

Ecological Role and Conservational Aspect of Lichenized Ascomycetes *Usnea sensu lato*, in Uttarakhand, India

Preeti Shukla^{*1, 2}, Dalip Kumar Upreti¹ and Lalit Mohan Tewari²

¹Lichenology Laboratory, Plant Diversity Systematics and Herbarium Division
CSIR- National Botanical Research Institute, Lucknow, U.P.- 226001, India.

²Department of Botany, DSB Campus, Kumaun University, Nainital, Uttarakhand-263001

Email:- pre.1988@gmail.com

Introduction

Uttarakhand is well known for its floral diversity similar to the other part of Himalayan regions. It has an estimated 4000 species of flowering plants, 63 species of gymnosperms and 560 species of lichens (Mishra and Upreti, 2015). The moist climatic conditions mostly above altitude of 1500 m of the forests in Uttarakhand favour the growth of *Usnea* species. At present, the state represents 28 species of *Usnea sensu lato*, out of which *Dolichousnea indica* Mot., *U. sordida* Mot. and *U. norketti* are endemic to the Himalayan region (Shukla *et al.*, 2014). The *Usnea* species are commercially used as spices, dyes, foods, in medicines and perfumes, as decorative etc. (Shah, 2013). Being bigger in shape and size, the local people collect the species of *Usnea* more frequently together with other lichens from forests areas and sold them to the local dealers. Trading of *Usnea* species along with other species of lichens such as *Everniastrum*, *Parmotrema*, *Heterodermia* and *Parmelia* is common in the foot-hills of Uttarakhand and has become source of living for many inhabitants (Upreti *et al.*, 2003). Besides destruction through commercial exploitation, deforestation, urbanization, air pollution and other anthropogenic activities together with climate change are also causing depletion of many lichens including *Usnea* species which are considered as one of the most pollution sensitive taxa of lichens.

Role of *Usnea* in Ecosystem

The species of *Usnea* can grow over wide range

of substrates and habitats including some of the most extreme conditions such ice covered regions of Antarctica. The species of *Usnea* preferably grow on bark of woody plants as epiphytes. Though *Usnea* exhibit no species specific association with plants on which they grow on but commonly Oak and coniferous trees together with *Betula*, *Rhododendron* and *Alnus* exhibit the maximum growth of *Usnea* species on their trunk and branches in higher altitudes of 2500-3500 m. In alpine regions which are mostly devoid of big trees, *Usnea* species grow luxuriantly on shrubs or even rocks. The species of *Usnea* play the following functional role in the forests ecosystems of the Uttarakhand:

1. Energy and nutrient recycling

Having both autotrophic and heterotrophic components in single thallus, *Usnea* produces its own food from sunlight, air, water and minerals present in the environments. The resulting role as of producers makes *Usnea* species as integral part of food chain in forest ecosystems. *Usnea* species are also important as food and fodder for organisms, like deers, sheep, goats, mice, bats etc. In higher Himalayan regions, the 'Musk deer' mostly feeds on *Usnea* species found fallen from trees due to heavy snow fall in winters. Thus *Usnea* plays its role in energy and nutrient cycling in the ecosystem. *Usnea* species having long threads also acts as nesting material for birds.

2. Rock Decomposition

In higher alpine regions, apart from higher plants and mosses, *Usnea* spp. can also be found





growing over bare rocks. The species of *Usnea* attach to the rock surface by a basal holdfast. The dissolution of respiratory CO₂ in water results in the production of carbonic acid which in turns supports the solubilisation of minerals of rocks (Zedda and Rambold, 2015). Although the holdfast of *Usnea* cannot cover much surface area of rock as other crustose lichens do, but the small contribution towards the mineral relocation through rock decomposition is noteworthy. Thus being first colonizer (Pioneer species) of inhabited rock, the saxicolous species of *Usnea* are also important for ecological succession.

3. Enrichment of Soil

In temperate regions of Uttarakhand, the forest floor under Oak forest exhibit large number of species of foliose lichens such as *Everniastrum*, *Cetralia*, *Parmelia*, *Parmelaria*, *Parmotrema*, *Ramalina* together with *Usnea* species which contribute up to the large extent of biomass. The biomass helps in improving soil texture by contributing nitrogen, carbon and other useful elements to soils.

4. Ecological indicator

Among the different growth forms of lichens, the fruticose lichens are considered as most sensitive to environmental changes and can be used to predict prevailing conditions of an area. The species of *Usnea* due to their higher sensitivity to environmental changes do not survive in areas with high level of atmospheric pollution and thus their absence or presence can be used to monitor the changes in the area. The *Usnea* species occurring on the canopy of trees also play crucial role in maintaining rainfall patterns in the forest.

Conservational aspects

The National Parks in Uttarakhand which cover about 13.8% area of the state are highly protected areas where human activity is totally banned. However, in Nanda Devi Biosphere Reserves and Govind Wildlife Sanctuary local communities are allowed to pursue traditional activities. Such protected areas are engaged in conservation and recreation of damaged forests ecosystems in

Uttarakhand for preservation of biodiversity. Once the forests of an area are conserved, the lichens are automatically conserved in the ecosystem. Upreti (2008) discussed the requirement to develop lichen gardens and sanctuaries in lichen-rich areas of the country. Such practices can replenish species in already exploited areas and lead to their conservation. Apart from forest conservation, the sites where lichens grow should be planted with the natural forests tree species (Divakar and Upreti, 2005).

For conservation of *Usnea* species in forests it is necessary to create awareness among the natives to protect species. Community participation is necessary for effective planning, monitoring and management of conservational programmes. Short term training programmes regarding conservation of nature and lichen flora should be conducted regularly in schools and colleges along with local voluntary organizations.

The botanical gardens and herbarias located in India are reservoirs created for *ex-situ* conservation of plants including lichens. The *ex-situ* methods for conservation of *Usnea* species involves tissue-culture and regeneration of lichen tissues in laboratory conditions. Many reports of successful regeneration of tissues of *Usnea* species have been published (Behera, 2009).

Apart from tissue culture, the deposition of genomic sequences of *Usnea* species in genomic libraries could be one of the methods of their conservation. Unfortunately, the genomic sequences of *Usnea* species from Uttarakhand are not available yet but they can be made available in near future.

Acknowledgements

Authors are thankful to the Director, CSIR-National Botanical Research Institute, Lucknow and authorities of the Department of Botany, Kumaun University, Nainital, for providing necessary laboratory facilities to work

Authors are also thankful to SAC, Indian Space Research Organization (ISRO), Ahmadabad, for financial support.



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Let us be good stewards of the Earth we inherited. All of us have to share the Earth's fragile ecosystems and precious resources, and each of us has a role to play in preserving them. If we are to go on living together on this Earth, we must all be responsible for it.

– Kofi Annan

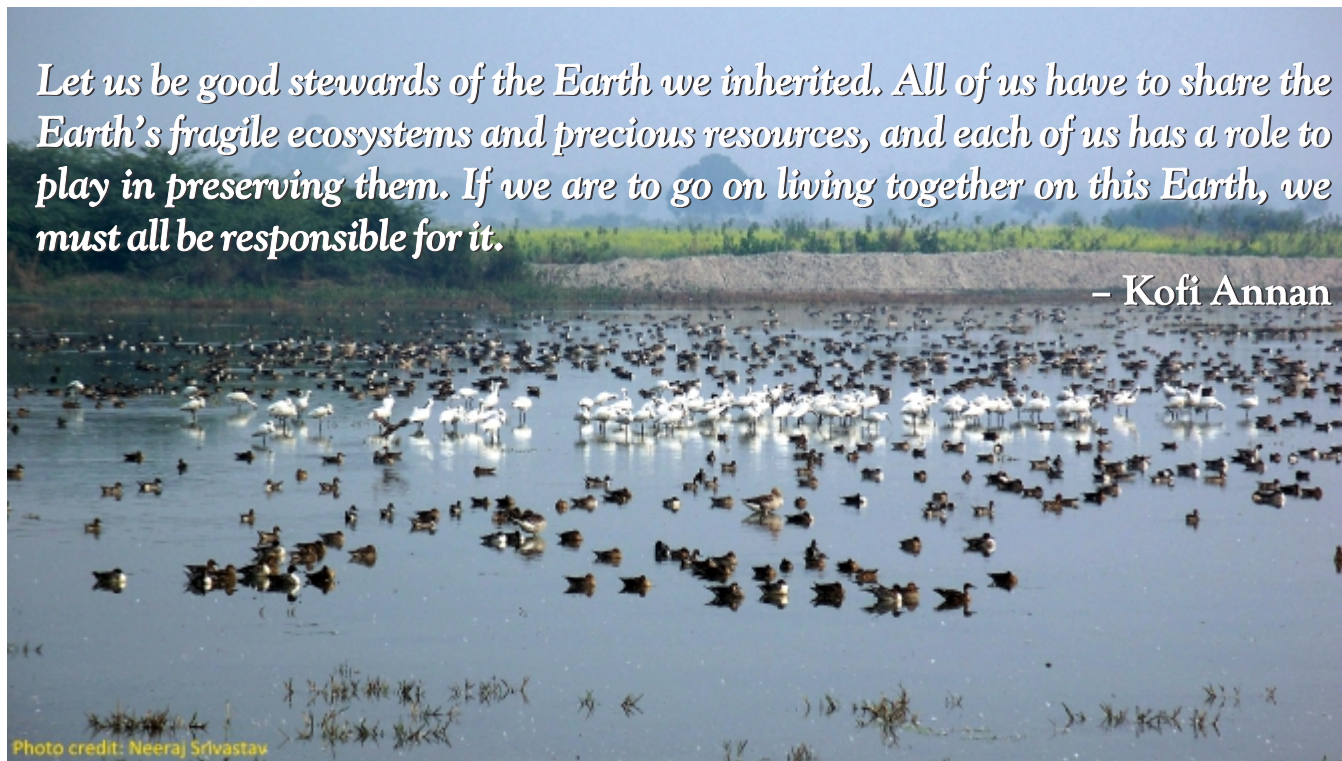


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