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Diversity and Distribution of Lichen around the National thermal Power plant Sipat Bilaspur , Chhattisgarh

*Lata Prajapati¹, Bhavana Dixit², Arvind Prajapati³, Samyak Singh⁴ and Akriti Tamrakar⁵

(1,2,4,5)Department of Forestry Wildlife & Environmental Sciences Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh 495009

3 Department of Forestry Central University of Odisha

1.lataprajapati924@gmail.com,

2.drbhavanadixit@gmail.com

3. arvind_forestry2@yahoo.com

4. singhsamyak95@gmail.com

5.greataakriti28@gmail.com

Corresponding author

Lata Prajapati

Department of Forestry Wildlife & Environmental Sciences
Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh 495009

Moblie no. 9399299294,8817839377

Email: lataprajapati924@gmail.com

Abstract

Lichens are very important component of the ecosystem serving as substrate, shelter, food, nutrient cycle, succession etc. Epiphytic lichens are generally considered to be good indicator of environmental quality. Changes in environmental condition may be reflected in changes to composition of lichen vegetation. They occur in all possible environmental habitats of the worlds. Current studies on lichen represents about 3099 species of lichen from the Indian subcontinent out of 20,000 lichen species from the world. Chhattisgarh is home to many rare, endangered and economically important species, including many species of plants, trees and climbers in diverse habitats, including lichens. In Bilaspur district of Chhattisgarh, NTPC has natural and artificial plantations representing the tropical dry deciduous forest types of the country. This study focused on lichen communities around the National Thermal Power Corporation (NTPC) power plant in Bilaspur district of Chhattisgarh. Lichen host species are: *Shorea rodusta*, *Diospyros melanoxylon*, *Lannea grandis*, *Madhuca longifolia* *Mangifera indica*, *Buchanania lanzan* and stone surface. A total of 18 lichen species were identified. The variety of lichens that are not disturbed by humans is currently in the pioneer succession stage. The available enumeration of lichen is of great interest will be helpful in conservation and restoration of lichen and their host species in NTPC Bilaspur.

Keyword: Lichen diversity, Host tree species, Conservation, Environmental quality

Article History

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Introduction

Lichens are remarkable organisms that result from a symbiotic relationship between fungi and algae or cyanobacteria. This mutualistic partnership is essential for their survival and gives rise to a unique composite organism with characteristics distinct from its individual components. Lichens exhibit remarkable diversity worldwide, with estimates suggesting there are between 13,500 to 17,000 species globally. This diversity is distributed across various ecosystems, from tropical rainforests to arctic tundra, and they occupy a range of habitats including rocks, trees, soil, and even man-made structures. In India, lichen diversity is also considerable, with around 2,714 species recorded so far Sinha et al 2018. The country's diverse geography, spanning from the Himalayan mountain range to coastal regions and deserts, provides a wide range of habitats for lichens to thrive. Some of the key lichen-rich regions in India include the Western Ghats, Eastern Himalayas, Western Himalayas, and the Nilgiri Biosphere Reserve. Lichens come in a variety of forms, including crustose (crust-like), foliose (leaf-like), and fruticose (shrub-like), each adapted to different ecological niches. They play crucial roles in ecosystems by contributing to soil formation, nutrient cycling, and providing habitats for microorganisms and small invertebrates. Despite their hardiness, lichens are sensitive to environmental changes, making them valuable indicators of ecosystem health and air quality. Prajapati, A. et al. 2015 Their susceptibility to pollution, particularly sulfur dioxide and heavy metals, has led to their use in biomonitoring programs worldwide. Overall, lichens are fascinating organisms that showcase the intricacies of symbiotic relationships in nature and serve as indicators of environmental quality and ecosystem vitality. Lichens are highly sensitive to environmental changes, particularly air quality, pollutants, and climatic conditions. Satya, G. et al. (2005) Their presence, abundance, and species composition can serve as reliable indicators of environmental health and quality. Tiwari, S.C., et al 2015 By studying lichen diversity in industrial areas, researchers can assess the impact of anthropogenic activities on local ecosystems and monitor environmental degradation over time. With a total geographic area of 1,37,880 km² and a forest area of 59,772 km², the state of Chhattisgarh is one of India's richest habitats for biodiversity. The state has 44.04 percent forest cover, or 8% of all of India's forests (ISFR, 2011). Lichen's sensitivity to perturbations can serve as a helpful indicator of the health of a forest. 2013, Prajapati, A., NTPC Sipat Super thermal power station is located in a small village called "Sipat" which is about 22 kilometres from Bilaspur city in the state of Chhattisgarh. The uncommon, endangered, and commercially significant plants found in the forests of Madhya Pradesh and Chhattisgarh, Dixit, B 2021.

Central India, include a variety of shrubs, climbers, and ground herbs having a remarkably wide range of environments. S. C. TIWARI et al 2012 Lichens from the state of Chhattisgarh, comprising 49 genera and 29 families, Bajpai, R. et al 2018 NTPC has natural and artificial plantations representing the tropical dry deciduous forest types of the country. NTPC Sipat in Bilaspur, Chhattisgarh, presents unique challenges to biodiversity due to anthropogenic activities. Dixit, B et al.2005 Understanding lichen diversity within such environments is crucial for assessing their ecological status and formulating effective conservation strategies. Sharath, K. P et.al 2021 This research paper presents a comprehensive assessment of lichen diversity around NTPC Sipat area, located in Bilaspur, Chhattisgarh. The study aims to document lichen species richness, distribution, and ecological significance within the industrial landscape of NTPC Sipat.

Study site

Situated in the Sipat district of the state of Chhattisgarh, near Bilaspur, lies the Sipat Super Thermal Power Station. NTPC Sipat lies N- 22^o08'960" between latitude and 81 25' to 82 5' E longitudes, This is one of NTPC's coal-fired power stations. The coal used in the power plant is supplied by South Eastern Coalfields Limited's Dipika Mines. The project has a 2980 MW installed capacity divided into two parts. Phase one, which was finished after schedule, comprised three 660 MW units that used super-critical boiler technology.

NTPC as a center point is divided into 3 zone 5 km,10 km,and 15km Major and popular villages ranges each distance has been selected for the study. Sampling sites were distributed at various elevations in the district.

Site	Locality	Altitude	Latitude	Longitude
1	Tharakpur	298	N-22 ^o 10'830"	E-082 ^o 20'746"
2	Bharuadih	306	N-22 ^o 10'790"	E- 082 ^o 20'747"
3	Karichhaper	293	N-22 ^o 10'864"	E- 082 ^o 20'750"
4	Kemadih	306	N-22 ^o 11'735"	E- 082 ^o 21'385"
5	Dalhapahad	300	N-22 ^o 06'901"	E- 082 ^o 23'328"
6	Khondra	415	N-22 ^o 15'296"	E- 082 ^o 20'896 "
7	Kanai	387	N-22 ^o 17'344"	E- 082 ^o 22'879"

Methods

In the NTPC Sipat area, lichen host tree species and their associated tree species was surveyed apart from 5 km, 10km and 15km area from power plant station.

Field trips were executed to collect lichen growing on different substrata were sampled by Quadrata method. Each quadrata measuring 20x20 m laid in different locations of the study area. A total of 30 quadrata was laid in 7 different locations in the study area. All species of lichens found in sampling area were harvested and species that are tightly adhered to bark or rock were collected with the help of chisel and hammer. Immediately after collection, samples were cleaned and wrapped in a tissue paper and stored in paper bags. Collected specimens were numbered and preserved in lichen herbarium packet with details of the locality and deposited in the herbarium of CSIR-National Botanical Research Institute Lucknow.

Identification of Lichen Species

A stereomicroscope was used to examine the exterior morphology. Using a compound microscope, the thallus and apothecia's anatomical features were examined. After cutting a slice of dry material with a safety razor blade and mounting it in lactophenol-soaked cotton blue, the anatomical structures were examined. Ascus, epithecium, hypothecium, and medulla colors were noted. Ascospore, conidia, and asci sizes and shapes were measured. The sections mounted on cotton blue were typically used to measure the thallus, medulla, epithecium, and hymenium. The thallus medulla, epithecium, hymenium thickness, asci, and ascospores were measured in millimicrons, while the lobe and ascocarp sizes were measured in millimeters. A chemical test on the samples consists of: extraction is used in thin layer chromatography (TLC) testing as well as color spot tests (K, C, KC, and P tests). utilizing Orange et al.'s methods (2001). Lichen identification was accomplished by consulting appropriate keys. DD Awasthi 1988, 1991, 2007 Nayaka (2004),

Table No.2 Lichen species distribution around NTPC Sipat

S.N	Lichen Genera and Species	TH	BH	KR	KM	DP	KH	KN	Substratum	Growth form
Caliciaceae										
1	<i>Dirinaria consimilis</i> (Stirt.) D.D.Awasthi	+	+	-	+	+	-	+	Corticolus	Foliose
2	<i>Dirinaria aegialia</i> (Afzel.ex Ach.)B.J.Moore	+	+	-	+	+	-	+	Corticolus	Foliose
3	<i>Sculptolumina serotina</i> (Malme) Marbach	-	-	-	-	+	-	-	Corticolus	Crustose
Physiaceae										
4	<i>Rhinodina sophodes</i> (Ach.)A.Massal.	-	+	+	-	+	-	-	Corticolus	Crustose
Lecanoraceae										
5	<i>Lecidella enteroleucella</i> (Nyl.)Hertel	-	-	-	-	+	-	-	Saxicolous	Crustose
6	<i>Lecanora tropica</i> Zahlbr.	+	+	-	+	+	-	+	Corticolus	Crustose
Parmeliaceae										
7	<i>Parmotrema praesorediosum</i> (Nyl.)Hale	+	+	+	+	+	-	+	Corticolus	Foliose
Pertusariaceae										
8	<i>Pertusaria cicaricosa</i> Mull.Arg.	+	+	+	+	+	-	+	Corticolus	Crustose
Teloschistaceae										
9	<i>Pyrenodesmia</i> sp.	-	-	-	-	+	-	-	Saxicolous	Crustose
10	<i>Caloplaca conciliascens</i> (Nyl.)Zahlbr.	-	-	-	-	+	+	-	Saxicolous	Crustose
11	<i>Caloplaca Cupulifera</i> (Vain.)Zahlbr.	-	-	-	-	+	+	-	Saxicolous	Crustose
12	<i>Oxneriopsis bassiae</i> (Ach.)	+	-	-	-	+	-	-	Corticolus	Crustose
Verrucariaceae										
13	<i>Staurothele fissa</i> (Taylor)Zwackh	-	-	-	-	+	-	-	Saxicolous	Crustose
Arthoniaceae										
14	<i>Herpothellon</i> sp.	-	+	-	-	-	-	-	Corticolus	Crustose
15	<i>Cryptothecia</i> sp.	-	-	-	-	-	+	+		
Peltulaceae										
16	<i>Peltula euploca</i> (Ach.)Poelt	-	-	-	-	+	-	-	Saxicolous	Crustose
Stereocaulaceae										

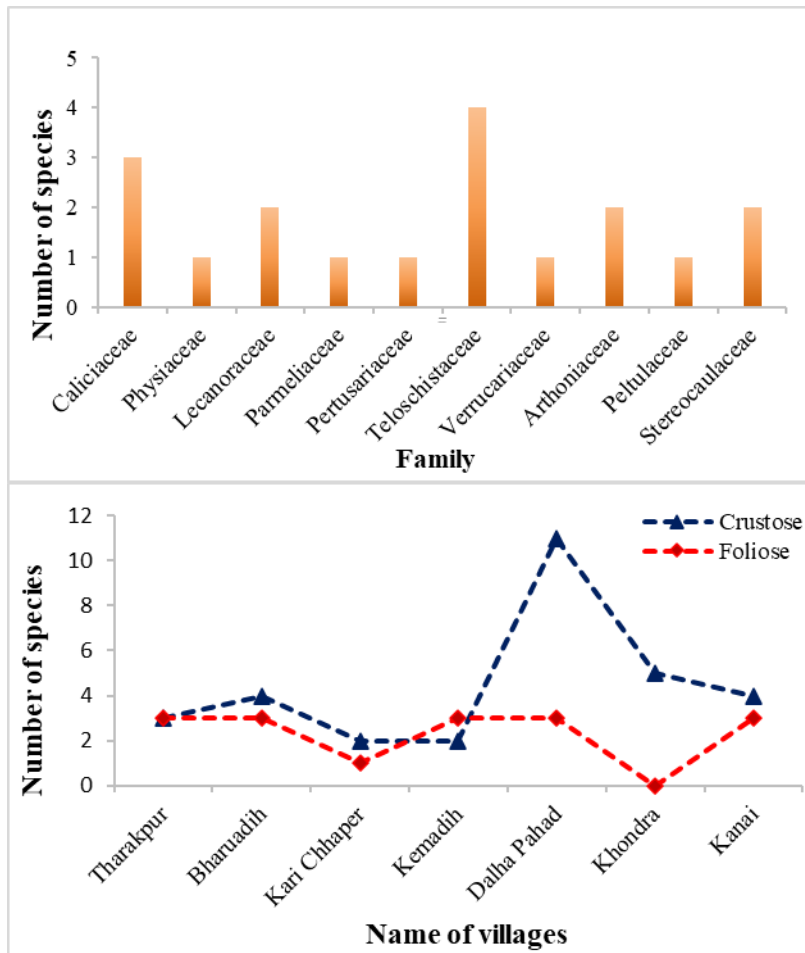
17	<i>Lepraria leuckertiana</i> (Zedda)L.Saag	-	-	-	-	-	+	-	Saxicolus	Crustose
18	<i>Lepraria lobificans</i> Nyl.	-	-	-	-	-	+	+	Corticolus	Crustose

TH- Tharakpur, BH- Bharuadih, **KR**- Karichhaper, KM- Kemadih, **DP**- Dalhapahad, **KH**- Khondra, **KN**- Kanai

Result and Discussion

Table 1 lists of the flora of Bilaspur district. The present study resulted the occurrence of 18 species of lichens belonging to 15genera and 10 families from the Bilaspur district Among different families **Caliciaceae, Pertusariaceae, Lecanoraceae and Parmeliaceae**, is the common and highly diverse family in the district. Both the tree and Rocks bears lichen but trees bear more as compare to rock almost similar numbers of lichens, represented by 7 saxicolous 11 corticolous species. The growth form of lichen of following species is dominant in bark viz. *Dirinaria consimlis* (Stirt.), *Dirinaria aegialia* (Afzel.ex Ach.)B.J.Moore, *Pertusaria cicaricosa* Mull.Arg., *Lecanora tropica* Zahlbr. *Parmotrema praesorediosum*(Nyl.)Hale, *Lepraria lobificans* Nyl. Other species of lichens viz. *Peltula euploca* (Ach.)Poelt, *Oxneriopsis bassiae*(Ach.) is found only the location that is Dalhapahad and Tharakpur respectly.The squamulose species such as *Peltula euploca* (Ach.)Poelt, *Lecidella enteroleucella*(Nyl)Hertel, *Lepraria leuckertiana* (Zedda)L.Saag, *Caloplaca conciliascens*(Nyl.) Zahlbr.and *Caloplaca Cupulifera* (Vain.)Zahlbr.exhibits luxurint growth on exposed rocks. .) *Herpothellon* sp. and *Cryptothecia* sp., *Pyrenodesmia* sp. found in setrile stage in respectly Bharuadih ,kanai, Khondra,and Dalhapahad sites. *Dirinaria aegialia* (Afzel.ex Ach.), *Lecanora tropica* Zahlbr. and *Parmotrema praesorediosum*(Nyl.)Hale,exhibits luxuriant growth in almost all sites .

Shorea robusta, *Lannea grandis*, *Madhuca longifolia*, *Diospyrous melanoxylon*, *Mangifera indica*, *Buchnanian lanzan* is best host tree species in all sites around NTPC Sipat Bilaspur Chhattisgarh. The present lichen distributional data of all localities Around NTPC Sipat Bilaspur will acts as a base line data for conducting future environmental studies in the area.



**Representation of Defferent lichen families
Lichens**

Growth form of

Conclusion

Lichen diversity assessments contribute to the development of effective conservation strategies in industrial areas. Identifying areas of high lichen diversity and species of conservation concern allows for the implementation of targeted conservation measures, such as habitat restoration, establishment of protected areas, and regulation of industrial activities to minimize ecological impacts. Industrial pollutants released into the environment can have adverse effects on human health. By monitoring lichen diversity and pollutant levels, scientists can assess potential risks to human health from exposure to air pollutants. This information can inform public health policies and interventions to protect human populations living in industrialized areas. Studying lichen diversity in industrial environments is crucial for understanding the ecological impacts of human

activities, assessing environmental health, guiding conservation efforts, and safeguarding both ecosystems and human well-being in industrialized regions.

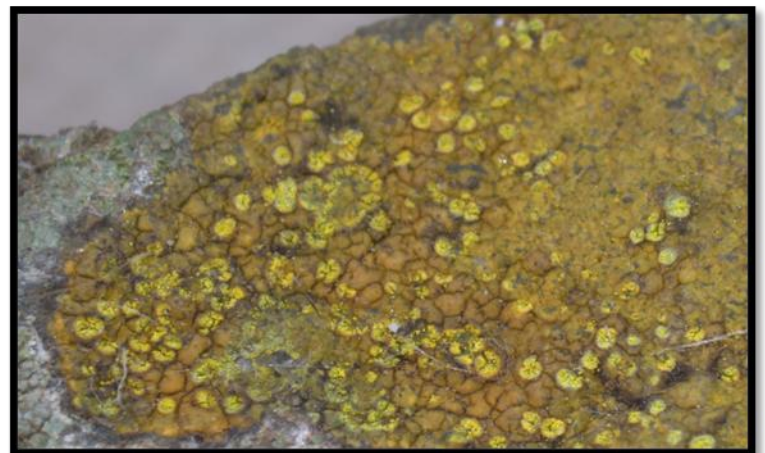
The current study demonstrates the diversity and richness of lichens in the Chhattisgarh state's around NTPC area. It featured a variety of flora types, In comparison to lowland and high elevation mountain peaks, the study found that as elevation increased from lowland to mountain peak, the total area also decreased. This resulted in the highest lichen species richness in terms of abundance, density, frequency, and distribution at mid elevation, where luxuriant growth of lichen species was observed. A baseline of the lichen diversity in Chhattisgarh provided by the enumeration of lichen species.

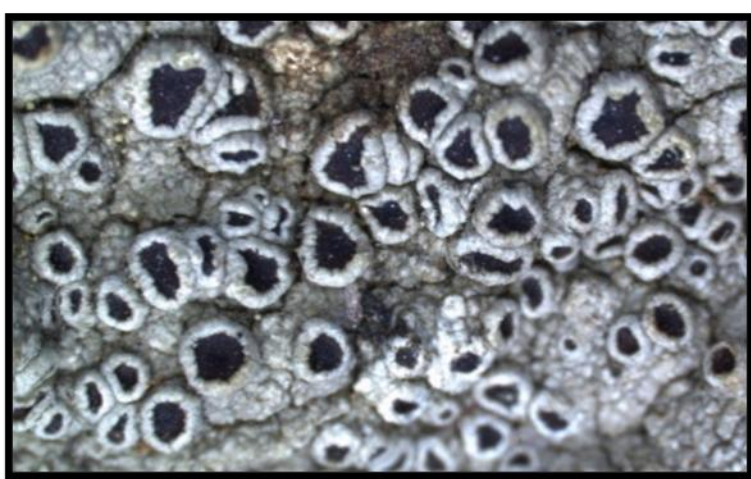
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Caloplaca conciliascens





Study of lichen habitat in the

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