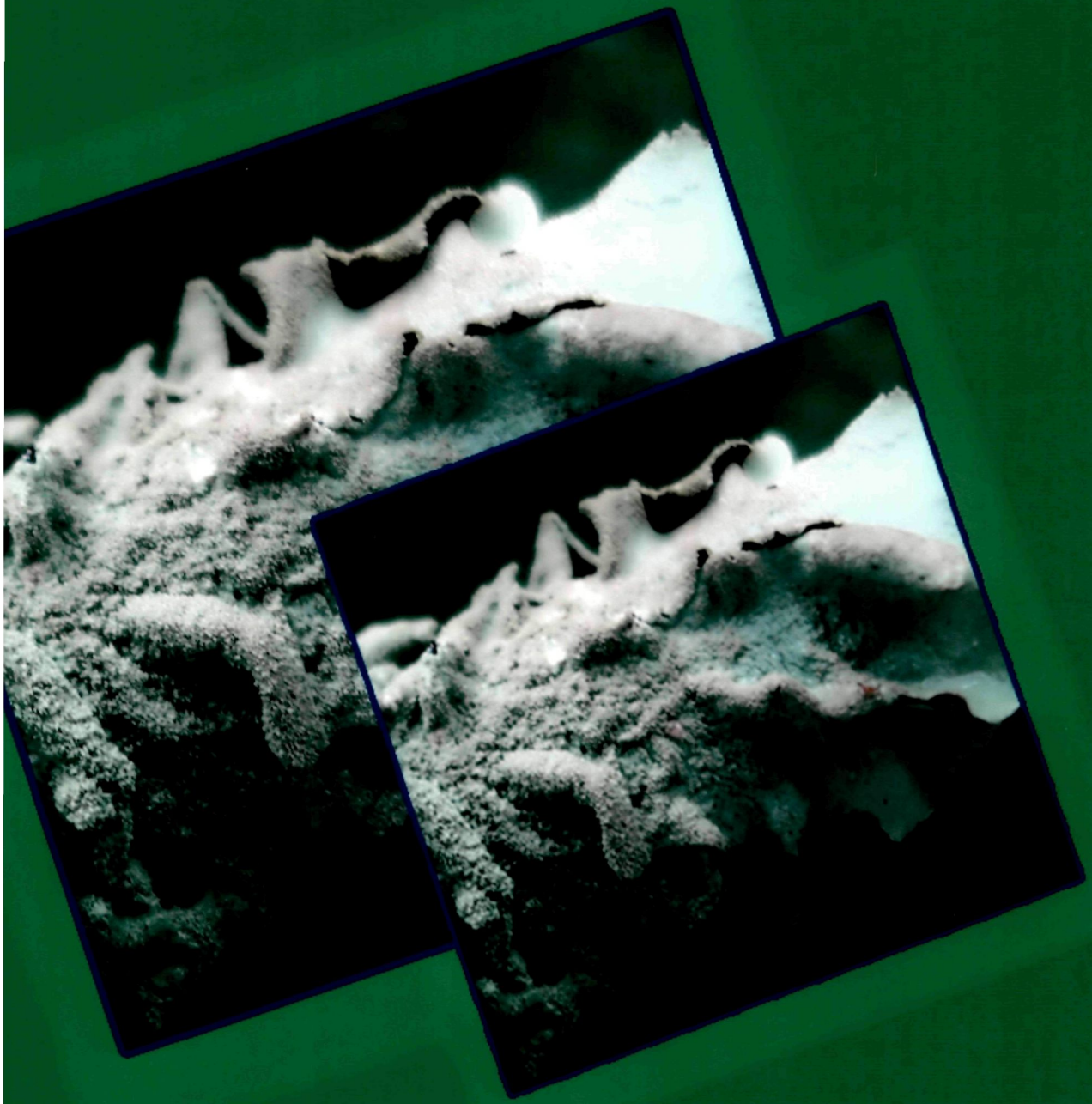
Chapter- I

General Introduction



Parmotrema sp.

Chapter - 1

GENERAL INTRODCTION : LICHENS

India's plant resources are well known with rich diversity distributed in different ecological habitats. These plant resources has tremendous value as they are used in diverse applications like food, feed, medicines, industrially important products obtained from higher plants, microorganisms, mosses, lichens and other plant communities. Lichens form an important floral community playing a major role in ecological indication and succession.

1.1. Lichen

Lichens are the complex organisms involve a symbiotic relationship between phycobionts and a mycobionts and have attracted considerable attention because they perceived position in the ladder of evolution to land plants. The fungal component is called the mycobiont and the algal component is known as phycobiont. The fungal partner usually as Ascomycetes and sometimes Basidiomycetes. The fungal element lives up to the food elaborated by algae, while the alga element gets its minerals and moisture from fungus. They are universal in distribution and grow at an average rate of 1-5 mm per annum. Lichens are often observed as the most significant bioindicators. Lichens are found in different forms and colours like white, orange, green, yellow, grayish green etc. Lichens have traditionally been referred to as a prime example of a symbiotic relationship.

There is physiological and ultra structural evidence that suggests the fungus parasitizes the algae in a controlled fashion and in some instances actually destroys the

algal cells. They range in size from minute type to large and conspicuous forms and by their appearance; they can be grouped into categories like micro and macrolichens. In macrolichens, it is classified into fructicose, foliose and squamolose. They are characterized by a variety of vegetative structures and are unique products of composite thallus. Many of them serve as vegetative diaspores while some are presumed to have physiological functions. The vegetative propagules are *soredia, isidia, cephalodia, pycnidia* etc. The Basidiomycete lichens produce basidiocarp as their fruiting body while ascomycete basically produces three types of ascocarps like unorganized ascocarp, *apothecium* and *perithecium*. Anatomically, lichens are divided into two different zones- fungal zone and algal zone. Fungal zone is further differentiated into cortex and medulla. Algae are sandwiched between cortical and medullary region.

1.2. Lichen Diversity and Distribution

There are about 20,000 species of lichens known and they are capable of living in environmental conditions that kill most other forms of life (Negi, 2000). Taxonomical studies of biodiversity depend upon biogeography of bioresources. Without insights into biogeographical patterns we cannot fully understand the evolution of species and without some knowledge of what grows where. The problem of biogeographical analysis is particularly severe in lichenology. Poorly understood morphologies, indistinct taxonomic circumscriptions and a messy nomenclatural history have hindered our understanding of lichen diversity. Distributional trends among lichen species have long been a problem. Life cycles are only presumed not known. Narrow endemism, curiously restricted geographical distributions and outlandish claims of enormous disjunctions are rarely

examined. Too little attention has been paid to the incomplete taxonomy of lichens. Too few workers have devoted their careers to lichenology.

Pertains to the analysis of the lichen diversity it is extremely important to make a thorough survey, characterization and monitoring of all bioresources at the local level. These are the fundamental requirements for a conservation programme. For that, a systematic understanding of the patterns of diversity, distribution, abundance and species richness of different communities over the rapidly changing ecological conditions is required (Upreti, 1996; Sequiera and Kumar, 2008).

1.3. Lichen Diversity in India

India is a rich centre of lichen diversity, contributing nearly 15% of the 13,500 species of lichens so far recorded in the world (Upreti 1998). India is one of the 12 megadiversity countries in the world, with a potential of supporting as many as 500,000 species of sexually reproducing organisms, of which only about 27 per cent have been so far described. The number of described species from India includes 17,500 species of flowering plants, 2021 species of lichens (Negi, 2000). However, in terms of species-area ratio, India would harbor only 2200 species of lichens, commensurate with its 2.2 per cent land area of the world. While Western Ghats, Western Himalaya and Eastern Himalaya, harboring 550 to 800 species, seem to be the rich centres of lichen diversity, Andaman and Nicobar islands emerge as a lichen 'hot spot', ranking first in terms of endemic species with smallest area as compared to the rest of the lichenogeographic regions in the country.

1.4. Lichen Diversity in Western Ghats

There are 949 lichen taxa in Western Ghats belonging to 929 species, 20 varieties, 150 genera and 54 families, which is around 45 per cent of the total lichens in India. The crustose lichen dominates in Western Ghats represented by 618 taxa followed by foliose lichens and fruticose lichens, which are represented by 269 and 62 taxa respectively. The highest number of endemic lichens 253 species (26.7%) is present. Parmeliaceae representing 137 species belonging to 22 genera is the dominant family in the Western Ghats while *Graphis* is the dominant genus with 49 species. The Parmelioid, Graphidaceous, Physcioid and Thelotremataceous lichens with 137, 103, 90 and 72 species respectively also dominates the area. Tamil Nadu has the highest number of lichens with 657 taxa followed by Karnataka, Kerala and Maharashtra with 336, 288 and 91 taxa respectively (http://www.ces.iisc.ernet.in /biodiversity, 2000).

1.5. Ecological Importance of Lichen

Epiphytic lichens have been widely used as bioindicators of the effects of atmospheric pollutants and for changes in environmental conditions in temperate regions. Lichens are among the most valuable biomonitors of atmospheric pollution (Nimis *et al.*, 2002). Their use in tropical zones has been hampered by the lack of taxonomic knowledge of tropical lichens and the absence of data on environmental and pollution conditions. It is now becoming apparent that the fate of atmospheric pollutants in tropical monsoon climates with high rainfall in strongly contrasting seasons may be rather different to that in temperate climates. Forest degradation not only cause reduction in biodiversity but also leads to the change in the community composition (Kumar, 2003).

Climate is probably the most important determinant of vegetation patterns globally and has significant influence on the distribution, structure and ecology of forests. They explained the global assessment have shown that future climate change is likely to significantly impact forest ecosystem give an account on the vegetation impact assessment model and data sources (Ravindranath *et al.*, 2006). Increasing human population in the last few decades demanding development in various sphere has resulted directly or indirectly in sudden and often for reaching disturbances in natural ecosystem (Raizada, 1983).

1.6. Molecular Study on Lichens

Significantly less number of works has been carried out regarding to the molecular phylogeny of the lichens. Divakar *et al.* (2005) worked on Molecular phylogeny of Parmeloid lichens (Ascomycota, Parmeliaceae). They identified that the revised genus *Parmotrema* includes species that have an upper cortex consisting of a palisade plectenchyma or rarely paraplectenchyma with vaults, have a pored or fenestrated epicortex, lack pseudocyphellae, have or lack cilia, have laminal, perforate or eperforate apothecia, usually have simple rhizines and filiform, cylindrical, bacilliform or sublageniform conidia. It is closely related to Flavoparmelia but the status of these genera requires further investigation. Nineteen new combinations are made. Schmitt *et al.* (2003) carried out a Bayesian analysis of nuclear and mitochondrial sequences for the Phylogeny of the lichen genus *Placopsis* and its allies. The phylogenetic relationships of the lichen genus *Placopsis* and related genera in the Agyriales were analyzed using molecular data.

1.7. Utilization and Ethnobotany of Lichens

About 320 tons of lichens are annually utilized for different purpose in Nepal and adjoining regions of India (Moxham, 1986). Approximately 750 metric tons of lichens are brought in annually from Uttaranchal hill and 200 metric tons from other regions of India, including Himachal Pradesh, Sikkim and Assam of this about 50-80 metric tons are exported (Shah, 1997). A survey on lichen samples available in local markets of Maharashtra, Karnataka and Tamil Nadu found 11 species of lichens (Upreti *et al.*, 2005). The utility of lichens is due of range of secondary compounds produced by them (Boustie and Grube, 2005).

India is rich in both ethnic and bio diversity; it offers immense scope for ethno-botanical studies (Lal and Upreti, 1995). Badola and Aitken (2003) reported that in India various communities use over 50 percent of the plant species of any ecosystem in ethno medicine and in general over 7500 species are utilized in primary health care by various tribes. Llano (1956) worked on ethnobotanical uses of some lichens from arctic and subarctic regions of the word. A few reports are available in India on ethno-lichenological uses of lichens (Saklani and Upreti, 1992; Lal and Upreti, 1995; Upreti, 1996). A wide range of secondary metabolites of lichens were characterized. The lichens have around 700 secondary metabolites, of which 550 are unique Most of these secondary metabolites have antibiotic properties and the much-exploited one is the usnic acid. Among the 949 lichen taxa of Western Ghats 23 species that have well documented ethnic or commercial utilization (Upreti *et al.*, 2005).

1.8. Threats to Lichen Conservation

The factors responsible for loss of lichen diversity in India include the change in the ecological conditions, forest cover, loss of habitat and increase of the urban and industrial areas. The anthropogenic activities in hilly regions such as 'Jhoom' cultivation, agriculture, mineral extraction, tourism, hydroelectric and road building projects are leading to the rapid deterioration of lichen rich habitats. Over exploitation and selective removal of economically important lichens by local people pose serious threat to the lichens in India (Upreti, 1995).

1.9. Relevance of the Present Study

The Western Ghats of India popularly known as 'Sahyadris' is an unbroken chain of hills with a length stretched about 1,600 km^2. It extends through the states of Maharashtra, Karnataka, Kerala and Tamil Nadu running parallel to the Western coast of peninsular India in the north-south direction. The elevation of the Western Ghats varies from 100m to 2695m msl with an average 140 km width. Central Western Ghats region of Karnataka comprises of various types of forest and Shola patches. In relation with altitude and physical proximity to the equator, climatic conditions vary in the Western Ghats from tropical to sub-tropical type. The climate is warm and humid during most months in a year. It receives most of the precipitation during southwest monsoons (June-September) due to obstruction to monsoon winds by high elevations of the Western Ghats. The clouds filled with super humid air during the southwest monsoon are carried from the Arabian Sea and poured on the western slopes of the Western Ghats, resulting in heavy rainfall on the windward side. This has marked influence on the vegetation pattern of the Western Ghats.

The Central Western Ghats cover the western and eastern slopes of Karnataka are selected for the present study. This area is called 'Malnad' region (Malnad means Male = hill and Nadu = land). The area spread across five districts viz., Shimoga, Chickmagalur, Hassan, Coorg and Uttarkannada. The malnad area in Karnataka is constituted by westward and eastward flowing rivers where beautiful peaks, valleys, gorgeous waterfalls, lush green fields, vegetation are important landscapes.

The level of endemism is high and the region is considered as one of the 8 hotspots (Myers *et al.*, 2000). Apart from biodiversity, the Western Ghats possesses high level of cultural diversity as many indigenous people inhabit in these forests. The deforestation rate is high. Forests are being transformed into agriculture and monoculture plantations. Hydroelectric projects, mining and extraction of forest products are also enhancing the changes in landscape of the Western Ghats (Menon and Bawa, 1997).

In Western Ghats region, most of the survey and collection of lichens have been made from Nilgiri and Palni hills. The mangrove vegetation has richer follicolous lichens and till today only 39 species of them are recorded from Western Ghats. An addition of minimum 200 species can be expected if thorough exploration of lichens is carried out in the Western Ghats (http://www.ces.iisc.ernet.in/biodiversity, 2000). Bio prospecting of lichen wealth is another interesting aspect to be attempted in the Western Ghats. It has become a necessity to create awareness among common people, forest officials and authorities regarding the importance of lichens and the actions to be taken to conserve their diversity now.

In Western Ghats there still remain a number of interesting protected areas and special habitats which are unexplored. Most of the collections earlier made from the Western Ghats were cursory. With this background we have made an inventory of lichens in this area.

AIMS AND OBJECTIVES

1.10. Aims and Objectives

Lichens are one of the most diversified organisms in the world. Understanding of community pattern is essential for understanding the functioning of ecosystem and sustainable use of bioresources. These tropical forests are under pressure of deforestation and habitat loss. Lichen diversity of Chikmagalur, Hassan and Shimoga districts of Western Ghats regions has not been catalogued. The lichen species occur in the area has to be catalogued for their economical and ecological benefits. In this direction the present research has been carried out based on the following objectives:

1. to prepare an inventory of macrolichens in central Western Ghats parts of Karnataka
2. to study the distribution patterns of macrolichens in various localities
3. to study the substrate ecology and host specificity of macrolichens
4. to study the ethnic / traditional usage of lichens in the study area and to assess the threats to the lichen community of the region and
5. to test the antimicrobial nature of some lichens against pathogenic fungi and bacteria.