2024) explained that *Phlyctis argena* was the most commonly found species due to its ability to adapt to various environmental conditions and its drought-resistant characteristics as well as microclimate variations that support extensive colony growth. Conversely, *Lepraria* sp. was found in the lowest numbers due to its narrow habitat preferences, namely in areas with high humidity and low light intensity. Meanwhile, the dominance of crustose thallus lichen such as *Cryptothecia striata* and *Diorygma sticticum* indicates that this thallus type has high resistance to temperature fluctuations and light intensity. The thallus structure that is firmly attached to the substrate allows the lichen to be more effective in reducing water loss and maintaining its physiological stability (Nugraheni & Prabowo, 2022). This finding aligns with research by Widodo *et al*. (2023) in Tulungagung and Sonia *et al.* (2024) in Bangka Belitung, which also reported the dominance of crustose thallus lichen in lowland tropical ecosystems.

Overall, the relationship between diversity index values and environmental conditions indicates that temperature, humidity, pH, and light are the main factors determining lichen distribution in the Banua Botanical Gardens. Balanced environmental conditions allow for the formation of stable and diverse lichen colonies. The results of this study reinforce the findings of Ghazali *et al*. (2021) and Sonia *et al*. (2024) that lichen diversity is highly dependent on the balance of abiotic factors that support symbiont photosynthesis and substrate stability. Therefore, the presence of various lichen species in the Kebun Raya Banua indicates relatively good environmental conditions and is suitable as an initial indicator for monitoring ecosystem quality in South Kalimantan.

CONCLUSION

Lichen diversity in the Kebun Raya Banua, Banjarbaru City, South Kalimantan Province is classified as moderate with a Shannon–Wiener index value (H' = 1.8233), consisting of 7 species from 6 families, with Phlyctis argena as the most dominant species. These results indicate that environmental conditions in the Kebun Raya Banua are still quite stable and support the growth of various types of epiphytic lichen. Environmental factors such as temperature, humidity, soil pH, and light intensity play an important role in determining the variation in diversity between stations. These findings confirm that lichen can be used as bioindicators of environmental conditions in the area. Identification of species that are still morphological is a limitation of this study, so further research is recommended to use molecular analysis

indonesian.biodivers.j.
Vol. 6, No. 3, December 2025
ISSN : 2722-2659

to obtain more accurate and in-depth identification results.

REFERENCE

Benita, A. A., Fitriani, A., Ramadhan, F., Masfurin, F. R., Grandisningtias, G. G., & Fitriyyah, I. (2025). Identifikasi Karakter Morfologi dan Reproduksi pada Thallophyta dan Bryophyta di UIN Sunan Gunung Djati Bandung Universitas Islam Negeri Sunan Gunung Djati Lingkungan kampus UIN Sunan Gunung Djati Bandung memiliki karakteristik lingkungan tertentu yang da. *Tumbuhan : Publikasi Ilmu Sosiologi Pertanian Dan Ilmu Kehutanan*, *2*(1), 82–94.

Eka Suryana, P. G., & Yudi Antara, G. M. (2021). Pengembangan Teknologi Informasi Geografi sebagai Media Eksplorasi Keanekaragaman Hayati (Biodiversitas) di Indonesia. *Jurnal Sistem Informasi Dan Komputer Terapan Indonesia (JSIKTI)*, *3 No 4*(4), 46–55. https://doi.org/10.22146/jsikti

Fr. Baiju Thomas. (2022). The Role of Purposive Sampling Technique as a Tool for Informal Choices in a Social Sciences in Research Methods. *Just Agriculture*, *02*(5), 1–8.

Ghazali, M., Nurhayati, Suripto, Sukenti, K., & Julisaniah, N. I. (2021). Bioscientist : Jurnal Ilmiah Biologi. *Bioscientist : Jurnal Ilmiah Biologi*, *9*(1), 63–71. https://e-journal.undikma.ac.id/index.php/bioscientist

Grimm, M., Grube, M., Schiefelbein, U., Zühlke, D., Bernhardt, J., & Riedel, K. (2021). The Lichens' Microbiota, Still a Mystery? In *Frontiers in Microbiology* (Vol. 12). Frontiers Media S.A. https://doi.org/10.3389/fmicb.2021.623839

Kamaluddin, Hano'e, E. M. Y., & Pardosi, L. (2022). Keanekaragaman Lumut Kerak (Lichenes) di Area Kaki Gunung Mutis. *Pro-Life*, *9*(3), 515–532. https://doi.org/10.33541/pro-life.v9i3.4153

Muvidha, A. (2020). *Lichen di jawa timur. tulungagung: akademia pustaka.* 23–24.

Nolan, K. ., & Callan, J. . (2006). Beachcomber Biology : The Shannon-Weiner Species Diversity Index. *ABLE 2005 Proceedings*, *27*, 334–338.

Nugraheni, L. I., & Prabowo, C. A. (2022). Keanekaragaman Jenis Tumbuhan Paku (Pteridophyta) Di Sungai Gayam Desa Walen Kecamatan Simo Kabupaten Boyolali Jawa Tengah. *Indonesian Journal of Biotechnology and Biodiversity*, *6*(3), 110–117. https://doi.org/10.47007/ijobb.v6i3.137

Sebagai, L., & Kualitas, B. (2024). *Environmental Pollution Journal*. *4*(November), 1075–1084.

Sonia, A., Lingga, R., Sofiana Fastanti, F., Biologi, J., Pertanian Perikanan dan Kelautan, F., Bangka Belitung Balunijuk, U., Bangka Belitung, K., Riset Biosistematika dan Evolusi, P., Riset Hayati dan Lingkungan, O., Riset dan Inovasi Nasional, B., Soekarno, K., & Raya Jakarta-Bogor, J. (2024). Keanekaragaman Jenis Lichen di Tahura Gunung Menumbing Kabupaten Bangka Barat Provinsi Kepulauan Bangka Belitung (Diversity of Lichens in Tahura Gunung Menumbing of West Bangka Regency Bangka Belitung Islands). *Berita Biologi*, *23*(2), 215–225. https://doi.org/10.55981/beritabiologi.2024.3840

Sun, W., & Ren, C. (2021). The impact of energy consumption structure on China's carbon emissions: Taking the Shannon–Wiener index as a new indicator. *Energy Reports*, *7*, 2605–2614. https://doi.org/10.1016/j.egyr.2021.04.061

Suniyanti, S., Mahrus, M., & Mertha, I. G. (2022). The Diversity of Lichens in The Tourist Area of The Stokel Waterfall Central Lombok. *Jurnal Biologi Tropis*, *22*(2), 660–667. https://doi.org/10.29303/jbt.v22i2.3586

Widodo, G. A., Kartikasari, D., Ichyaiddina, A. N., & Pitaloka, D. (2023). Keragaman Lichen di Kawasan Wisata Alam Kandung Kabupaten Tulungagung. *RADIKULA: Jurnal Ilmu Pertanian*, *2*(01), 47–59. https://doi.org/10.33379/radikula.v2i01.2911

Yuliani, R., Imaningsih, W., & Yuwati, T. W. (2021). Lichen as bioindicator of air quality at buffer zone of Banjarbaru town. *Jurnal Galam*, *2*(1), 54–65. https://doi.org/10.20886/glm.2021.2.1.54-65