

Distribution of Lichen Flora at Different Altitudes of Gunung Machincang, Langkawi Islands, Malaysia

(Taburan Flora Liken Pada Altitud Berbeza di Gunung Machincang, Pulau Langkawi, Malaysia)

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ABSTRACT

Lichen samples were collected from Gunung Machincang, Langkawi Islands based on an alternation of altitudes, which are 0, 300 and above 600 m. Morphological identification resulted in 15 genera of microlichens (crustose) and five genera of macrolichens (foliose) and they fall under 14 families. As the altitude increases, the number of foliose type of lichen also increased. The common microlichens obtained were from the Family of Graphidaceae and can be found from the sea level right up to the peak of Gunung Machincang. The most common crustose lichens found were Heterodermia sp., while Eugenia sp. is the most common tree habitat for lichens in Gunung Machincang, Langkawi Islands. This study represents the first record of lichens in Gunung Machincang, Langkawi Islands, Malaysia.

Keywords: Elevation; Graphidaceae; Heterodermia sp.; lichen types; mountainous region

ABSTRAK

Sampel liken telah dipungut dari Gunung Machincang, Pulau Langkawi mengikut ketinggian, iaitu 0, 300 dan lebih dari 600 m. Kaedah pengenalanpastian morfologi menunjukkan bahawa terdapat 15 genus mikro-liken (krustos) dan 5 genus makro-liken (folios) dan semuanya terletak dalam 14 famili. Apabila ketinggian meningkat, bilangan liken jenis folios juga meningkat. Mikro-liken yang sering didapati adalah daripada famili Graphidaceae dan boleh ditemui pada ketinggian dari paras laut hingga ke ketinggian puncak Gunung Machincang. Liken krustos yang paling biasa ditemui adalah Heterodermia sp. sementara Eugenia sp. adalah habitat pokok paling biasa untuk liken di Gunung Machincang, Pulau Langkawi. Kajian ini mewakili catatan pertama liken di Gunung Machincang, Pulau Langkawi, Malaysia.

Kata kunci: Graphidaceae; Heterodermia sp.; jenis liken; kawasan bergunung; ketinggian

INTRODUCTION

Lichens, although abundant in Malaysia as a source of biomass, have always been left unnoticed and unexplored. Possibly the first records of lichen collection in Malaysia was put on by Beccari (1904) and he made collections in Sarawak. A bibliography of Malaysian lichenology was prepared by Galloway et al. (1994) comprising 90 entries and an additional list compiled another 192 entries (Galloway et al. 1997). Din et al. (1998) identified seven genera of lichens at Bario, Sarawak and Zakaria et al. (2000) reported on the morphology and chemical constituents of *Cladia aggregata* collected from Gunung Jerai, Kedah. Some specific collections of *Heterodermia fabellata* and *H. leucomelos* were also described at Gunung Jerai, Kedah (Din et al. 2002) and also Cameron Highlands, Pahang for its chemical components study. Lichens of North Eastern Langkawi and Gunung Machincang were investigated by Zulkifly and Merican (2005).

Gunung Machincang, with an altitude of about 708 m above sea level, is situated in the north western part of

Langkawi Islands, the archipelago of which encompasses 104 islands and is located off the north western coast of Peninsular Malaysia. The islands' geology consists of quartzite sandstone in the north western part overlain by metamorphosis of Setul limestone, shale and minor sandstone of Signa formation and a massive dolomitic limestone sequence of Chuping Formation (Hussin et al. 2005). In Langkawi, the oldest dated rocks are mudstone, siltstone and quartzitic sandstone bed of the Machincang Formation, which forms the Machincang anticline. Fossil tracks of the similar rocks give a Late Cambrian to Early Ordovician age to the uppermost part of the Machincang Formation (Lee 2006). The quartz that made up the island is from the Cambrian Era about 500 million years ago, making the mountain one of the oldest rocks in Malaysia. This, in turn, makes Gunung Machincang an excellent foliage and wildlife sanctuary. Gunung Machincang is so solid and stable that it is able to be used as a platform for the Gunung Machincang cable car station, used for tourists to see the pristine forests of the Machincang hills and the sea view below.

The first report of Langkawi's lichen was published by Zulkifly and Merican (2005). This study extended the previous results and aimed to identify and study the different lichen flora distribution at different altitudes of Gunung Machincang.

MATERIALS AND METHODS

The study was conducted in the northwestern mountain in the Langkawi Island (6° 10'N - 6° 30'N 99° 35'E - 100°E). The climate is warm tropical, with an annual average temperature of 24°C - 33°C and monthly rainfall can go as low as zero in January and as high as 342 mm in the month of December where there is heavy monsoon rain which starts in November (Malaysian Meteorological Service 2005).

Lichens were randomly collected along the trail that leads to the peak of Gunung Machincang at altitudes of 300 m interval. Global Positioning System (GPS) was used to record the exact location of sampling. All types of lichens were collected and the type of trees from which its habitat lies was noted. Lichens were identified using microscopes, thin-layer chromatography (TLC) methods and chemical analysis.

RESULTS

LICHEN COLLECTIONS

A total of 230 lichens were collected and Figure 1 shows images of representative of the collected lichens.

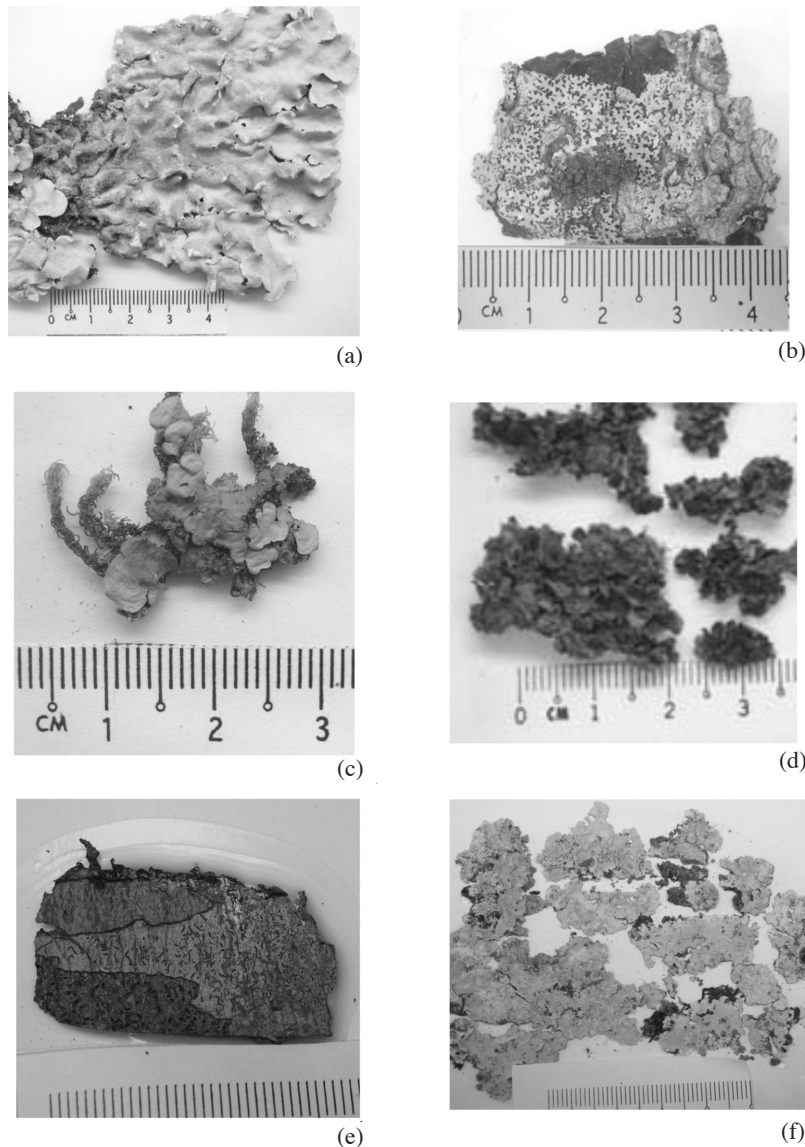


FIGURE 1. Selected lichens collected based on altitudes. (a) *Parmotrema tinctorum* (600 m), (b) *Heterodermia* sp. (0 m, 300 m and 600 m), (c) *Coccocarpia pellita* (300 m), (d) *Leptogium* sp. (300 m), (e) *Graphis* sp. (0, 300 and 600 m) and (f) *Lepraria* sp. (0, 300 m and 600 m)

ANALYSIS OF LICHEN DISTRIBUTION

Pie charts were produced to analyse lichen distribution at the 3 levels of altitudes under study (0-299 m: Figures 2 and 3; 300-599 m: Figures 4 and 5; above 600 m: Figures 6 and 7). Figures 2 and 3 show the distribution of lichens according to family and species, respectively. Based on the pie chart of Figure 2, it was found out that majority of the lichen family occupying 0-299 m altitude are Graphidaceae (32%), Trichotheliaceae (23%) and Trypetheliaceae (19%), all of which are crustose type of lichens. However, the next in rank is the foliose *Physciaceae* (7%), followed by the leprose lichen, *Leprariaceae*, *Lecanoraceae*, and *Pertussariaceae* of which exhibit similar distribution (5%). Lastly, *Thelotremataceae*, and *Pyrenulaceae*, each contributed to 2% of the lichen samples. Based on the pie chart of Figure 3, majority of lichen samples collected were

from the crustose group (93%) compared to the foliose group (7%). *Heterodermia* sp., foliose lichen could be found in this elevation.

The middle level (300-599 m) is the Middle Station of the Machincang Cable Car. The most collected lichens are from the family *Leprariaceae* (25%) and the *Graphidaceae* (23%) and next in ranking is the *Trichotheliaceae* (14%) (Figure 4). *Pertussariaceae* and *Coccocarpiaceae* are next at 8% respectively, whereas *Bacidiaceae* and *Trypetheliaceae* were found to be amounting to 4%, respectively. Lastly, the last 12% of the total lichen collected, were shared by the lichen families of *Physciaceae*, *Lecanoraceae*, *Collemataceae*, *Gyalectaceae*, *Leprariaceae* and *Pyrenulaceae* at 2%, respectively. We could see a mixture of crustose and foliose lichens here (Figure 5). It is apparent that the number of foliose lichens

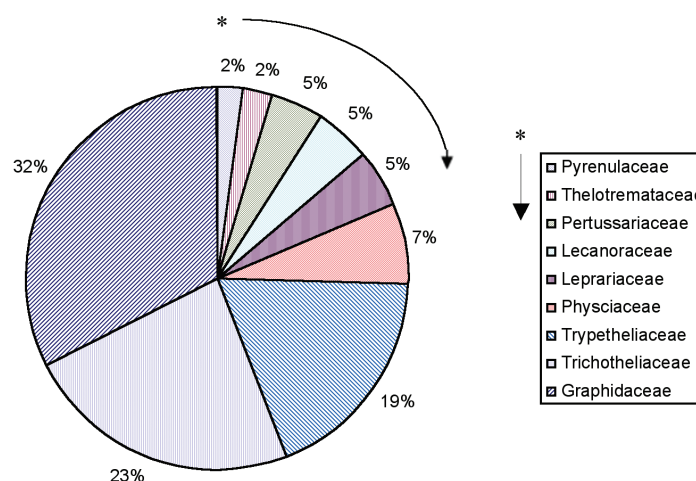


FIGURE 2. Distribution of lichen families according to altitudes of 0-299 m

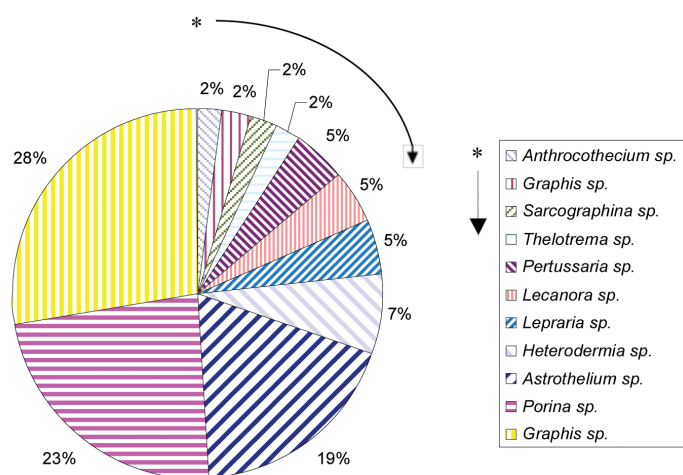


FIGURE 3. Distribution of lichen species according to altitudes of 0-299 m

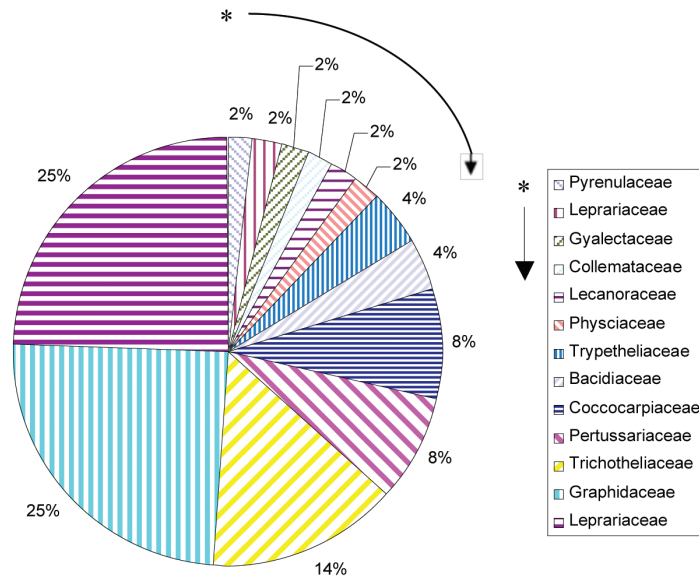


FIGURE 4. Distribution of lichen families according to altitudes of 300-599 m

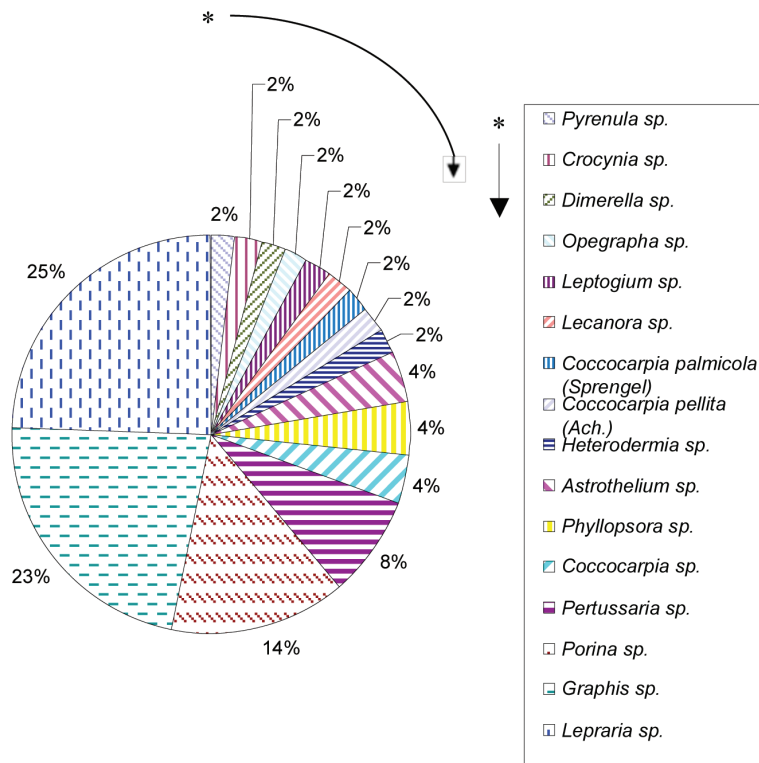


FIGURE 5. Distribution of lichen species according to altitudes of 300-599 m

are increasing from 7% to 12%. Even though, the leprose lichen, *Lepraria* sp., is the most in numbers for samples from the middle elevation, but the presence of *Coccocarpia* sp. in addition to *Heterodermia* sp. should also be worth mentioning as the representative of the foliose lichen.

Above 600 m is the peak of Gunung Machincang, where it was found that, foliose type of lichens dominated such as *Parmotrema tinctorum*, *Colemma* sp. and *Heterodermia* sp. (Figure 7). In the Figure 6, the foliose lichen *Coccocarpia* sp. seemed to dominate at 28%. This

is followed by the big family of foliose Parmeliaceae at 26%. Physciaceae and Collemataceae add to the foliose percentage at 10% and 4%. For the crustose type, the Graphidaceae dominated at 14% followed by Trichotheliaceae and Leprariaceae at 6%, Bacidiaceae at 4% and lastly Lecanoraceae at 2%. From the graph (Figure 6), it was also noted that 68% of the lichen collected were from the foliose type, compared to 32% of the crustose lichens. It is apparent the number of foliose lichens increased with the increase of altitude (Figure 7).

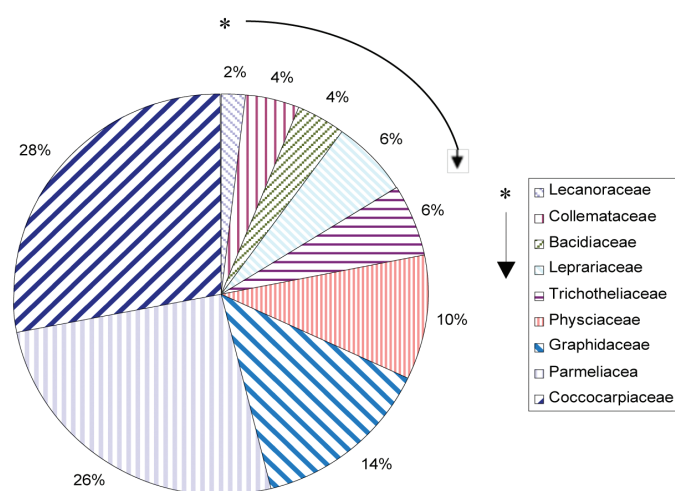


FIGURE 6. Distribution lichen families according to altitudes of above 600 m

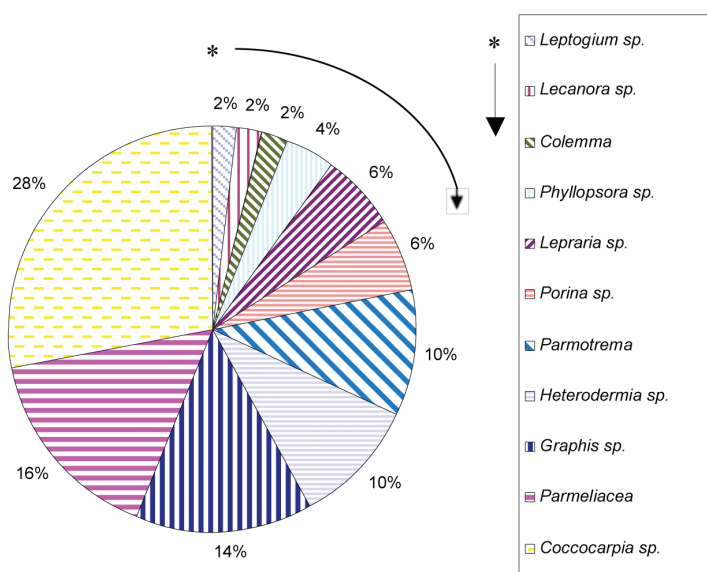


FIGURE 7. Distribution of lichen species according to altitudes above 600 m

The majority of the lichen habitats are *Eugenia* sp. and *Vatica* sp. (Figure 8). *Eugenia* sp. encompasses 19% of the tree species of the lichen habitat. Approximately 11% of the tree flora is from the *Vatica* sp., 6% of the tree habitat is from *Parkia speciosa*, *Mesua ferrea*, *Leptospermum flavescens*, *Eurycoma longifolia*, and *Calophyllum symingtonianum*; 5% of the tree habitats are of 2 species namely, *Calophyllum biflorum* and *Artocarpus integere*; 3% of the tree habitat was made up from tree species of *Shorea platyclados*, *Murraya* sp., *Microcos malayana*, *Grewia* sp., *Garcinia* sp., *Artocarpus* sp. and the tree family Annonaceae; and the last 2% of the trees habitat was made up of *Diospyros* sp., *Diospyros buxifolia*, *Cotylobium* sp., *Cinnamomum iners* and *Alseodaphne albifrons*.

Distribution of lichen habitats according to tree families are shown in Figure 9. There are 3 major families of tree habitat for lichens in Gunung Machincang, Langkawi Island namely the Myrtaceae (26%), the Guttiferae (20%) and Dipterocarpaceae (16%). Other families that are also identified are Malvaceae (11%), Simaroubaceae and Fabaceae family which shared 6% of the total population. The least common tree habitate for lichen species are: Tiliaceae, Rutaceae, Lauraceae, Ebenaceae and Annonaceae which are shared by the 3% of the total population.

LICHEN DISTRIBUTION DEPENDING ON ALTITUDES

Families such as Graphidaceae, Thelotremaaceae are generally common in lowland forests (Sipman 1993). Hale (1974) observed that the family of Thelotremaaceae requires undisturbed rain forest such as the forests of Gunung Machincang. Based on Sipman (1989), lichen zonation is based on three levels: 1) less than 1000 m 2) 1000-2000 m 3) more than 2000 m. For the zone of less than 1000 m, the crustose types of lichens dominate and this is true for the lichen samples from Gunung Machincang. At the lowest level (0-299 m), the Graphidaceae dominates while *Porina* sp. and *Astrothelium* sp. could also be spotted. Besides that *Lepraria* sp. is also present. At the middle level (300-599 m), lowland tropical lichens such as *Leptogium* sp. are present. Besides *Coccocarpia pellita* are abundant. *Phyllopsora* sp., a lichen characteristic of its squamulose thallus and cylindrical isidia, is also present in Gunung Machincang. Above 600 m (Figures 6 and 7), it was noted that 68% of the lichen collected are from the foliose type, compared to 32% of the crustose lichens. It is apparent the numbers of foliose lichens are increasing with the increase of altitude.

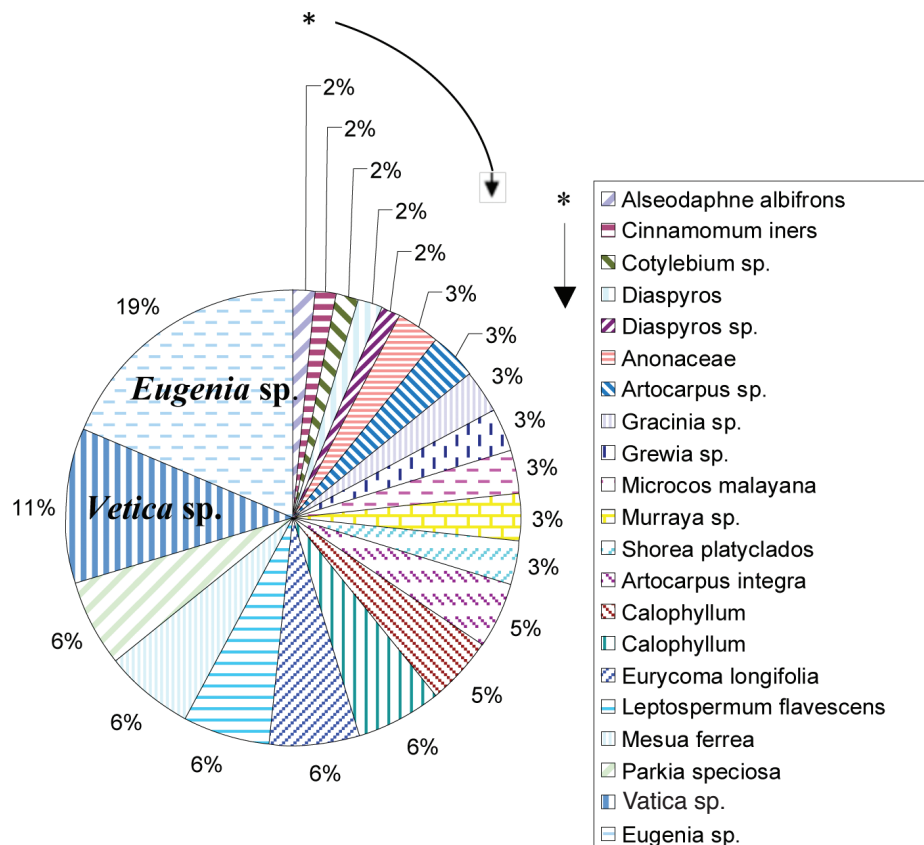


FIGURE 8. Percentage of lichens according to tree species

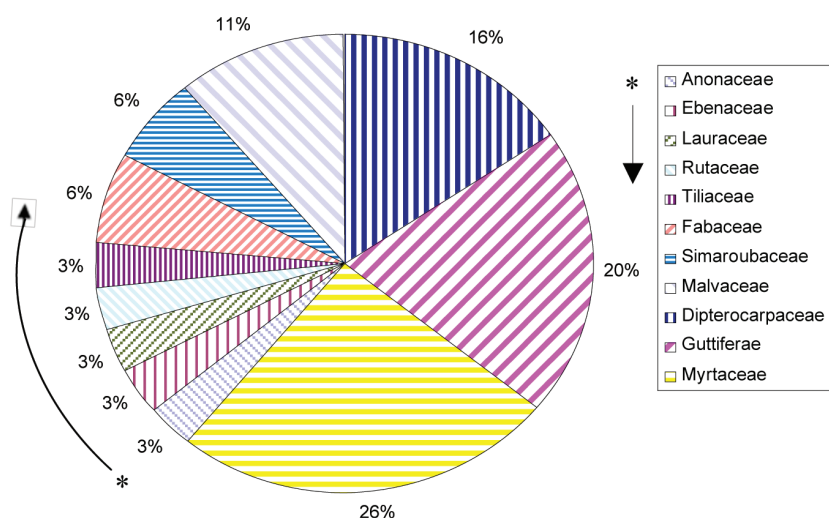


FIGURE 9. Lichen habitats according to Tree Families

The crustose and foliose types of lichen occupy the Gunung Machincang. Crustose type lichens were found in the lowland as well as the high altitude. The foliose lichens are found mostly in higher altitudes of more than 700 m in dry areas, and also in low areas, near the river (riparian), which has a certain amount of moisture and sunlight. Smith (1991) stated that the lichen flora is poor in the rainforest where the bark is colonised and dominated by hepatics and mosses. Suitable habitats favour the growth of folicolous species. In Gunung Machincang, it is clearly found that lichen biodiversity thrives in the lowlands, in areas near the river, but not necessarily so, in high altitudes where it is abundant in the canopy and branches which are exposed to the sunlight. Most temperate and boreal forests with light exposed trees has a richer lichen vegetation than the trees of the interior forest (Rose 1992). In the Pacific Northwest of United States of America, lichen biodiversity is high along the coastal and riparian areas, in high rainfall, low to mid elevation forests (McCune & Geiser 1997). The crustose families of Graphidaceae and Telothremataceae are suitable habitats particularly for lichens in the forests of Gunung Machincang. As the top of the mountain barely reaches 800 m, the lichen species that regularly appear on cloud forest such as *Lobaria*, *Pseudocyphellaria* sp. and *Sticta* sp. was not found in Gunung Machincang. Gunung Machincang is a pristine and protected area where there is less exploitation therefore resulting is a more extensive collection of lichens. The area has no fruticose type of lichens due to its altitude.

LICHEN HABITATS ON TREE FLORA

From this study, it was found out that most of the lichens inhabit the *Eugenia* trees, as most of the lichen samples

are taken from them. However, it is not conclusive to say that lichens only prefer *Eugenia* trees. Most of the *Eugenia* tree barks are also brittle (Wyatt-Smith 1999). They tend to break up whenever the bark is scraped off, making the collection of lichens difficult. From this study, it was also found out that lichens prefer smooth bark next to rough bark. Smooth bark poses a suitable area for the lichens to inhabit. All of the lichens that were collected are from smooth barks, although some may pose to be fissured.

The range of Gunung Machincang mountain areas is isolated from the other parts of the Island and to be facing the sea. The trees are also very limited due to the restrictions of the choice of epilithic and terrestrial substrates, which is very delimiting for the lichen flora. It is possible that Gunung Machincang, isolated from the other part of the Island by its rocky altitude and separated by the sea, has limited number of tree species.

CONCLUSION

The Graphidaceae family thrives in all altitudes. Foliose lichens such as *Parmotrema tinctorum* (Nyl.) Hale and *Coccocarpia pellita* were found as the altitude rises. At elevations of 0-299 m of Gunung Machincang, crustose group dominates (93%) compared to foliose group (7%). At elevations of 300-599 m, composition of crustose group declines to 88% compared to the foliose group. At the elevations of more than 600 m, foliose group reached a higher percentage of 32%. From these analyses, the trend is that the foliose lichens seemed to increase as the elevation increased.

It was also found that, lichens from Gunung Machincang, Langkawi Island thrives on the trees of

Eugenia sp. (Myrtaceae family). The *Eugenia* sp. has a smooth bark and is suitable for most lichens. Another possible explanation is due to the high number of this tree in Gunung Machincang.

Lichenological study in Malaysia is still developing. Basic groundwork must be comprehended in order to meet the nation's needs and also to strive towards the biotechnology industry. As this is the first study of lichens in Gunung Machincang, Langkawi Island, the taxonomical identification is far from complete. Better lichen sample representation of the lichen should be collected; furthermore, since the lichens can only be fully identified through its fruiting bodies, the task of collecting sterile lichens should be avoided.

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