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Ecological impact of coal mines on lichens: A case study at Moghla coal mines Kalakote (Rajouri), J&K

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Abstract : The data on the frequency, density and abundance of the lichens growing around the Moghla Coal mines, Kalakote has been recorded and compared with lichens growing in a forest area away from the coal mines to work out effect of coal mines on the diversity and distribution of lichens. The data revealed that pollutants released by the open coal mining activities not only effected qualitative distribution but also have effect on the quantitative parameters. Over all 10 species of lichens belonging to 9 genera and 6 families have been recorded from the vicinity of coal mines as compared to 15 species, belonging to 9 genera and 7 families, recorded from the forest area.

Keywords: Lichens, Ecological impact, Kalakote coal mines, J&K

INTRODUCTION

Lichens have sensitivity, both physiological and ecological, to pollutants and therefore have been employed almost exclusively to monitor the extent or spread of air pollution particularly SO_2 (Gries *et al*., 1997). Lichen diversity is an excellent indicator of pollution by phytotoxic gaseous substances and respond relatively fast to a deterioration in air quality. Due to lack of cuticle, lichen absorbs both gases and dissolved substances through their surface. Reduction in air pollution has been reported to result in recovery of lichen abundance (Showman, 1990; Kirschbaum *et al*., 1996). The pollutants such as SO_2 and O_3 (ozone) which are absorbed by the lichens leads to loss of chlorophyll, reduced rate of photosynthesis and eventual plasmolysis of algal cells (Rao and de Blanc, 1965). Murphy *et al*. (1999) used lichen abundance to indicate whether a rural, coal burning, electrical generating station in the northern USA has measurable impacts on the surrounding forest.

In the present study frequency, density and abundance of the lichens has been recorded near the Moghla coal mines, Kalakote (latitude 33^0 10\ N, longitude 74^0 45\ E and altitude 600 m above m.s.l) in Rajouri district of J&K state, to know the effect of the coal mines on the qualitative and quantitative distribution of lichen vegetation present in the surrounding areas.

MATERIALS AND METHODS

To analyse the impact of coal mines on lichens, collection of the lichens were made from base to chest height of the tree trunks of the selected trees from two different location: Site I, in the vicinity of coal mines (100m) and Site II, Treru forest area located 6 km away from the coal mines. A quadrat of 25x 25 cm size was used for recording the data on frequency, density and abundance of lichens growing on the selected trees. However, the collection of lichen samples has been made from all the available substratum in the study area. The specimens were identified by the recent literature of Awasthi (1988, 1991, and 2000), Divakar (2001) and Nayaka (2004). Thin layer chromatography was performed by the methods of Culberson (1972) and Walker and James (1980) for lichen substances. The data was recorded from the dominant tree species- *Mallotus phillippensis, Punica granatum, Carissa opaca* and *Alnus incongruens* at both the sites.

RESULTS AND DISCUSSION

The lichen community present at the Treru Forest area and Moghla coal mine area form two types of assemblage of lichen species i. e. either growing on tree trunks (corticolus) or on the rocks (saxicolous). The area is represented by 2 growth forms of lichens - crustose and foliose. At Site- I, only 10 species belonging to 9 genera and 6 families have been recorded while as 15 species belonging to 9 genera and 7 families have been observed to grow at Site-II (Table 1and 2). This clearly indicated that the coal mines have effected the qualitative distribution of the lichens in the area under report, same was observed by Murphy *et al*. (1999) in England.

Perusal of the table 3 also revealed that all the quantitative parameters i.e. frequency, density and abundance of the species, have been effected by the coal mine pollution. All these parameters have been recorded to have lower values at Site I (coal mines area) than that of the Site II (forest area). Smith *et al. (*1993) also reported that by estimating lichen cover, the lichens can be used for bioindicator studies.

The analysis of the recorded data further revealed that seven lichen species grow at both of the sites (Table 4) and show variations in their quantitative parameters. These species may be recognized as pollution tolerant species and can be further exploited for recording the effects of coal mines pollutants on the growth and development of lichens.

Thus, results of present study indicated that various pollutant gases (SO_2, H_2S etc.) and particulate matter (SPM) produced at Moghla coal mines, Kalakote affected the diversity and distribution of the lichen vegetation both qualitatively and quantitatively.

Table 1. Lichen species collected from Site I (coal mines area).

Lichen taxa	Family	Substratum	Growth form
Bacidia arnoldiana Korber	Bacidiaceae	R	Cr
Graphis sp.II	Graphidaceae	B	Cr
Hyperphyscia adglutinata (Florke) Mayrh. & Poelt	Physciaceae	B	Fo
Lecanora perplexa Brodo.	Lecanoraceae	B	Cr
Lepraria lobificans Nyl.	Lichenes imperfecti	B	Cr
Lepraria sp.I	Lichenes imperfecti	R	Cr
Pyxine subcinerea Stirton	Physciaceae	B	Fo
Phaeophyscia orbicularis(Necker) Moberg	Physciaceae	B	Fo
Physcia sp.	Physciaceae	B	Fo
Verrucaria coerulea (Ram) DC.in Lam. & DC	Verrucariaceae	R	Cr

Table 2. Lichen species collected from Site II (Forest area).

Lichen taxa	Family	Substratum	Growth form
Bacidia incongruens (Striton) Zahlbr.	Bacidiaceae	R	Cr
Caloplaca malaensis (Rasanen) Awasthi	Teloschistaceae	B	Cr
Caloplaca subsolata (Nyl.)) Zahlbr.	Teloschistaceae	R	Cr
Graphis sp.I	Graphidaceae	B	Cr
Graphis sp.II	Graphidaceae	B	Cr
Hyperphyscia adglutinata (Florke) Mayrh. & Poelt	Physciaceae	B	Fo
Lecanora perplexa Brodo.	Lecanoraceae	B	Cr
Lecanora sp. I	Lecanoraceae	B	Cr
Lecanora sp. II	Lecanoraceae	B	Cr
Lepraria lobificans Nyl.	Lichenes imperfecti	B	Cr
Lepraria sp.I	Lichenes imperfecti	R	Cr
Lepraria sp.II	Lichenes imperfecti	B	Cr
Parmotrema praesorediosum (Nyl.) Hale	Parmeliaceae	B	Fo
Pyxine subcinerea Stirton	Physciaceae	B	Fo
Phaeophyscia orbicularis(Necker) Moberg	Physciaceae	B	Fo

Table 3. Showing frequency, density and abundance of lichens at Site I and Site II.

Lichen taxa	Host	Site-I			Site-II		
		Freq. (%)	Dens./ 625 cm2	Abun.	Freq. (%)	Dens./ 625cm2	Abun.
Graphis sp.II	*Punica granatum*	1.0	20.1	3.0	1.2	40.0	3.5
Hyperphyscia adglutinata	*Alnus incongruens*	50.0	0.9	2.6	63.3	1.6	3.0
Hyperphyscia adglutinata	*Mallotus philippensis*	40.0	1.0	2.7	42.8	1.7	5.0
Lecanora perplexa	*Punica granatum*	1.2	20.0	4.2	1.5	40.0	5.7
Lecanora perplexa	*Carissa opaca*	10.0	0.2	1.0	18.2	0.27	1.5
Phaeophyscia orbicularis	*Mallotus philippensis*	40.0	1.0	2.0	57.1	3.2	5.7
Phaeophyscia orbicularis	*Alnus incongruens*	45.5	1.0	2.7	50.0	1.6	3.3
Pyxine subcinerea	*Carissa opaca*	10.0	0.2	1.0	27.2	0.9	3.3

Table 4. Lichen species common at Site I and Site II.

Lichen taxa	Family	Substratum	Growth form
Graphis sp.II	Graphidaceae	B	Cr
Hyperphyscia adglutinata (Florke) Mayrh. & Poelt	Physciaceae	B	Fo
Lecanora perplexa Brodo.	Lecanoraceae	B	Cr
Lepraria lobificans Nyl.	Lichenes imperfecti	B	Cr
Lepraria sp. I	Lichenes imperfecti	R	Cr
Pyxine subcinerea Stirton	Physciaceae	B	Fo
Phaeophyscia orbicularis (Necker) Moberg	Physciaceae	B	Fo

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