

Lichen: Comparative Study Between Campus Area and Forest Sekipan Karanganyar Central Java

Efri Roziaty, Ade Ratna Furi¹

¹Universitas Muhammadiyah Surakarta, Faculty of Teacher Training and Education
Pabelan Kartasura, Surakarta 57162, Indonesia
er375@ums.ac.id

Abstract

Lichens are organism usually found on tree trunk and rocks. They are also very sensitive to pollutions. Meanwhile, the rapid increase in the use of motor vehicles has a huge impact on the emergence of pollution in most of environments. In fact, the increasing quantity of emission from the transportation sector, especially vehicles on the roads, has resulted high level of air pollution that influences the morphology of lichens. The aim of the research was to identify lichens growing naturally in the campus area and the natural habitat of the Sekipan forest. It was done by observing the population of lichens in two different stations. The study site was divided into two stations, namely campus area and the Sekipan forest. The research employed exploration method. The 1st station was the campus area and the 2nd station was the Sekipan forest. The parameters were the morphology and the colony of lichens. Species richness was revealed in which the diversity of lichens in Sekipan forest was higher in compared with those in the campus area. The results of the survey demonstrated the different species of lichen in campus area (Station 1) and Sekipan forest in Karanganyar, Central Java. Basically, lichens in the campus area are less in species diversity, but they have species richness in forest.

Keywords: air pollution, pollutants, bioindicator, lichens, emissions, UMS campus

1. Introduction

Lichens are composite organisms composed of two different or types of organisms. The lichen plants body (thallus) is made of fungi and algae living together in a symbiotic arrangement in which both partners are benefited and the composite plant body can grow in places where neither component could live alone. The thallus needs a very fresh air to make it grow well and varies in types (Wetmore, 1989).

Lichens absorb nutrients from the air and water. Harmful molecules are absorbed with these nutrients, and lichens are often unable to metabolically process or to isolate these harmful molecules quickly to avoid any damages (Coffey & Fahrig, 2012). Lichens occur on a wide range of areas or substrata, including man-made materials and also trees. (Aptroot, Diaz, Barcenas-Pena, & etc, 2014).

The pollutions from automobile are definitely different. Fossil fuels contain many kinds of heavy metals that will be emitted to the environment during the combustion. Automobiles are also recognized for being responsible for heavy metal pollutions, including Pb [7]. Meanwhile, the relatively high frequency of students passing by the campus area of Universitas Muhammadiyah Surakarta (UMS) potentially leads to serious air pollution. Such a regular pattern of pollution is foreseen to bring damage to the ecosystem.

This study was designed to investigate lichens in the area of UMS campus and in a natural habitat, namely the Sekipan forest, Karanganyar, Central Java. We identified lichens growing at the area affected by campus traffic activities and those also lichens in the forest. It would be an earlier report of study of lichens around the campus area that are affected by motor vehicles. Vehicles release many harmful gasses in the atmosphere, such as sulphur dioxide (SO₂) and nitrogen dioxide (NO₂) (Rindita, Sudrman, & Koesmaryono, 2015).

Sekipan forest is an area near the Surakarta city, Central Java. It is located on the elevation or gradient of Mount Lawu, Central Java. The altitude is 1100 m above sea level. Sekipan forest was selected as the study site because the location is assumed to support the growth of vegetation, including lichens. The macroclimate is humid. Humidity supports the existence of several forests in Central Java. Likewise, lichens grow extensively in forests. It is a constructive habitat for lichens. The aim of this study was to identify lichens growing around the campus area and the natural habitat Sekipan forest by observing the population of lichens in these two different sites/stations.

2. Materials and Methods

Methods and sampling. The research was conducted in January to February 2016 using exploratory descriptive method with survey technique. The purposive sampling technique was employed. The samples were obtained from two different stations, namely from the study sites of the campus area and the Sekipan forest. The 1st station was the campus area and the 2nd station was the Sekipan forest. Station 1 is assumed as the area with high risk of air pollution since it is intensively exposed from air pollutions. The pollutions are generated from the emissions of vehicles containing SO₂, NO₂ and CO.

Lichens collected as the samples were obtained from the tree trunks. Several species of lichens are commonly found in most of trees. The covers of lichen were measured by drawing the thalli colonies. Sample pouch made from plastics were used to collect samples of the lichen for further study. The collected samples were further identified in laboratory.

Identification and cover measurements. Identification of lichens was carried out based on the guideline book but there is little information about lichens in the tropical area (Rindita, Sudriman, & Koesmaryono, 2015). Identification of the morphology of lichens and their colonies was done using the light microscope and obtilab. Observation of the characteristics of lichens was subsequently verified with a guideline from (Rosentreter, Bowker, & Belnap, 2007). The samples were documented with digital camera. In order to measure the coverage, each thallus was cut and weighed on an analytical scale.

Data analysis. The number of thallus, coverage and average coverage were calculated. The ecological parameters were determined with sources from the Internet and the abiotic measurements were performed in the fields. The total thallus of each species in each station was also counted.

3. Results and Discussion

Lichens in the campus area

The species of lichens found in the study site included *Parmelia* sp., *Arthonia radiata*, and *Candelariella reflexa*. *Parmelia* sp. has overlapping leaf-like lobes with a network of pale lines that become soredia. Genus *Parmelia* usually exist in the forms of *Parmelia sulcata* and *P. saxatilis*. Both of these species have an isidia on the upper surface. *Arthonia radiata* has whitish thallus, fruiting bodies, brown to black, irregular to branched, not raised above the surface. *Candelariella reflexa* has soredium-like granules (<1 mm) often with yellow fruiting bodies. The figures of the species are demonstrated below.



Arthonia radiata



Parmelia sp.



Candelariella reflexa

Fig. 1. The species of lichens found in the campus area.

The diversity of species of lichens in the campus area is low. Only three species were identified, including *Arthonia radiata*, *Parmelia* sp. and *Candelariella reflexa*, as demonstrated in Fig. 1.

The percentage of lichen colonies in the 1st station (UMS campus area) was 16.3%–48.3%. The diameter of the colonies was 4.6 cm–15.3 cm. The number of vehicles passed by in the campus area was approximately 143– 1757 vehicles/30 minutes. The emission of motor vehicles had significant effect on the growing of lichens in this area. Traffic pollution is a limiting factor for the growth of lichens. This study indicated lichens sensitively respond the

air pollution. The parameters of environment are diverse in accordance with the distance of lichens from the roadside (Sujetoviene, 2010).

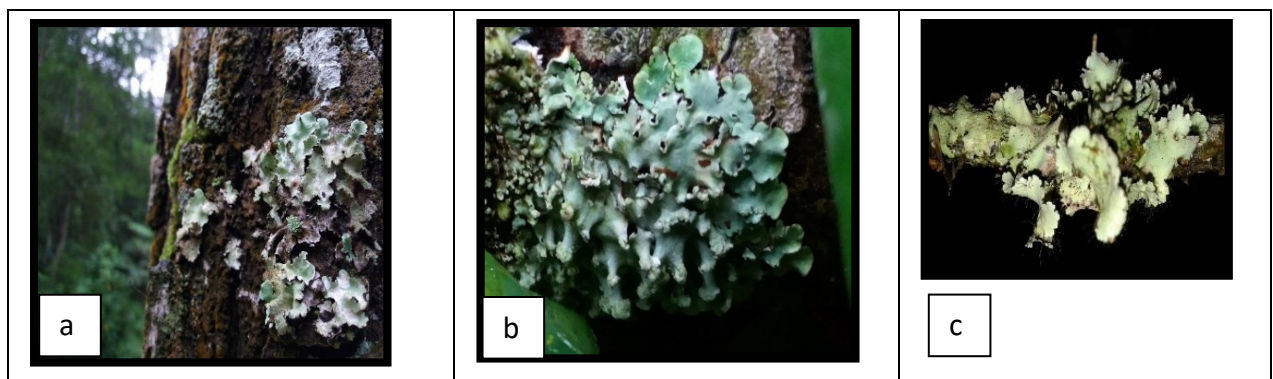
Lichens in the Sekipan forest, Karanganyar

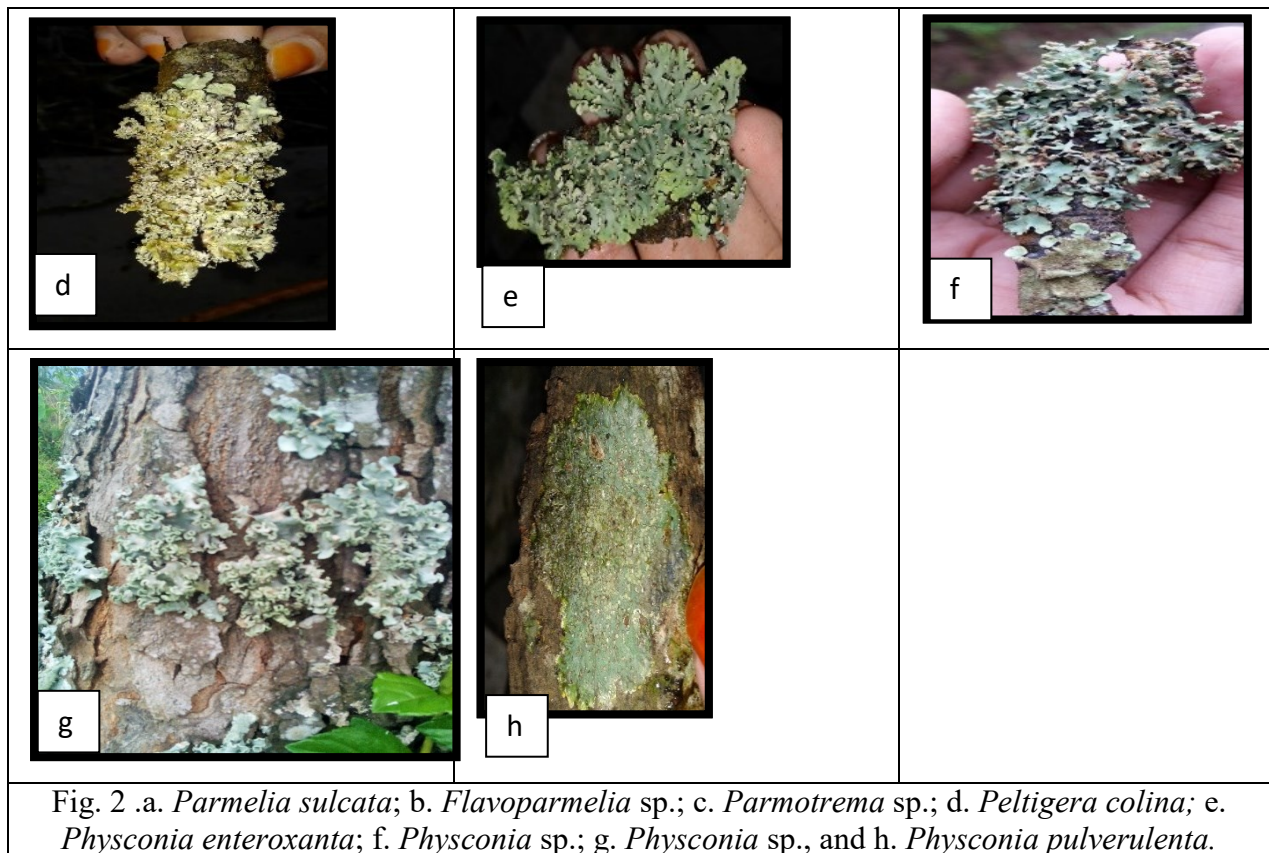
The analysis showed there are 5 (five) families of lichens found in the Sekipan forest, Karanganyar, Central Java. They are Graphidaceae, Parmeliaceae, Peltigeraceae, Physciaceae and Lecidellaceae. They are illustrated in detail in Table 1.

Table 1. Lichen colonies in the Sekipan forest, Karanganyar, Central Java

Families	Species	Percentage of lichen colonies
Graphidaceae	<i>Graphis scripta</i>	75%
	<i>Graphis</i> sp.1	83%
	<i>Graphis</i> sp.2	80%
	<i>Graphis</i> sp.3	80%
Parmeliaceae	<i>Parmelia</i> sp.1	50%
	<i>Parmelia</i> sp.2	82%
	<i>Parmelia</i> sp.3	80%
Peltigeraceae	<i>Peltigera colina</i>	90%
Physciaceae	<i>Physconia</i> sp.1	75%
	<i>Physconia</i> sp.2	72%
	<i>Usnea</i> sp.	49%
Lecidellaceae	<i>Lecidella elaeochroma</i>	80%

In forest, lichens vary and relatively have high diversity in compared with those found in the campus area. The habitats of the two stations were very different. Habitat of forest is more suitable for the growth of lichens. Although in this habitat, i.e. in the tree bark, the colonies of lichens (*Usnea* sp.) have a smaller space than the others. Lichens in this study site appear to have high diversity because the Sekipan forest was located at an altitude of 1100 m above sea level (Fig. 2). It is a mountainous area. The mountain area varies with different ecology characteristics (McCune, Dey, Peck, Heiman, & Will-Wolf, 1997). In such altitudes with clean air quality, lichens grow and flourish well since they are very sensitive to the air quality. The species richness in the Sekipan forest is an evidence.





4. Conclusions

The findings of this study revealed the existence of 3 (three) species of lichens in UMS campus area and 12 species of lichens in Sekipan forest, Karanganyar, Central Java. Furthermore, it indicates the different species of lichens in campus area (Station 1) and Sekipan forest (Station 2). It implies the diversity of lichens in the campus area is low while the species richness of lichens in the forest is evident.

Further study to investigate the species of lichens in association with certain hosts of tree is required. Although it seems to be impossible because the host of lichens may be very range, a study of the types of tree that support the growth of lichens is required.

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