Himanshu Rai
Dalip K. Upreti *Editors*

Terricolous Lichens in India

Volume 1: Diversity Patterns and Distribution Ecology

Springer

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Cladonia subradiata taken at 3,170 m, at Gangotri town, in Uttarkashi district of Uttarakhand, India on 28 Oct 2010. The sample is preserved in the CSIR-NBRI herbarium with collection No: 10-0014526 (LWG), by Himanshu Rai and Pramod Nag, using Fujifilm FinePix S5800 S800 camera.

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Editors
Dr. Himanshu Rai
National Botanical Research Institute
Council for Scientific and Industrial Research
Lucknow
Uttar Pradesh
India

Dr. Dalip K. Upreti
National Botanical Research Institute
Council for Scientific and Industrial Research
Lucknow
Uttar Pradesh
India

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Preface

An organism occurs in a characteristic, limited range of habitats and within this range they are found to be most abundant indicating their specific environmental optimum (Körner 2003). The distribution of organisms is strongly influenced by factors such as elevation, precipitation, moisture, temperature, and nutrients in the substratum (Huang 2010). In last 50 years though considerable attention has been accorded in documenting the taxonomic diversity of lichens in India, investigations of their community ecology have only recently begun, and those so far undertaken, except some instances (Rai et al. 2011, 2012) have not explored the distribution ecology of terricolous lichens as a functional group (Negi 2000; Negi and Upreti 2000; Pinokiyo et al. 2008). With increase in understanding on soil crust lichens, their functional role in maintenance of physical stability, hydrology, and nutrient pool of soil crust is well recognized worldwide (Elbert et al. 2012). The investigations on Indian terricolous lichens were initiated at lichenology laboratory of CSIR-National Botanical Research Institute (NBRI), as an assessment of their diversity in Western Himalaya and their role in soil stabilization in alpine habitats (Rai 2012). The study revealed a substantial diversity of terricolous lichens and found that soil lichens play a very crucial role in the stabilization of soil crust, soil respiration, amelioration of soil temperature, and growth of soil microflora. In the course of study, various patterns and factors of terricolous lichen diversity were observed and the need for a publication dealing with these aspects was realized, leading to conceptualization of this volume.

The Vol. 1 of *Terricolous Lichens in India*, in five chapters discusses lichenology in India with special reference to terricolous lichens (Chap. 1); comparative assessment of biological soil crusts (BSC) development in India with global patterns (Chap. 2); altitudinal patterns of soil crust lichens in India using generalized additive models (*GAM*; Chap. 3); role of novel molecular clades of *Asterochloris* in geographical distribution patterns of *Cladonia*—a dominant soil crust lichen (Chap. 4) and photobiont diversity of soil lichens along substrate ecology and altitudinal gradients in Himalayas (Chap. 5). The volume enumerates various patterns and factors of terricolous lichen diversity in India, as a prelude to Vol. 2 which deals with the taxonomy of Indian soil crust lichens. The book should be of interest to the specialists and also intends to generate interest among ecologists, biologists, natu-

ralists, teachers, students, protected area managers, policy makers, and conservation agencies. We hope that this book will widen the overall understanding of Indian lichens and specifically the terricolous lichens, both for native as well as international workers and would serve as foundation of many more taxonomic as well as applied researches in Indian lichens.

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Contents

Contributors

Voytsekhovich Anna Department of Lichenology and Bryology, M.H. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, Kyiv, Ukraine

Chitra Bahadur Baniya Central Department of Botany, Tribhuvan University, Kirtipur, Kathmandu, Nepal

Roshni Khare Lichenology laboratory, Plant Diversity, Systematics and Herbarium Division, CSIR-National Botanical Research Institute, Lucknow, Uttar Pradesh, INDIA

Dymytrova Lyudmyla Department of Lichenology and Bryology, M.H. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, Kyiv, Ukraine

Ondřej Peksa The West Bohemian Museum in Pilsen, Plzeň, Czech Republic

Himanshu Rai Lichenology laboratory, Plant Diversity, Systematics and Herbarium Division, CSIR-National Botanical Research Institute, Lucknow, Uttar Pradesh, INDIA

Tereza Řídká Department of Botany, Faculty of Science, Charles University, Prague, Czech Republic

Roger Rosentreter Idaho Bureau of Land Management, Boise, ID, USA

Pavel Škaloud Department of Botany, Faculty of Science, Charles University, Prague, Czech Republic

Dalip Kumar Upreti Lichenology laboratory, Plant Diversity, Systematics and Herbarium Division, CSIR-National Botanical Research Institute, Lucknow, Uttar Pradesh, INDIA

Chapter 1
Lichenological Studies in India with Reference to Terricolous Lichens

Himanshu Rai, Roshni Khare and Dalip Kumar Upreti

1 Introduction

Lichens, a mutualistic association of a dominant fungus (mycobiont) and a green (phycobiont) and/or blue-green algae (cyanobiont), are by far known as one of the most successful symbionts in nature (Galloway 1992). At times, strictly regarded as an ecological instead of a systematic group, lichens have developed a specialized mode of nutrition, where an algal/blue-green algal partner is the sole source of carbohydrate for the fugal partner, which envelops their photosynthetic partner forming a discreet thallus (Hawksworth 1988). Thus lichen thallus is a relatively stable and well-balanced symbiotic system with both heterotrophic and autotrophic components and can be aptly regarded as a self-contained miniature ecosystem (Farrar 1976; Seaward 1988). About one-fifth of all known extant fungal species form obligate mutualistic symbiotic associations with green algae and/or cyanobacteria. Presently, the consensus of known lichenized taxa amounts to 13,500 (Hawksworth et al. 1983; Hawksworth and Hill 1984; Hawksworth 1991) revised from the earlier estimates of between 15,000 and 20,000 (Galloway 1992), constituting about 23 genera of green and 15 genera of blue-green algae (Purvis 2000).

Of all known lichenized fungi, 98 % are ascomycetes, 1.6 % deuteromycetes, and 0.4 % basidiomycetes (Honegger 2008). Nearly 40 genera of algae and cyanobacteria have been reported as photobionts in lichens (Tschermak-Woess 1988; Büdel 1992; Friedl and Büdel 2008; Honegger 2009). About 85 % of lichen-forming fungi associate with green algae (often referred to as chlorolichens; Ahmadjian 1993), about 10 % with cyanobacteria (cyanolichens; Ahmadjian 1993), and about 4 %,

H. Rai (✉) · R. Khare · D. K. Upreti
Lichenology laboratory, Plant Diversity, Systematics and Herbarium Division
CSIR-National Botanical Research Institute,
Rana Pratap Marg, Lucknow
Uttar Pradesh-226001, INDIA
e-mail: himanshurai08@yahoo.com

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