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COMPOSITION OF ASCOLICHEN IN GAYO HIGHLAND

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ABSTRAK

Ascolichen adalah kelompok lumut yang tersusun oleh spesies ascomycetes (mycobiont) dan algae (photobiont) yang berperan dalam ekologi dan industri. Spesies Ascolichen di Indonesa belum terdata dengan baik, terutama di Kawasan dataran tinggi. Kawasan kampus Universitas Syiah Kuala Gayo Lues merupakan bagian dari Dataran Tinggi Gayo yang memiliki karakteristik lingkungan yang khas. Tujuan penelitian adalah untuk mengetahui species ascolichen, jenis talus dan substrat. Penelitian ini menggunakan pendekatan kualitatif. Pengumpulan data dilakukan dengan melakukan survey eksploratif di 2 stasiun penelitian, yaitu Stasiun I (area kampus) dan Stasiun 2 (di luar area kampus). Data dianalisis secara deskriptif. Hasil penelitian menunjukkan bahwa terdapat 28 spesies ascolichen yang ditemukan di lokasi tersebut yang termasuk ke dalam 3 class, 6 ordo, 15 familia, dan 25 genus. Selanjutnya, jenis talus Ascolichen adalah crustose (16 spesies), foliose (8 spesies), dan fruticose (4 spesies). Jenis substratnya adalah batang pohon (22 spesies), kayu mati (9 spesies) dan batuan (4 spesies). Derajat keasaman substrat berkisar 4-6 (bersifat asam).
Kata kunci: Ascolichen, thallus, substrat, pH

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ABSTRACT

Ascolichen is group of lichen composed by ascomycetes (the mycobiont) and algae (the photobiont) species which play ecological and industrial roles. Ascolichen species in Indonesia has not well recorded, specially at highland areas. The campus area of Syiah Kuala University Gayo Lues is a part of the Gayo Highland which has specific environmental characteristics. The research aim was to determine the Ascolichen species, the type of talus and the substrate characteristics. This study used a qualitative approach. Data collection was carried out by conducting explorative survey in 2 stations, namely Station I (campus area) and Station 2 (outside campus area). Data was analyzed descriptively. The results showed that there were 28 species of Ascolichen found in the location which

belong to 3 classis, 6 orders, 15 families, and 25 genera. Moreover, the thallus types of lichen species were crustose (16 species), foliose (8 species), and fruticose (4 species). The types of lichen substrate were tree trunks (22 species), dead woods (9 species) and rocks (4 species). The acidity of the substrates ranges 4-6 (acidic).

Keywords: Ascolichen, thallus, substrate, pH.

INTRODUCTION

Gayo Highland is located in three districts of Aceh province, one of which is the Gayo Lues district. This area is dominated by mountains and hills, so it is known as the land of a thousand hills. The Syiah Kuala University campus area is a part of the Gayo Highlands with relatively humidity and high rainfall. This condition has the potential to produce lichen diversity. The abiotic and biotic factors such as air temperature, humidity, light intensity, pH, and host plant greatly support the growth of lichens [1][2][3].

Lichen is a unique plant grouped into a non-vascular plant. It is a composite organism consisting of fungal organisms (mycobiont) and photosynthetic organisms (photobiont), which is known as a symbiotic organism [4]. The eukaryotic photosynthetic organisms are green algae (Chlorophyta) known as phycobionts, while the prokaryotic ones are blue-green algae (Cyanophyta) called cyanobionts [4][5][6].

The symbiotic relationship pattern has not well understood yet. The relationship between algae and fungi is considered a heloticism which mean that the mutual benefits are only temporary. In fact, the fungi exploit the algae. For the temporary benefits, photosynthetic partner produce carbohydrates for growth of the fungi, whereas fungal mycelium provide suitable habitat for algae and serve as mechanical protection. In term of resistance to dehydration, the fungal helps the algae to absorb and retain water and minerals [7][8].

The organism has been grouped based on the fungal partner and thallus structure. Regarding to fungal groups, there are Ascolichenes, Basidiolichenes, and Imperfect lichen which are noticed by their fruiting body

characteristics. Associated with the thallus structures, lichen can be crustose, foliose, fruticose, squamulose and fruticose lichens. The thallus types vary in distribution of alga in the lichen (evenly or unevenly distributed) and parts of the thallus (upper cortex, algal layer, medullary layer, lower cortex, and rhizines) [9][10].

Ascolichen can occupy in extreme environments and play important roles in degradation of materials from living organism and nonliving thing, known as biogeochemical cycles. Consequently, it produces nutrients for plants to grow. The organism also produces many potential secondary products for pharmaceutical industry, natural dyes, and perfume manufacturing [11][4]. Several invitro studies have confirmed that lichen extracts have high efficacy even better than commercial drugs [12]. Extract from *Usnea* sp. have a better antihelmintic activity compared to Pyrantel Pamoate (worm medicine) and physiological NaCl and is relatively safe for host cells [12][13]. In term of food source potential, India and France people have used Parmelia, a genus of Ascolichen, as spices and raw material in chocolate industry respectively [11].

The area of Gayo Highland, a home for thousands of flora and fauna, is a potential area to find new food sources and drugs. The data of Ascolichen in the area of study will help others to expand their research topic regarding to lichen life. Therefore, this study will determine the Ascolichen species, the thallus and the substrate types.

RESEARCH METHODS

The study used qualitative approach which was an explorative study. The object was species of Ascolichen in the area of study. The study was conducted in the area of campus of Syiah Kuala University in Gayo Lues District from June to December 2020. The research area was divided into 2 locations as shown in Figure 1.

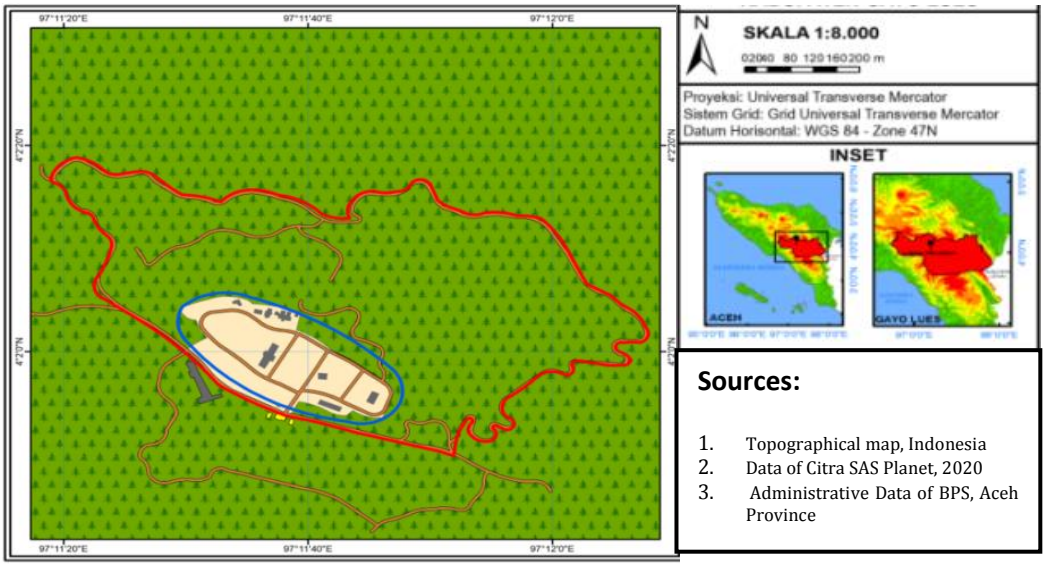

Figure 1. Location of Research Area. The Blue and Red Circles are Station I and II Respectively.

The instruments and materials.

The instruments used in this study were three ways soil tester, thermo hygrometer, Camera, whereas the materials were Litmus paper, Merck KgaA, Alcohol 70 %, Potassium Chloride solution. The parameters were species of Ascolichen, types of thalli and substrates, and environmental factors including air temperature, humidity, light intensity, and substrate pH.

Procedures of Collecting Data

The area of study was divided into 2 stations based on the composition of vegetation (Figure 1). The vegetation of Station 1 includes *Pinus merkusii* Jungh.et de Vriese., *Swietenia mahagoni* L., *Hibiscus tiliaceus* L., *Cocus nucifera* L., *Mangifera indica* L., *Artocarpus heterophyllus* Lamk., *Aleurites moluccana* Wild.), whereas Station 2 is dominated by Pine tree. Exploratory survey was carried out to collect the lichen species. Data was recorded including the species, habitat, type of thallus and the pH of the substrate. The unidentified lichen species were taken by slashing their substrates with 0.1-0.3 cm thickness

and then sprayed using Alcohol 70% prior to put it into a plastic bag. Each lichen was labelled based on the station, type of substrate, type of thallus and pH of the substrate. Identification of species was done using the field guide of lichen identification book and confirmed by the website (www.gbif.org).

Measurement of physical factors was carried out at 3 points at each station. The data was collected three times (the first (9.00 am-10.00 am), the second (1.00 pm-2.00 pm) and the third (4.00 pm- 5.00 pm) and repeated twice. The pH measurement of the lichen substrate was carried out by selecting the surface of the substrate around the lichen and spraying it with 0.1 M Potassium Chloride solution to dissolve the protons on the substrate and left it for 20 seconds. Next, a litmus paper was affixed to the surface for 3 minutes [14]. The results of pH measurement data are recorded. The data was analyzed descriptively.

RESULTS AND DISCUSSION

Composition of Ascolichen

Ascomycota is a lichen with mycobiont ascomycetes and the largest division in term of number of species. This division has about 15,000 species that have been identified worldwide [15]. The lichen is composed of fungi that have spore pockets in the form of ascus and fruiting bodies with apothecium and perithecium [9].

According to Table 1, there are 29 species of Ascolichen found in the research area. These species are the members of 3 classis, 6 order, 15 families, and 24 genera. The area was dominated by species of lecanorales accounting for 12 species which are from different family and genus. This order which belongs to the Lecanoromycetes consisting of 26 families, 269 genera and 5695 species [16]. Of the seven families, Parmeliaceae and Physciaceae dominates the research area which have 5 species each. Parmeliaceae consists of Parmotrema (2 species) and Canoparmelia, Pseudoparmelia, and Usnea (1 species each), whereas the latter family includes Dirinaria (2 species) and Buellia, Heterodermia, and Physcia (1 species each).

Most of the lichen species of Parmeliaceae are foliose lichen and the others are fruticose one (*Usnea* sp).

The lichens have root-like structure known as rhizines which function in absorbing minerals and water. Therefore, this ability ensures their nutrient needs. The family species can grow and occupy from uncontaminated area to polluted one [17]. Regarding to Physciaceae, its species are cosmopolitan ranging from mountainous to tropical areas [16]. It has been reported that these lichen members can be found in mountainous ecosystems with fluctuated environmental factors [18].

Arthoniaceae and Graphidaceae species have also dominated the area. This can be considered by the number of species, 3 and 2 species respectively. The species of Arthoniaceae is from 3 genera called Arthonia (2 species) and Cryptothecia and Arthothelium (1 species each). A tropical area is a home for these family members [19]. All the species found in the area were crustose lichen. Crustose grow slowly, but it is an ecologically-adaptive thallus. Therefore, it enables them to survive in wide ecological ranges, both in lowlands and highlands. The lichen species with the talus crustose type are very resistant to environmental changes [4]. The structure of the talus is relatively simple compared to other types of talus. This type of talus resembles a crust, a flat and thin thallus attached tightly to the substrate, thereby reducing the potential for dehydration. Water loss occurs at the top of thallus surface which is extensively exposed by abiotic factors. Regarding to Graphidaceae, there are 3 species with different genus namely Graphis, Diorygma, and Phlyctis. It is assumed that broad ecological needs and morphological structures play significant roles in their survivals

Table 1. Composition of Ascolichen, Types of Thallus and Substrates, and Potential Hydrogen of Substrates.

Divisio	Classis	Ordo	Familia	Genus	Species	Types of Thallus	Station		Types of Substrate and Its pH					
							1	2	Tree Trunk	pH	Dead wood	pH	Rock	pH
Ascomycota	Lecanoromycetes	Ostropales	Graphidaceae	Graphis	*Graphis scripta* (L.) Ach	Crustose	✓	✓	✓	5	-	-	-	-
				Diorygma	*Diorygma poitaei* (Fee) Kalb, Staiger & Elix	Crustose	-	✓	✓	4	-	-	-	-
			Phlyctidaceae	Phlyctis	*Phlyctis argena* (Ach.) Flotow	Crustose	✓	✓	✓	5	-	-	-	-
		Teloschistales	Teloschistaceae	Teloschistes	*Teloschistes flavicans* (SW.) Norman	Fruticose	✓	✓	✓	5	✓	4	-	-
			Physciaceae	Buellia	*Buellia subdisciformis* (Leight.) Vain	Crustose	-	✓	-	-	-	-	✓	5
				Dirinaria	*Dirinaria confluens* (Fr.) D. D. Awasthi	Foliose	✓	-	✓	5	-	-	-	-
					Dirinaria frostii (Tuck.) Hale & Culb	Foliose	✓	✓	✓	5	✓	4	-	-
				Heterodermia	*Heterodermia leucomela* (L.) Poelt	Fruticose	✓	✓	✓	5	✓	4	-	-
				Physcia	*Physcia aipolia* (Ehrh. Ex Humb) Furnr.	Foliose	✓	✓	✓	5	-	-	✓	5
		Lecanorales	Malmideaceae	Malmidea	*Malmidea granifera* (Ach.) Kalb, Rivas, P & Lumbsch	Crustose	✓	✓	✓	5	-	-	-	-
					Malmidea leucopiperis Nov	Crustose	-	✓	✓	5	-	-	-	-
			Stereocaulaceae	Lepraria	*Lepraria barbatica* Lendemer	Crustose	✓	✓	✓	4	-	-	-	-
			Cladoniaceae	Cladonia	*Cladonia cristatella* Tuck.	Fruticose	-	✓	-	-	✓	4	-	-
			Lecanoraceae	Lecidella	*Lecidella euphoresa* (Florke) Herte	Crustose	-	✓	✓	6	-	-	-	-
			Parmeliaceae	Parmotrema	*Parmotrema rubifaciens* (Hale) Hale	Foliose	✓	✓	-	-	✓	4	-	-
					Parmotrema latissimum (Fee) Hale	Foliose	✓	✓	✓	5	-	-	-	-
				Canoparmelia	*Canoparmelia amabilis* Heiman & Elix	Foliose	✓	✓	✓	5	-	-	-	-
				Pseudoparmelia	*Pseudoparmelia uleana* (Müll. Arg.) Elix & T.H. Nash	Foliose	✓	✓	✓	4	-	-	✓	5
				Usnea	*Usnea* Diil.ex. Adans	Fruticose	✓	✓	✓	6	✓	5	-	-
			Ramalinaceae	Bacidia	*Bacidia millegrana* (Taylor) Zahlbr	Crustose	-	✓	-	-	-	-	✓	5
			Pilocarpaceae	Eugeniella	*Eugeniella psychotriae* (Mull. Arg) Lucking, Serus. & Kalb	Crustose	✓	-	✓	5	✓	5	-	-
		Peltigerales	Pannariaceae	Pannaria	*Pannaria rubiginosa* (Thunb.) Delise	Foliose	✓	-	✓	4	-	-	-	-
	Arthoniomycetes	Arthoniales	Arthoniace	Cryptothecia	*Cryptothecia striata* Thor	Crustose	✓	✓	✓	4	-	-	-	-
				Arthonia	*Arthonia cinnabarina* Mull. Arg	Crustose	-	✓	✓	6	-	-	-	-
					Arthonia elegans (Ach.) Almq	Crustose	-	✓	✓	6	-	-	-	-
				Arthothelium	*Arthothelium albovirescens* (Nyl.) Fink	Crustose	-	✓	-	-	✓	4	-	-
			Chrysotricaceae	Chrysothrix	*Chrysothrix candelaris* (J.R) Laundon	Crustose	-	✓	✓	5	-	-	-	-
	Lichenomycetes	Lichinales	Peltulaceae	Peltula	*Peltula zahlbruckneri* (Hasse) Wetmore	Crustose	-	✓	-	-	✓	4	-	-

Thallus and Substrate Types

According to analysis of thallus morphology, the lichen species are grouped into crustose, foliose, and fruticose lichens (Table 1). However, crust-like lichens dominated the area (17 species), which belong to Ostropales (3 species), Lecanorales (6 species), Arthoniales (5 species), Teloschistales (1 species), and Linchinales (1 species). The Arthoniaceae was the dominant family with 4 species followed by Graphidaceae and Malmideaceae (2 species each) and Phlyctidaceae, Teloschistaceae, Stereocaulaceae, Lecanoraceae, Ramalinaceae, Pilocarpaceae, Chrysotricaceae, and Peltulaceae (1 species each). Crustose lichen is the most resistant lichen thallus to environmental changes and extreme environments such as drought and heat [20].

The area of the study was also a home for foliose and fruticose lichens. The number of foliose lichens was higher than that of fruticose's accounting for 9 species and 4 species respectively. The leaf-like lichens are species belong to Physciaceae (3 species) and Parmaliaceae (4 species). There were four fruticose lichens found in the location belonging to Parmeliaceae, Lecanoraceae, Physciaceae, and Teloschistaceae. The foliose lichen has a leaf-like shape with flat and wide shapes. The thallus has a rhizine, a root like structure that helps the lichen attach to the substrate. However, the lichen attaches to the media loosely, so it detaches easily. The lichens are the species of Parmeliaceae and Physciaceae. One of Parmaliaceae genera found in the research location is Parmotrema which is a lichen that has high sensitivity to sulfur oxide (SO2). The effect of this gas is a change in the color of the lichen talus and a decrease in reproductive activity and physiology of mycobiont and photobiont [21]. The presence of this lichen indicates that the study area still has good air quality.

The availability Physciacea members in the area is assumed due to their capabilities to spread their body parts throught asexual organs. The species of *D. confluens* (Fr.) D. D. Awasthi, *D. frostii* (Tuck.) Hale & Culb, and *P. aipolia* (Ehrh. Ex Humb)

Furnr have powdery propagules (soredia) consisting hypha and the algal cells fragmented easily by certain factors such as wind and activities of insects and human. Substrate surface and environmental condition may also affect their survivals. Fruticose lichens grow vertically and is commonly found as a beard-like lichen. As drought and sunlight exposure sensitive lichens, they have lack capability to survive in certain areas, such as coastal area and dessert [22]. The structure of the thallus with large evaporation area worsen even limit their chance to grow.

The types of substrate were tree trunks (22 species), dead wood (9 species), and rocks (4 species). There were 7 lichen species found in both locations attaching to different substrate. The lichens attaching to tree trunk and dead wood were *T. flavicans* (SW.) Norman, *Usnea* sp. Diil. Ex. Adans, *D. frostii* (Tuck.) Hale & Culb, *H. leucomela* (L.) Poelt, and *E. psychotriae* (Mull. Arg) Lucking, Serus. & Kalb, whereas attaching to tree trunk and rock were *P. uleana* (Müll. Arg.) Elix & T.H. Nash and *Physcia aipolia* (Ehrh. Ex Humb) Furnr. All species were found in a pine forest (Station II), but two species, namely *Eugeniella psychotriae* (Mull. Arg) Lucking, Serus. & Kalb and *Pannaria rubiginosa* (Thunb.) Delise. Pine plants have leathery bark retaining water. Their condition and structure are preferable requirements for lichen to grow. The abundance of lichen on a trunk is highly correlated to the substrate surface as it provides micro-protection from drying and traps more water and propagules than fine one [23].

Acidity of the Substrates

The air temperature in the area ranged from 26 ℃ to 30 ℃. In term of humidity, the values were 58 %-66 %, whereas light intensity ranged from 1500-1836 cd. All substrates were acidic ranging from 4 to 6. The specific pH values of tree trunk were 4-6, dead wood (4-5), and rock (5). Most lichen species were found in tree barks and dead woods. Both substrates are acidic as the pH ranging 4-6. The acidity properties are produced through degradation of the substrate into acetic acid and formic acids. Moreover, the dead wood's pH decreases gradually as time increase [24]. Similar findings

have been noted to rock pH (pH=5). It has been known that lichen produces carbonic acids during the degradation decreasing the pH value [25].

REFERENCES

[1]Pratiwi, M. E. (2006). Lichen Study as Air Quality Bioindicator - Case Study: Pulo Gadung Industrial Estate, Cibubur Arboretum and Cikabayan Mahogany Stand.Bogor: IPB Press.

[2]Handoko S, A., Tohir K, R., Sutrisno, Y., Brillianti H, D., Tryfani, D., Oktorina, P., Yunita, P., dan Hayati, N, A. 2015. Lichen Diversity as a Bioindicator of Air Quality in the IPB International Dormitory Area. Bogor: Institut Pertanian Bogor Press.

[3]Wardiah & Nurhayati. 2013. Characterization of Lichenes in the Pocut Meurah Intan Park, Aceh Besar District. *Jurnal Biologi Edukasi*, 5(2): 92-95.

[4]Nash H, T. 2008. *Lichen. Biology*. 2nd edn. Cambridge, United Kingdom: Cambridge University Press.

[5]Andrea S, E., Zuhri, R., dan Marlina, L. 2018. Identification of Lichen Types in the Wang Sakti Bay. *Jurnal Pendidikan Biologi dan Biosains*, 1 (2): 7-14.

[6]Supriati, R & Satriawan, D. 2013. Diversity of Lichen Species in Bengkulu Research Report. Bengkulu: Universitas Bengkulu.

[7]Thomas N, T., Taylor L, E., dan Krings, M. 2009. Paleobotany, The Biology and Evolution of Fossil Plants. 2nd edn. USA: Academic Press.

[8]Simon E, J., Dickey L, J., Reece J, B., dan Hogan A, K. (Eds.). 2016. Essential Biology. 6th edn. Wasingthon D. C: Pearson Education, Inc.

[9]Hasanudin & Mulyadi. 2015. Botany of Non- Vascular Plant. Banda Aceh: Syiah Kuala University Press.

[10]Bhat P, S., Dudani N, S., dan Ramachandra V, T. 2011. Lichenes: General Characteristic. *Sahyadri E-News*, 34: 2-34.

[11]Oksanen, I. 2006. Ecological and Biotechnological Aspects of Lichenes. *Appl Microbiol Biotechnol*, 73, 723-734.

[12]Septiana, E. 2011. Potential of Lichen as a Source of Medicinal Substances: A Literature Review. *Jurnal Biologi*, 15 (1): 1-5.

[13]Solihin, A. 2015. Lichen Extract Antihelmintic Test (*Usnea* sp.) Against Pig Roundworm (Ascaris suum Goeze 1782), pdf. 1-8.

[14]Nimis L, P., Scheidegger, C., Wolseley, P. A. 2002. Monitoring Lichen.

Netherlands: Academic Publishers.

[15]Newberry, C. 2004. Plants That Aren't "Plants": Moses and Lichenes. Proceedings Of The 25th *Workshop/Conference Of The Asspciation For Biology Laboratory Education (ABLE)*, 25:179-197.

[16]Kirk P, M., Cannon P, F., Minter D,W., dan Stalpers J, A. 2008. Dictionary of the fungi. Edisi 10. *Patrick CABI*. Hal: 364-365.

[17]Madjeni, H., Hendrik, A. C., & Bullu, N. I. 2019. Diversity of Lichen as Bioindicator of Air Pollution in Camplong Natural Park, Kupang. *Jurnal Pendidikan dan Sains Biologi*, 2(2): 65-72.

[18]Panda, M., Murthy T. V, R., Samal R. N, L, N., Patnaik A, K., dan Mohan P, K. 2017. A Comparative Study of Manglicolous Lichenes and Their Distribution inside Bhitarkanika National Park (Odisha), India. *Journal Studies in Fungi*, 2(1): 1-13.

[19]Park, J. S., Park, S. Y., Park, C. H., Jang, S. H dan Hur J. S. 2017. *Arthothelium punctatum* (Arthoniaceae, Arthoniales), A New Lichen Species from South Korea. *Journal Mycobiology*, 45(4): 255-262.

[20]Lalley J, S., Dan Viles H, A. 2008. Recovery of Lichen Dominated Soil Crust in A Hyper Arid Desert. *Biodiversity and Conservation*, 17(1): 1-20.

[21]Panjaitan M, D., Fitmawati., Martina, A. 2012. Diversity of lichen As Air pollution Bioindicator in Pekan Baru Riau. 1: 1-17.

[22]Ohmura, Y., Kawachi, M., Kasai, F., Sugiura, H., Ohtara, K., Kon, Y., Hamada, N. 2009. Morphology and Chemistry of *Parmotrema tinctorum* (Parmeliaceae, Lichenized Ascomycota) Transplanted into Sites with Different Air Pollution Levels. *Bulletin National Museum of Nature and Science*. 35(2): 91-98.

[23]Siregar, F.E, 2020. Inventory of lichenes on Pulau Dua Bakongan, South Aceh. Thesis.

[24]Whelan, P. 2011. *Lichenes of Irelands*. Ireland: The Collins Press.

[25]Chen, J., Blume P, H., dan Beyer, L. 2000. Weathering of Rocks Induced by Lichen Colonization. *Journal Catena*, 39: 121-146.