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# A PRELIMINARY SURVEY OF LICHEN EXISTENCE IN URBAN POCKETS OF KASHMIR, INDIA

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## Abstract

The present study aims to gather baseline information and preliminary observe the existence of lichens at two sites of Srinagar district of Kashmir Division, which have received less attention lichenologically being city centers as well as busy populous sites. The study also aims to understand how lichens thrive in extremes of conditions especially when the disturbances have anthropogenic origin and the list is not exhaustive in any way. Site I seems to be more of lichen desert, with only two species striving to boil the ocean. The presence of these species in such stressed environment could be used as reliable, pollutant tolerant indicator systems in urban ecosystems. The study also seems to pinpoint how modifications in local environmental conditions at site II, by certain favorable parameters, can reflect through lichens colonization in terms of better count, irrespective of countless urban pressures. Moreover another important outcome seemed to be the relation of particular lichen groups (whether Nitrophytic, Acidophytic or Neutrophytic) and growth forms (crustose, foliose or fructicose) with local environmental parameters, with could provide us with an alternative path, in understanding the environmental quality of area.
***Keywords*:** Lichens, Pollution, Environment, Urbanization, Microclimate, Urban Pressures.

## Introduction

Lichens the amazing and outstanding symbionts share one of the most successful relation that of Algae and Fungi. As such they do not completely resemble either group, but have their own beautiful and distinctive look. Lichens play an under recognized yet very important role in all types of ecosystems and add to overall biodiversity. They possess no root, shoot or leaves allowing them to live efficiently even in most oppressive kind of environmental situations, which can range from low tide level on the sea shore to high reaches of Himalayas beyond the tree line extending into arctic tundra. (Negi, 2003) They have ability to grow in extreme condition, often growing less than a millimeter a year. An estimated number of 13,000-30,000 lichen species occupy our earth and every year new species get added to the list. They almost dominate 8% of total earths land surface (Hale, 1983; Ahmadjian, 1995). Slow growth, longevity and ability to sequester good amount of carbon, Lichens are quick to respond to environmental stresses and as such are good indicators of status of environment at any place (whether clean or polluted), extent of pollution, presence of heavy metals as well as detectors of climate change. In certain cases merely their presence or absence marks the air quality of an area. Sometimes certain parameters about lichen community provide ideas about air quality. Lichen communities can be categorized into three groups. Nitrophytic lichen species that benefit from excess $N_2$ in form of $NO_2$ from vehicle exhaust and $NH_3$ from intensive agriculture (van Herk, 2001). Acidophytic lichen species are sensitive to pollutants and show less counts in areas of higher pollution (van Herk, 2001) and Neutrophytic lichens that are moderately sensitive to pollution (van Herk,1999). Lichen studies started in our J&K in fifties of last century. An appreciable number has been added since then. But every now and then new records and new species are being discovered. Kashmir still stays unexplored in this regard.

## Study Area

The present study was undertaken in Srinagar district of Kashmir. The region has humid subtropical climate (koppen Cfa).The city is largest and summer capital of Union territory of J & K, lying on the banks of River Jhelum. The average temperature ranges between 23.3°C during summers and 3.2°C in winters. The locations surveyed are both prime city locations, Site I in the uptown area of Gogjibagh with Graticules $34^0 03'14''$ N $74^0 48'34''$ E with an area of 35 hec and Site II in downtown area of Hawal with Graticules $34^0 06'14''$ N $74^0 48'39''$ E, with an area of 12.17 acre and with mountainous topography. The satellite imagery can provide an overview about the extent of urbanization near and around the sites (Plate I).

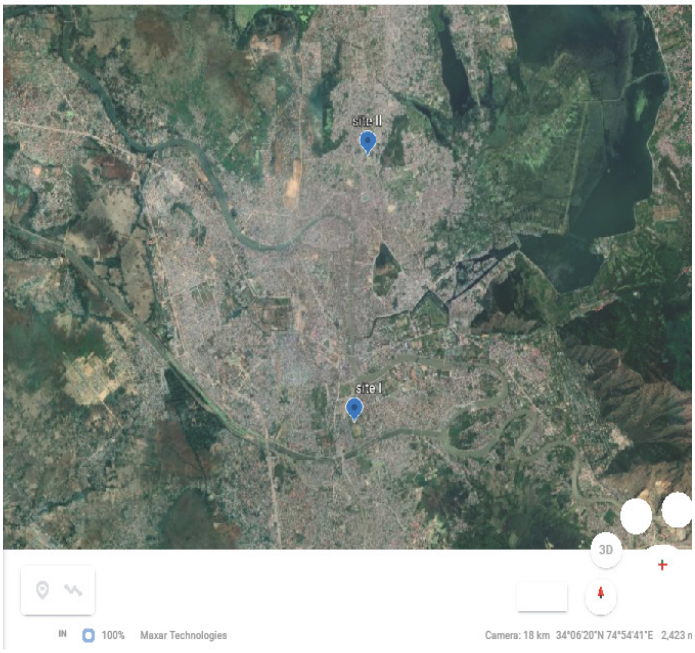


**Plate I**: Satellite image of study area.

## Material and Methods

Lichens growing on all different substrata like tree trunks, rocks, concrete and soil were collected with the help of hammer, chisel and knife. The loosely attached foliose lichens were removed from all the substrates with the help of a knife. Due care was taken that the fixing organs (rhizines, hold fasts) remain attached to the thallus as much as possible.

The lichen collections were made from base to head height of the tree trunks and rocks. Along with the lichen collection the details of locality and substratum were also recorded. The specimens were identified by studying the morphology, anatomy and chemistry. The recent literature of Awasthi (1988, 1991 & 2000), Upreti (1984, 1988), Divakar (2001) and Nayaka (2004) was consulted for identification of most of the lichen taxa. The morphology of the taxa was studied under stereo-zoom binocular microscope. Anatomical details of the thallus and fruiting bodies were studied in free hand sections with water as mounting medium under compound microscope. The color spot tests were carried out on cortex and medulla with the usual chemical reagents, such as aqueous potassium hydroxide (K), Steiner's stable para-phenylenediamine (PD) and aqueous calcium hypochlorite (C). Thin Layer Chromatography was performed for authentic identification of the lichen substances in solvent system A (Toluene, 180 ml: 1-4 Dioxane, 60ml: Acetic acid, 8 ml) following Walker & James (1980).

## Results and Discussion

**Site I:**

Air borne pollutants travel and impact lichen communities even from far off places. Pollution and anthropogenic disturbances seem to have taken direct toll on lichens by constricting their growth so much that the area seems to be more of lichen desert. The emergence of only two lichen species i.e. *Xanthoria parietina* and *Physcia sps.* can be seen in the area. Both species are visibly trying hard to mark their presence, as they are trying to emerge as small spots of less than 2cm diameter, from few moisture and moss laden crevices. Among hundreds of trees, only 8 trees were marked positive for lichen presence that too over the west facing side which is moist rather than east facing side .This can be a clear indication that species try to grow upwind of source of pollution. The blowing wind perhaps effortlessly blows off most of the pollutants especially particulate ones in direction away from west side, hence this side experiences a little bit of cleaner air. Then again upto 100m, no lichen species is observed. The general absence can be attributed to continuous disturbance by a number of factors working together which all represent urban pressures. Dust, smoke, exhaust fumes, rain shadows and deep shadows, all limit the number of conditions that otherwise favor the lichen growth. The area also visualizes huge expansion in form of urbanization, different forms of constructional activities every now and then, increasing number of vehicles and movement because of recent flyover construction which gives easy and more better access to site hence more people and more vehicles, frequent burning of biomass during fall season, emanacating huge plumes of smoke (Plate II; Fig 1 & 2). There are many weakened trees in the area which are further on damaged by blowing winds and many have got inflicted by diseases as well, as such numbers of them are being continuously axed as they pose danger. Also Lichens are found to mark their presence at a particular height of 1.5 - 2mts on all occurring trees which may be an indicative of pollution affecting lichen height negatively.

**Fig-1**

**Fig-2**

**Plate II (Fig 1&2)**: Visible smoke plumes, a common practice during fall season adding to ground level pollution which might be attributed to lichen absence at Site I.

**Site II:**

Although being another popular urban site with continuous interference by humans in form of construction, concretization, mass people movement, and traffic movement and intensity in vicinity hence exposure to large number of gaseous and particulate pollutants is quite common. But the site certainly has some advantages which make environment somehow conducive hence the diversity, density, abundance and health of lichens gets better as the area seemingly appears fertile with greenery, rich tree diversity, humid and moist climate, being located near a mountain. Cool and moisture laden winds always blow in this mountaineous topography. All seem to be congenial for growth of lichens in spite of frequent disturbances. The topography and varied altitude all add to the advantage (Plate III; Fig. 1 &2). Topographical variables are known to affect the water and nutrient budget of any given site (Horsch, B. 2003).This acts as a boon for lichens as they can benefit from these , taking up all their supplies from air in absence of roots, shoots and cuticle. The site seems to be rich as it is still retaining and promoting growth of significant number of species in spite of being centre of urbanization. The study revealed the occurrence of Eleven (11) species of lichens belonging to nine (9) genera and five (5) families (Table 1), most

dominant being family of Teloschistaceae followed by Physciaceae family. We found two growth forms of lichens, namely crustose and foliose; fructicose lichens were not found in the study. Smoke, dust, $SO_2$, $NO_2$, Fluorides, photochemical toxins and metallic pollutants all have taken their toll on lichens, as bleached, dust and smoke impregnated thallus is quite a visible phenomenon. Bleaching occurs as a result of decomposition of chlorophyll.

The deciduous trees receiving extra quota of light during winter, foster rich growth of *Physia sp.*, *Xanthoria sp*. and other lichen species. Foliose Species seem to grow well in shady places and show poor growth at well lit places. Also lichen physiology is believed to be influenced by exposure to solar radiation, environmental humidity and temperature (Nash, T. H.1996). For the purpose of height relation, no gradient was found at this site. Similarly no preference, direction wise was observed. They were widespread on every side though the frequency and size varied considerably. Similarly certain species like *Xanthoria parietina*, *Physcia sp*. etc. marked their presence quite frequently while few like *caloplaca sp.*, *Xanthoria elegans*, *Rhinodena sp.* etc showed rare occurrence on only few trees with small colony size. Pollution especially dust emissions favour Nitrophilous lichen species to flourish at this Site. The complete dominance of nitrophytes indicates simply excessive nitrogen emissions in the area favouring their growth. This fact is further proven by the widespread and predominant occurrence of species of genera *Phaeophyscia* and members of Physciaceae. Also the obvious pattern emerging from data shows dominance of tolerant and competitive Foliose forms which provides us insight into air quality of site. The onsite prevalent lichen groups (Nitrophilous type) and growth forms (dominated chiefly by foliose forms) can be hence used to the benefit of understanding the quality of environment, extent and type of pollution in any area.

Also observed lichen species were not found to be selective of any tree species. Same species were found to inhabit different tree species. Hence possibility of tree preference by selective lichen species seems to rule out.

**Fig -1**

**Fig-2**

**Plate III (Fig 1&2):** In spite of being under various urban pressures, mountainous topography and other favorable microclimatic conditions support lichen growth.

**Table I:** Lichen Diversity at Site II

| S. No | Lichen Taxa | Family | Substratum | Occurrence (at area) | Sensitivity | Growth Form |
|---|---|---|---|---|---|---|
| 1. | *Candelaria sp.* | Candelariaceae | Bark | Rare | Medium | Foliose |
| 2. | *Caloplaca sp.* | Teloschistaceae | Bark | Rare | Medium | Crustose |
| 3. | *Lecanora muralis Schreb.) Rabenh* | Lecanoraceae | Bark | Rare | Medium | Crustose |
| 4 | *Punctelia sp.* | Parmeliaceae | Bark | Rare | Medium | Foliose |
| 5. | *Physia sp.* | Physciaceae | Bark | Common | Low | Foliose |
| 6. | *Phaeophysia sp.* | Physciaceae | Bark | Common | Low | Foliose |
| 7. | *Physconia distorta* (With.) Laundon | Physciaceae | Bark | Rare | Medium | Foliose |
| 8. | *Rhinodena sp.* | Physciaceae | Bark | Rare | Medium | Crustose |
| 9. | *Xanthoria parietina* (L.) Th.Fr. | Teloschistaceae | Bark/ Concrete | Common | Low | Foliose |
| 10. | *Xanthoria elegans* | Teloschistaceae | Bark/Concrete | Rare | Medium | Foliose |
| 11. | *Xanthoria sp*. | Teloschistaceae | Bark | Common | Low | Foliose |

## Conclusion

With no substantial difference in vehicular traffic at the two sites, being close to important roads nearby connecting various important routes in the city, there are various other transect roads within the site itself. Both sites are continuously disturbed by huge rush of people, continuous introduction of new plant and tree species, addition of foreign material, regular visits and grazing by animals and represent very different habitats. In these human modified and disturbed habitats it isn't surprising to find very low density and diversity of lichens. But still Site II seems to show good counts in spite of all these anthropogenic burdens. It could be that local microclimatic modifications due to altitude, mountainous topography, presence of diverse kinds of tree species, the shady islands created thereof, cool breeze, good environmental humidity level etc all are acting as significant drivers of lichen diversity. Decrease in lichen diversity at urban centers can be attributed to two main causes; decrease in the number of phorophytes and the ambient atmosphere due to emissions. The present communication will act as a baseline record for conducting biomonitoring studies in future in the areas. Also presence, absence, diversity, species type etc can be used as remarkable tools in assessing the

prevailing environmental conditions of any area. Also the existence of few species like *Xanthoria parietina* and *Physcia sp*. at even heavily polluted site can be clear indicative of these as pollution tolerant species that are capable of remarkable growth even in stressed environments.

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