



Survey of lichen diversity in Vathal Hills of Dharmapuri District, Tamil Nadu

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Abstract

Lichens are some of the most fascinating and widespread life forms on the planet. Their fundamental make up alone inspires the imagination as they are not one single organism but at least two. Diversity, distribution and occurrence of lower and higher plants were highly influenced plants deteriorated due to climate change in forest areas. In present condition an urgent need of an hour a study was carried out to document the diversity of lichen groups in Vathal hills Dharmapuri district belonging to Eastern Ghats, Tamil Nadu, India. Temperature and relative humidity with rainfall pattern which controls the lichen distribution. The study revealed that of 98 species belongs to 29 genus and 13 families have been recorded. The lichen genera *Heterodermia* (15), *Parmotrema* (16) and *Pertusaria* (6) and *Usnea* (12) dominates in the area.

Keywords: Eastern Ghats, Vathal Hills, lichens

Introduction

The majority of lichen is an intensive cooperation between a fungus and an algae or a cyanobacterium and sometimes all three symbionts are required to form a lichen. They grown in a extreme habitats worldwide and dominates particularly land ecosystems at 8%. There are about 20,000 species of lichens are described worldwide. In India, the population has 2,450 species of lichens (Awasthi, 2000) ^[1]. The lichen population has drastically decreased recently because of the environmental changes. Every year, some rare lichen species are being endangered followed by extinct from forests ecosystem due to air pollutants (Ponmurugan *et al.*, 2002) ^[11]. The whole lichen is considered as thalli it can be characterized in to three main growth forms: crustose, foliose and fruticose.

About 760 species of lichen present in Tamil Nadu state when compared to other states. Nilgiri and Palni Hills have the major portion of Western Ghats falling in Tamil Nadu. These are the main sources for lichen richness. In addition to the parts of Eastern Ghats in Tamil Nadu also has rich diversity of lichens (Nayaka *et al.*, 2013) ^[10]. Even in Eastern Ghats forests are the most affected areas are due to human activities for the purpose of forest resources (Jha *et al.*, 2000) ^[6]. However, there are many localities and protected forest areas in Tamil Nadu that are unexplored till now particularly for lichens studies. Although, there has been substantial research need in particularly lichens in Eastern Ghats. Thus to reveal about the diversity of lichens, a random survey has started in the year 2021 January to December, and the documentation of lichens from the Vathal hills is presented in the study.

Materials and Methods

The Vathal hills in Dharmapuri district is located between N 11 47' and 12 33' latitudes and E 77 02' and 78 40' longitudes. It occupies an area of 4497.77 km² (i.e. 3.46% of Tamil Nadu). The Entire district is surrounded by hills and forests. Temperature in the study area ranges from 11°C to 22°C during November 2021 - October 2021 and averages between 12°C during December 35°C during April - May 2021. An average the rainfall in the district receives annually by 895.56 mm. The vathal hill is located in Dharmapuri district, Tamil Nadu, India with several villages. Every Malayali village has several hamlets. Hamlets are found in different elevations (1,418 m) 4,652 ft. Malayali's dwell in hamlets found at elevations of about 1100 m. The temperature in the study site ranges from 12°C to 25°C. The vathal hills are situated between 780.45' - 790.10' E and 140.25' - 140.45' N.

Lichen samples were collected from various altitudes in the hills region during from January 2021 to December 2021. Fruticose lichens were collected with their holdfasts intact on the substratum. The specimens were cleaned by careful removal of debris, sun dried and deposited in the herbaria of Postgraduate and Research Department Botany, Government Arts College, Dharmapuri, Tamil Nadu. The morphological features were studied using trinocular Stereo zoom dissection microscope (Olympus, India). Anatomy of the samples was studied with the help of a compound microscope. The microtome sections were made with the thickness up to 10-15 mm. The K, C, KC and P tests and TLC analysis (Culbertson, 1972; Santesson, 1973; Awasthi, 1991), which are important for identification of chemical substance in lichen, were made on thallus cortex and medulla.

Results and Discussions

This study showed that excellent distribution of all the growth forms of lichens in the region of Vathal hills. From our observation, 55 species of foliose lichens were dominates over the other types of growth forms such as fruticose (21) and crustose (22) lichens. In particular, about the distribution of lichen families Parmeliaceae dominates with 39 species in the study area followed by the members of Physciaceae (21) and Pertusariaceae (6). Only three species of cyanophycean lichens exhibit their poor growth. Among the different genera *Heterodermia* with 15 species dominates the area. These lichen species were identified based on morphology, anatomy and colouring tests of thallus and including thin layer chromatography methods. The results indicated that there were about 98 different species covering 13 families with 29 genus of lichens listed in Table 1. Nearly, about 13 new species of lichens were recorded in the lichen database of Eastern Ghats as per the report of Nayaka *et al.*, (2013) [10].

Hill and Ahmadjian (2003) [5] have been reported that the number of lichen species distributionis affected many reasons. Due to the toxic chemicals present in the air which might affect the growth of the lichen thallus. These toxic chemicals present in the air also damage the algal partner present in lichen and lead to poor attachment of fungal partner on the substratum and finally senescence take place (Karakoti, 2014). Ponmurugan *et al.*, (1999) also have revealed that higher altitude areas at roadsides showed a slight reduction of lichen growth due to automobile smokes.

These lichen species are mostly macrolichens either foliose or fruticose which belongs to the families of Parmeliaceae (39 spp.) and Physciaceae (24 spp.). The Parmelioid lichens are more common in the hilly area and are often represented by *Parmotrema austrosinense*, *Parmotrema grayanum*, *Parmotrema nilgherrense* and *Parmelinella wallichiana*. Among the lichen families some of them are represented only one genus have one species (Collemaataceae and Lobariaceae) (Figure 1-3). The gradual increase in moisture content of all tree bark samples were collected from different altitudes. The moisture level which determines the distribution of lichen species, there were constant after 1100m above MSL altitude.

There was a direct influence of moisture content on the distribution of lichen species. When high moisture leads to the maximum number of lichen population and least lichen population on rocks might be due to low or poor attachment and less moisture. These factors affects the photosynthetic pigments of cyanobacterial photobionts in the lichen thalli. A total of three foliose lichens (*Parmotrema*, *Xanthoparmelia* and *Pyxine* spp.) existing in Eastern Ghats are considered as indicators of healthy forests (Marmor *et al.*, 2011). In addition, *Parmelioid* and *Physcioid* lichens are most commonly found in the study area (Matchavariani *et al.*, 2015). The present study would be more useful to focus the ecological preferences of lichens distribution in Vathal hills, besides global warming, anthropogenic impact areas for conservation purpose.

Table 1: The Lichen distribution in Vathal hills of Dharmapuri district, Tamil Nadu

| Name of the Lichen | Family | Growth form |
|------------------------------------------------------------|------------------|-------------|
| <i>Bulbothrix isidiza</i> (Nyl.) Hale | Parmeliaceae | Foliose |
| <i>Bulbothrix tabacina</i> (Mont. & Bosch) Hale | Parmeliaceae | Foliose |
| <i>Cetraria</i> sp. | Parmeliaceae | Foliose |
| <i>Cladonia</i> sp. | Cladoniaceae | Fruticose |
| <i>Cladonia cartilaginea</i> Mull. Arg. | Cladoniaceae | Fruticose |
| <i>Cryptolechia carneolutea</i> (Turner) A. Massal. | Arthroniaceae | Crustose |
| <i>Cryptothecia anamalaiensis</i> Patw. & Makhija | Arthroniaceae | Crustose |
| <i>Cryptothecia nilghiriensis</i> Patw. & Makhija | Arthroniaceae | Crustose |
| <i>Dirinaria applanata</i> (Fee) D.D. Awasthi | Caliciaceae | Crustose |
| <i>Dirinaria confluens</i> (Fr.) D.D. Awasthi | Caliciaceae | Crustose |
| <i>Everniastrum cirrhatum</i> (Fr.) Hale ex Sipman | Parmeliaceae | Fruticose |
| <i>Heterodermia angustiloba</i> (Mull. Arg.) D.D. Awasthi | Physciaceae | Foliose |
| <i>Heterodermia boryi</i> (Fee) Kr.P. Singh and S.R. Singh | Physciaceae | Foliose |
| <i>Heterodermia dendritica</i> (Pers.) Poelt | Physciaceae | Foliose |
| <i>Heterodermia diademata</i> (Taylor) D.D. Awasthi | Physciaceae | Foliose |
| <i>Heterodermia isidiophora</i> (Vainio) D.D. Awasthi. | Physciaceae | Foliose |
| <i>Heterodermia leucomela</i> (Fee) Swinscow & Krog | Physciaceae | Foliose |
| <i>Heterodermia microphylla</i> (Kurok.) Skorepa | Physciaceae | Foliose |
| <i>Heterodermia speciosa</i> (Wulfen) Trevis | Physciaceae | Foliose |
| <i>Lecanora</i> sp. | Lecanoraceae | Crustose |
| <i>Leptogium javanicum</i> Mont. | Collemaataceae | Fruticose |
| <i>Myelochroa aurulenta</i> (Tuck.) Elix & Hale | Parmeliaceae | Foliose |
| <i>Myriotrema decortcatum</i> Hale | Thelotremataceae | Crustose |
| <i>Myriotrema microporum</i> (Mont.) Hale | Thelotremataceae | Crustose |
| <i>Ocellularia diacida</i> Hale | Thelotremataceae | Crustose |
| <i>Parmelia direagens</i> Hale | Parmeliaceae | Foliose |
| <i>Parmelina muelleri</i> (Vain.) Hale | Parmeliaceae | Foliose |

| | | |
|------------------------------------------------------------------|----------------|-----------|
| <i>Parmelinella simplicior</i> (Hale) Elix & Hale | Parmeliaceae | Foliose |
| <i>Parmotrema austrosinense</i> (Zahlbr.) Hale | Parmeliaceae | Foliose |
| <i>Parmotrema andinum</i> (Mull. Arg.) Hale | Parmeliaceae | Foliose |
| <i>Parmotrema austrosinense</i> (Zahlbr.) Hale | Parmeliaceae | Foliose |
| <i>Parmotrema dilatatum</i> (Vain.) Hale | Parmeliaceae | Foliose |
| <i>Parmotrema grayanum</i> (Hue) Hale | Parmeliaceae | Foliose |
| <i>Parmotrema indicum</i> Hale | Parmeliaceae | Foliose |
| <i>Parmotrema melanothrix</i> (Mont.) Hale | Parmeliaceae | Foliose |
| <i>Parmotrema mesotropum</i> (Mull. Arg.) Hale | Parmeliaceae | Foliose |
| <i>Parmotrema permutatum</i> (Stirt.) Hale | Parmeliaceae | Foliose |
| <i>Parmotrema nilgherrense</i> (Nyl.) Hale. | Parmeliaceae | Foliose |
| <i>Parmotrema praesorediosum</i> (Nyl.) Hale | Parmeliaceae | Foliose |
| <i>Parmotrema saccatilobum</i> (Taylor) Hale | Parmeliaceae | Foliose |
| <i>Parmotrema tinctorum</i> (Nyl.) Hale | Parmeliaceae | Foliose |
| <i>Parmotrema xanthinum</i> (Mull. Arg.) Hale | Parmeliaceae | Foliose |
| <i>Parmelinopsis expallida</i> (Kurok.) Elix & Hale | Parmeliaceae | Foliose |
| <i>Pertusaria</i> sp. (Ach.) | Pertusariaceae | Crustose |
| <i>Pertusaria leucosorodes</i> Nyl. | Pertusariaceae | Crustose |
| <i>Pertusaria pseudococcodes</i> Mull. Arg. | Pertusariaceae | Crustose |
| <i>Pertusaria</i> sp. (Taylor) | Pertusariaceae | Crustose |
| <i>Phaeophyscia hispidula</i> (Ach.) Moberg | Physciaceae | Foliose |
| <i>Physcia aipolia</i> (Ehrh. ex Humb.) Furnr. Physciaceae | Physciaceae | Foliose |
| <i>Physcia caesia</i> (Hoffm.) Furnr. | Physciaceae | Foliose |
| <i>Physcia dilatata</i> Nyl. | Physciaceae | Foliose |
| <i>Physcia dimidiata</i> (Arnold) Nyl. | Physciaceae | Foliose |
| <i>Physcia integrata</i> Nyl. | Physciaceae | Foliose |
| <i>Physcia tribacia</i> (Ach.) Nyl. | Physciaceae | Foliose |
| <i>Physcia tribacioides</i> Nyl. | Physciaceae | Foliose |
| <i>Phyllopsora orallina</i> (Eschw.) Mull. Arg. | Biatoraceae | Crustose |
| <i>Phyllopsora parvifolia</i> (Pers.) Mull. Arg. | Biatoraceae | Crustose |
| <i>Pseudocephalaria argyraceae</i> (Bory.) Vain. | Lobariaceae | Foliose |
| <i>Pyxine cocoes</i> var. <i>prominula</i> (Stirt.) D.D. Awasthi | Caliciaceae | Foliose |
| <i>Pyxine cognata</i> Stirt. | Caliciaceae | Foliose |
| <i>Pyxine nilgiriensis</i> D.D. Awasthi | Caliciaceae | Foliose |
| <i>Pyxine petricola</i> Nyl. | Caliciaceae | Foliose |
| <i>Pyxine soredata</i> (Ach.) Mont. | Caliciaceae | Foliose |
| <i>Pyxine subcinerea</i> Stirt. | Caliciaceae | Foliose |
| <i>Ramalina baltica</i> Lettau | Ramalinaceae | Fruticose |
| <i>Rimelia reticulata</i> (Taylor) Hale and Fletcher | Parmeliaceae | Fruticose |
| <i>Rimelia clavulifera</i> (Rasanen) Kurok. | Parmeliaceae | Fruticose |
| <i>Tephormela atra</i> (Huds.) Hafellner | Lecanoraceae | Crustose |
| <i>Usnea albopunctata</i> Nyl. apud Crombie | Parmeliaceae | Fruticose |
| <i>Usnea bornmuelleri</i> J. Steiner | Parmeliaceae | Fruticose |
| <i>Usnea corallina</i> Motyka | Parmeliaceae | Fruticose |
| <i>Usnea dendritica</i> Stirt. | Parmeliaceae | Fruticose |
| <i>Usnea galbinifera</i> Asahina | Parmeliaceae | Fruticose |
| <i>Usnea pectinata</i> Stirt. | Parmeliaceae | Fruticose |
| <i>Usnea picta</i> (J. Steiner) Motyka | Parmeliaceae | Fruticose |
| <i>Usnea pictoides</i> G. Awasthi | Parmeliaceae | Fruticose |





Fig 1: Lichen Distribution in this study. A. *Parmotrema arnoldii*, B. *Parmotrema perforatum*, C. *usnea Pectinata* D. *Parmeliopsis hyperota*, E. *Ramalina pacifica*, F. *Caloplaca bolacina*, G. *Parmotrema austrosinense*, H. *Physcia aiolia*. (Scale bar = 1cm)

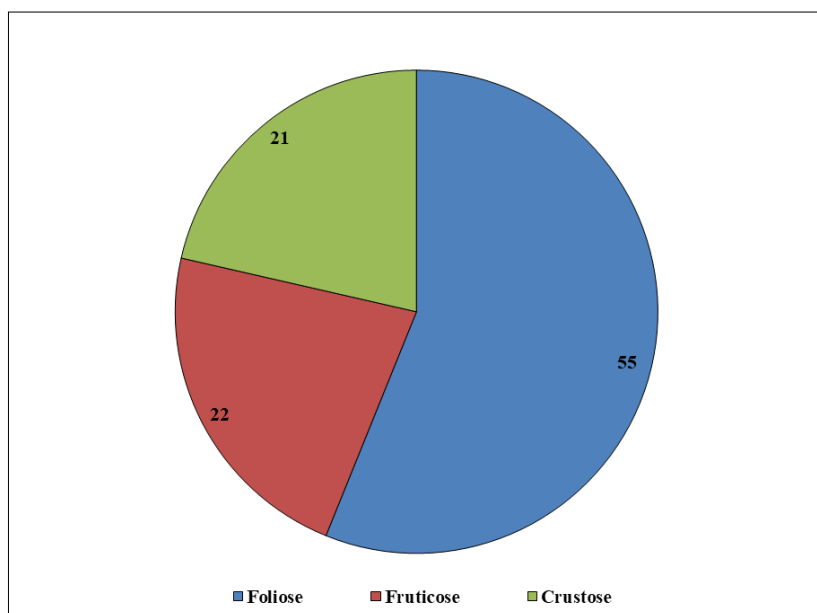


Fig 2: The pie chart diagram showing the lichen morphology.

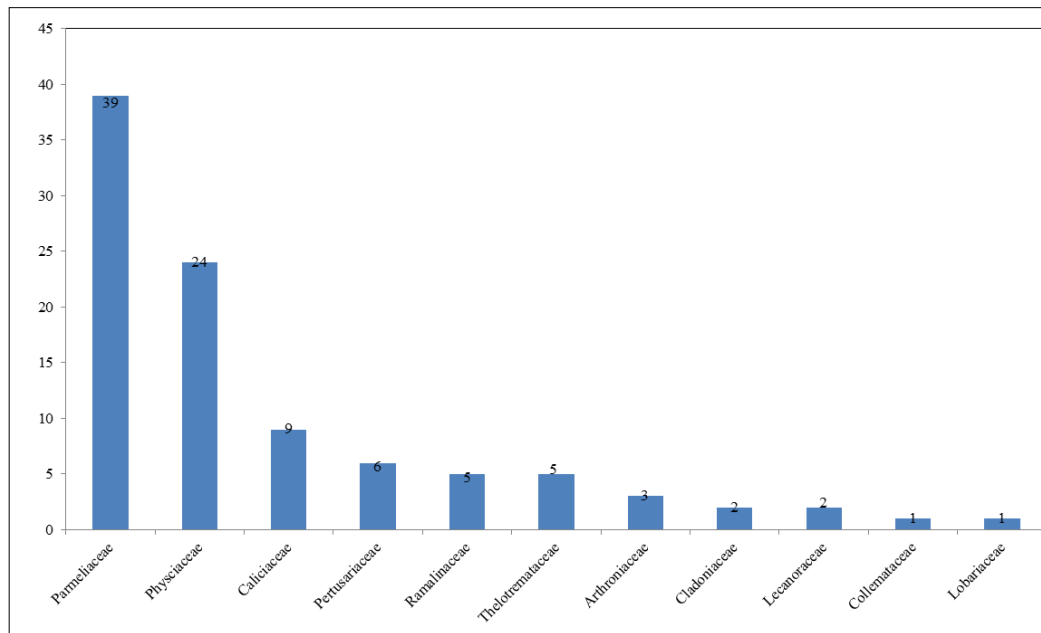


Fig 3: Family wise distribution of lichen species

Conclusion

The study area located above the altitude of 1000 m. The abundance and richness of lichen species are depending upon the different factors influenced such as temperature, moisture, forest type, altitude and anthropogenic activities. In particular the lichen families of Physciaceae and Parmeliaceae are documented. The present study revealed that a clear cut distribution pattern of lichens, which is highly informative for conservation and biomedical applications especially in wide range of bioactivity. The study also recommended that there was a significant level of lichen deterioration in the population of lichen is due to climatic change.

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References

- Awasthi DD. A Hand Book of Lichens. Shiva Offset Press, Lucknow, India, 2000, 87-92.
- Awasthi DD. A key to the microlichens of India, Nepal and Sri Lanka. Biblioth. Lichenology,2020:40:1-337
- Culbertson CF. Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. Journal of Chromatography,1972:72:113-125
- Hariharan GN, Krishnamurthy KV, Upreti DK. Lichens of Shervaroy hills of Eastern Ghats, India. Phytotaxonomy,2013:3:1-23
- Hill DJ, Ahmadjian V. Relationship between carbohydrate movement and the symbiosis in lichens with green algae. Planta,2003:103:267-277
- Jha CS, Dutt CBS, Bawa KS. Deforestation and land use changes in Western Ghats, India Current Science,2002:79(2):231-237.
- Karakoti N, Mishra GK, Bajpai R, Srivastava A, Upreti DK, Nayaka. Effect of metal content on chlorophyll fluorescence and chlorophyll degradation in lichen *Pyxine cocoes* (Sw.) Nyl.: A case study from Uttar Pradesh, India, Environment and Earth Science,2014:71:2177-2183
- Marmor L, Torra L, Leppik E, Saag L, Randlane T. Epiphytic lichen diversity in Estonian and Fennoscandian old coniferous forests. Folia Cryptogams Estonica, Fasc.,2011:48:31-43
- Matchavariani L, Kalandadze B, Lagidze L, Gokhelashvili N, Sulkhaniashvili N, Paichadze N, Dvalashvili G. Soil quality changes in response to their pollution by heavy metals, Georgia Journal of Environmental Biology,2015:36:85-90
- Nayaka S, Reddy AM, Ponnurugan P, Devi A, Ayyappadasan G, Upreti DK. Eastern Ghats' biodiversity reserves with unexplored lichen wealth. Current Science,2019:104:7:821-825
- Ponnurugan P, Deepa MA, Damodaran PN. Effect of environmental factors on lichens distribution. Ecology and Environmental Conservation,2002:8:147-150.
- Ponnurugan P, Venkatesan S, Sevugaperumal R. Studies on Lichen deterioration in higher altitude areas. Ecology and Environmental Conservation,2019:5:265-269.
- Singh KP, Sinha GP. Indian Lichens, An Annotated Checklist. Botanical Survey of India, Kolkata, 2010, 571.