CHAPTER I

Introduction
INTRODUCTION

The Indian region (8° – 30° N and 60° – 97.5° E) with its total area of 329 million hectare is indeed very rich in biological diversity. It is one of the world’s top twelve mega diversity countries, harbouring an estimated 500,000 out of 10 to 30 million species of living organisms, only 20% of which have so far been described (Gadgil and Meher Honji, 1990; Groombridge, 1992; Gadgil, 1994). India holds 7% of the flora and about 4,9000 species of plants have been catalogued so far. The main reason of remarkable diversity of life forms in a single country is the great diversity of ecosystems, which it has supported down the ages. Almost every major type of habitat is to be found here from areas of the coldest to the hottest climatic conditions, from the highest elevation down to
the sea level, India enjoys a wide range of topographical and climatological diversity. It is bestowed upon rich vegetation and diverse flora. Different plant groups including lichens exhibits their luxuriant growth in most of the phytogeographical regions of India.

The word ‘lichen’ has a Greek origin, which denotes the superficial growth on the bark of olive trees. Theophrastus, the father of Botany, introduced the term ‘Lichen’ and this group of plants to the world.

Lichen is a combination of two organisms, an alga and a fungus, living together in symbiotic association. The algal component in the lichen is called phycobiont or photobiont while fungus as mycobiont. The phycobiont and the mycobiont loose their original identity during the association and the resulting entity (lichen) behave as a single organism, both morphologically and physiologically. Hence the lichen is called as a composite organism. In lichen thallus (body) the mycobiont predominates with 90 % of the thallus volume and provides shape, structure and colour to the lichen with partial contribution from the algae. Whatever is visible from outside in a lichen thallus is the fungal part, which holds algal cell within. Hence the lichens are placed within kingdom Mycota (Fungi). The fungi present in lichen are called as lichenized fungi. Among the 20,000 lichen species known in the world 95% belongs to the Ascomycetes group of fungi while Basidiomycetes and Deuteromycetes groups are represented by only 3% and 2% of species respectively.

Lichen can grow in diverse climatic conditions and on diverse substrates. The lichens that which are growing on tree trunk and bark are called corticolous lichens, twig inhabiting ones are ramicolous, on wood – lignicolous, on rocks and boulders- saxicolous (epilithic), on moss muscicolous, on soil- terricolous and on evergreen leaves- folicolous (epiphyllous). The lichens growing on other plants are called epiphytic. Lichens can grow on under water rocks, but not freely in water or on ice. They are widely distributed in
almost all the phytogeographical regions of the world. Requisite moisture, light and altitudes, unpolluted air and undisturbed perennial substratum often favours growth and abundance of lichens.

Based on the growth forms the lichens can be grouped into three main categories (Fig. 1):

1. **Crustose lichens:** The thallus in crustose lichen is closely attached to substratum without leaving any free margin. The thallus usually lacks lower cortex and rhizines (root like structure).

2. **Foliosc lichens:** They are also called as leafy lichens. The thallus in this case is loosely attached to the substratum at least at the margin.

3. **Fruticose lichens:** The thallus in fruticose lichens is attached to the substratum at one part and the remaining major portion is either growing erect or hanging. Lichen usually appears as small shrub on bark.

Besides the three major growth forms some intermediate forms of thallus are leprose, placodioid, squamulose and dimorphic forms of lichens. The leprose lichens form powdery mass on the substratum. The squamulose lichens are crustose in the central part and lobate on margins. The dimorphic lichen comprises two types, a primary thallus of squamules and the secondary thallus is an erect podetia or pseudopodetia. The crustose, few placodioid and squamulose lichens are generally called microlichens, because of their smaller size and require microscopic studies to identify. The foliose, dimorphic and fruticose on the other hand are called as macrolichens. The macrolichens have comparatively larger thallus. A hand lens, dissection or stereozoom microscope is sufficient to use them.

The crustose, foliose, placodioid, squamulose and sometimes dimorphic forms of lichens usually grows in a circular or centripetal manner. The rough and uneven shapes of
Fig. 1: Lichen growth form types. a=algal layer; ax=axis; l=lower cortex; m=medulla; r=rhizine; s=substrate; ts=transverse section; u=upper cortex; Source: Hawksworth 1976.
the substratum may change the shapes of the lichen colony. The leprose lichens form irregular patches of thallus on the substratum. The fruticose lichens of smaller size usually grow erect while larger ones hang from the substrate with their growing point located at the tips.

The non-lichenized fungi, algae, mosses, liverworts are the plants, which grow on rocks, bark and on soil and can be confused for lichens at least to the beginners. However, lichens can easily be differentiated from these plants in the field. The lichens are never as green as algae, liverworts or mosses. Foliose lichens in the moist places or in wet condition may look greener, and have thick, leathery thallus while liverworts have non-leathery and shiny thallus. The dimorphic form of lichens such as *Cladonia* may easily be confuse with the leafy liverworts and mosses. However, leafy liverworts and mosses have dense small leaf like structures throughout the central axis of the plant while in case of dimorphic lichens the squamules of semicircular shape usually present at the base of the central axis or sparse throughout. Algal mat are usually found in water flooded habitat and shiny. The beginners may confuse the dried mat on rocks and bark for lichens. By spraying some water on these mats one can make out whether it is algal mat or lichen.

The non-lichenized fungi are the most confusing one with crustose lichens in the field. Such fungus usually form patches with loosely woven hyphae, which will be evident under hand lens. The lichens on the other hand form smooth and circular patches. The fungi are usually whitish in colour and lichens are grayish, off white, yellowish, yellowish green or sometimes bright yellow or yellow orange in colour. The lichen thallus usually bears button or cup like structures called apothecia, or bulged, globular or immersed pitches like structures called perithecia as sexual reproductive organs. The finger like projections called isidia or granular, powder like structure called soredia is common vegetative organs. Some crustose lichens belonging to family Graphidaceae bear
worm like structures, the modified apothecia, called as lirellate apothecia. While collecting lichens it is necessary to look for such structures with the help of hand lens. When a lichen thallus does not have any such structures makes it difficult to differentiate from fungus.

Lichens are extremely sensitive to environmental stress, especially concerning atmospheric pollution, eutrophication and climate change. The absence of cuticular membrane and root system together with spongy nature of thallus, slow growth rate, dependence on atmospheric depositions for mineral nutrient, long life and non shedding organ parts are characteristic features of the lichens for their extreme sensitivity to environmental stress.

The climate i.e. condition of a particular area plays vital role for habitat diversity of lichens. The availability of water, sunlight, moderate cold climate, unpolluted atmosphere, wind currents and absence of biotic interference together with nature and type of substratum are additional factors responsible for diversity in habitat of lichens.

Areas having frequent rain has luxuriant growth of lichens as the metabolic activities are dependent mainly on moisture content in the thallus. In the absence of rain, dew and humid atmosphere can partially fulfill the moisture requirements. Different types of taxa grow or suitably adapted to the availability of water. Moist tropical region having frequent rain is suitable for member of Pyrenocarpous and Graphidaceous lichens. Semi moist tropical area has seasonal rains and provides favorable condition for member of Lichinaceae which retain moisture for longer while temperate regions, where the rain are intermittent; the foliose and fruticose lichens grow luxuriantly. The cold deserts and hot deserts have scares or no rains, exhibits poor growth of few crustose and squamulose lichens on rocks and soil. The different climatic factors which influence the lichen growth are:
**Sunlight:** Bright sunlight and high temperature has an inhibiting effect on lichen growth. Such lichens develop cortical pigments. The thallus of such lichens contains anthraquinones to protect the algal layer e.g. *Acarospora* and *Rhizocarpon* growing in exposed places in alpine cold deserts. Majority of lichens occur in intermediate situation of moderate exposure between the two extremes.

**Temperature:** The most suitable temperature for lichen growth is 20-25°C, therefore the lichen growth and their variety, particularly of macrolichens is more in temperate regions of the world.

Many lichens are able to withstand high temperatures of the tropics with high rainfall. These lichens are mostly corticolous (growing on trees). Many lichens can tolerate very low temperature in high altitudes in the Arctic and Antarctic regions as their thallus structure is well adapted for such climate.

**Wind:** In areas of high wind currents the crustose lichens exhibit their dominance. The *Usnea* and *Ramalina* lichens have cushion like or bush like growth which help them to withstand the strong wind currents.

**Substratum:** The lichens need a certain period of time for the establishment of the thallus on a substratum. It is essential that the substratum remains undisturbed for that period. Freshly cut soil profiles, recently broken surface of rocks, trees with periodic exfoliation of bark are usually devoid of lichens.

The texture, water relation and chemistry of the substratum also play an important role in the type of lichen vegetation. On the basis of the substrata on which lichen grows they are often referred to as terricolous – on soil; saxicolous- on rock, stone, boulders; lignicolous- on dead wood; corticolous- on bark of trees; foliicolous- on leaves; muscicolous- on mosses; humicolous- on humus; calcicolous- on lime or cement plaster; omnicolous- on different kind of substrates.
The chemical composition of soil is also play important role for the type of lichens that grow on it. The saxicolous lichens exhibit diversity of the habitat due to the influence of the chemical composition and physical texture of rocks and boulders. The quartzite rocks have few lichens on them due to their hardness and smoothness. *Caloplaca* only prefers to grow on such rocks. Lichen genera *Endocarpon*, *Lecanora*, *Peltula* and *Staurothele* prefers lime containing rocks while majority of saxicolous lichens grow on granite and allied rocks.

The bark with rich nutrient is known as eutrophiated and the bark with less nutrients and low pH is known as non-eutrophiated. Usually some species of *Arthonia*, *Bacidia*, *Graphis* and *Lecanora* requires a non eutrophiated bark while *Caloplaca*, *Phyllospora*, *Phaeophyscia* and *Physcia* requires a eutrophiated bark.

The foliicolous lichen needs a perennial leaf for their growth. The ferns, broad leaved trees and shrubs growing in shady or subshady situations in tropical, subtropical regions with frequent and sufficient rainfall support a luxuriant growth of foliicolous lichens. The most common genera are *Strigula*, *Psora* and *Fellhanera*.

The air pollution and dry atmospheric conditions are responsible for the disappearance of lichens in urban areas. The calcicolous lichens growing on cement plaster of buildings are pollution tolerant and overcome both the adverse conditions of urbanized areas. The calcicolous lichens being alkaline in nature have an inbuilt protection from SO₂ pollution (acidic gas) hence such habitat exhibit a dominance of pollution tolerant species of *Arthopyrenia*, *Bacidina*, *Endocarpon*, *Phylliscum* and *Peltula* on the lime / cement plaster of buildings.

About 43 genera of photobionts are associated as a primary or secondary constituent of lichen taxa. Out of these 14 genera of cyanobacteria, 27 of Chlorophyceae
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(green algae), one genus each of Xanthopyceae (yellow-green algae) and Phaeophyceae (brown algae) are known.

The unicellular and colonial cyanobacteria in some lichen genera are *Anacystis* in *Peltula*, *Chroococcus* in *Phylliscum*, *Gloeocapsa* in *Heppia* while the filamentous cyanobacteria are *Calothrix* in *Lichina*, *Nostoc* in the members of lichen family Collemataceae and Peltigeraceae, *Scytonema* in *Coccocarpia* and *Stigonema* in *Huellia*.

The unicellular Chlorophyceae in lichens are *Chlorella* in *Micarea*, *Pseudocyphellaria*, *Coccomyxa* in *Baeomyces* and *Peltigera*, *Trebouxia* in *Graphis*, *Lecanora*, *Stereocaulon*, *Ramalina* and *Xanthoria*. The most common filamentous Chlorophyceae in lichens are *Trentepohlia* and *Phycopeltis*.

More than 90% of the lichen thallus consists of fungus (mycobiont) hyphae. The hyphae are septate, branched, thin or thick walled and the walls are colourless or variously coloured. The majority of lichen taxa, over 95% the mycobiont belong to the Ascomycetes class while 5% belongs to Basidiomycetes and Deuteromycetes.

The vast topographical and climatic diversity of India has endowed it with a rich lichen flora, both in luxuriance and species diversity. Inspite of constant endeavour in exploration and survey during the last five decades the knowledge about lichens remains incomplete. Vast areas of the country are still unexplored lichenologically (Awasthi, 1983). Even many floristically rich areas like the North- Eastern India, considered to be the “Botanical Eden” (Balakrishnan, 1981, 1983; Haridarsan & Rao, 1985-1987; Jamir and Rao, 1988; Joseph, 1982 Karjilal etal, 1934-40; Kataki, 1986; Rao, A. S. 1974; Rao and Hazra, 1986) remain terra incognito from the lichenological point of view.

India is one of the twelve megadiversity centres of the world with two peculiar hot spots (Eastern Himalayas and Western Ghats) and the Himalayan region situated in the North eastern tip of India bounded by Myanmar on its east, Bhutan on the west, China on
the north and north east is Arunachal Pradesh. It lies between 26° 28' and 29° 30' N and 90° 30' and 97° 30' E extending over a geographical area of 83,743 sq km with a total forest cover of 57,540 sq km and protected area of 27,260 sq km (Chowdhry, 1999). Average rainfall is above 3000 mm per year. The vegetation has been broadly outlined in to five major types - tropical, sub-tropical, coniferous, temperate and alpine (Karl and Haridasan, 1987) which harbor a wide spectrum of floristic diversity (Fig. 2). The tropical and sub tropical types, occupying the lower elevations and foothill regions of the state, are the most disturbed and exploited mainly to meet the demand for agricultural land, timber, fuelwood, fodder and other commercially valuable non timber forest products (NTFPs) such as bamboos and canes (Shukla and Rao, 1993).

The whole state is an intricate labyrinth of precipitors, rocky and high hills and mountains, towering high on both sides of the river or streams. Hills are generally from 1000 to 10,000 feet high scattered throughout the state. There is luxuriant, though not very thick, growth of forest on these hills. Constant cutting of trees for the jhum cultivation does not allow the forests grow very thickly. Soil erosion and land slides are some of the characteristic features of the state leading to floods, blocking of tracks and endangering human and animal lives. The whole area is ecologically homogenous with negligible difference. The population is mainly concentrated in the valley of rivers. Population density is thinnest in the place with only 13 persons per sq km.

Due to heavy and continuous rains in most of the month of the year, luxuriant evergreen vegetation is most common. Thick jungles, with tall stout trees with long creepers around them, are to be found everywhere and in the lower areas there are bush jungles and shrubs in abundance. Bamboo and cane are available in plenty in almost all the jungles. Another cane like parasitic creeper used for making hats is also found in the lower areas. Though some hills are over 4,000 to 5,000 feet high, pine trees are not
Fig. 2: Vegetation type map of Arunachal Pradesh
available. With increase in altitude a lichen variation in the flora is to be seen. At higher altitude, thin bamboos in thick clusters are noticed. Various wild fruit trees – both sweet and citrus are also found, varying in kind and taste with altitude. Jackfruit tree are countless, while mango, guava and other fruits representing the vegetation of the plain areas, are few and for between. Oranges are in plenty in the central and the southeastern areas while lemons are rare. Rhododendrons and Orchids beautify the higher hills. Various other flowers with a variety of colour and fragrance adorn the countryside.

The fauna is typical of the cis- Himalayan regions. Tigers and panther are found in the lower jungle of the foothills. The high steep mountains are probably not suitable for their habitation. Elephants are found only in a few selected areas of foothills. Right from the western border, that is from Subansiri River, up to its eastern boundary across the Simen. There are only a few elements in the daring-Gensi jungles. Deers are in plenty and available in almost in the jungles. Inspite of regular hunting of deer, they have not been exterminated like the bears. Monkeys, squirrels and rats are found without number and are delicious items of the Gallong menu. Barking deer, otters, pheasant, jungle fowl and bats are also not uncommon. Pigeons and hornbills are in plenty. Snakes are numerous, but cases of snake bite are rare and those of consequent death are rarer still. Various other reptiles are also to be seen, of which the centipedes are important. Varieties of leeches – plain and striped are found, and it would not be unrewarding for a zoologist to come here for their study. After a few showers, they come out in millions, and then, as the people say, it is easy to count the number of grass blades but not the leeches. Greenish yellow tanyak and blackish tali flies swarm horribly in the villages. Rivers and streams are well stocked with fishes.

The richness of life forms in the flora and fauna that occur in these forests presents a panorama of biological diversity with over 5000 plants, about 85 terrestrial
mammals, over 500 birds and larger number of butterflies, insects and reptiles. Such an unparallel occurrence of life forms can be attributed to the peculiar location of the state which is at the function of the paleoarctic, Indo-Chinese and Indo-Malayan biogeographic regions, biotic elements from all these regions occur in the state making it very rich in floral and faunal resources.

Tropical forests

These forests occur up to an elevation of 900 metres above MSL in all the districts along the foothills. The forests can be further classified into two tropical evergreen forests and tropical semievergreen forests.

Tropical evergreen forests are dominated by *Altingia excelsa*, *Anthonothallus chinensis*, *Ficus drupacea* and *Premna bengalensis*, occurs in regular pattern adjoining the Assam border and along the river. Total area covered by these forests is about 158.7 sq km. Tropical semi-evergreen forest is confined to the heavy-rainfall tracts adjoining the Assam border and occupies a very limited area. It occurs in areas receiving 3000-6000 mm rainfall or having high humidity. Due to their accessibility, these are exposed to large-scale exploitation and destruction as a result of shifting cultivation. Common species occurring in this forest type are *Terminalia myriocarpa*, *Altingia excelsa* and *Albizia procera*. It covers 46.16 sq km of the total area of the district.

Subtropical forests

This type of forests occurs in districts between altitudes of 800 m to 1900 m. These are essentially evergreen and dense in nature. The tree attains large dimensions (25-40 μm high). The forests are rich in species diversity and dominated by fagaceae members. *Castanopsis indica*, *C. armata*, *Quercus lamellosa*, *Q. griffithi*, *Q. spicata*, *Q.
semiserrata, Q. fenestrata, Michelia oblonga, Manglietia insignis, Osodes paniculata, Ulmus lancifolium, Engathardia spicata, Ficus spp., Acer oblongum, Schima wallichi and S. khasiana are the dominated trees. Luxuriant growth of climbers, orchids and ferns occur in these forests.

Subtropical evergreen forest I

Spatially, the forest shows irregular pattern, small and fragmented patches at lower altitude, and accessible site, contiguous and large patches on the inaccessible and higher reaches. It has been noticed that this forest type has been subjected to more degradation. The dominant species are Saurauia roxburghii, Trevasia palmata and Quercus lemellosa. It covers 1886.24 sq km area of the district.

Subtropical evergreen forest II

The subtropical evergreen II class derived in this area has a great ecological implication. This type was found occurring at an altitude of above 1000 m up to 1600 m. It was observed mainly distributed along the riverbanks. Since some amount of open space exists, this patch of vegetation could receive some sunlight. This could have led to a special degree of microclimate, giving rise to variation in species composition. Common species are Altingia excelsa, Bischofia javanica, Lagerstroemia speciosa, Olea dioica, Terminalia myriocarpa, Shorea assamica and Mangifera sylvatica. Majority of these species were noticed to be deciduous in nature. This has thus imparted a distinct spectral response on the satellite imagery from among the surroundings. The species composition on ground was enumerated to confirm the class. These forest types covered 956.68 sq km of the district.
Pine forests

These forests extend both in the subtropical and temperate regions between the altitudes of 1000m to 1800m. These are generally met within rain shadow area and are represented by *Pinus rouxburghii*, *P. wallichiana* and *P. merkusii* is found in Rupa and Dirang valley of Kameng district and forms either pure stands or occasionally mixed with *Pinus wallichiana*, *Quercus* spp. and *Prunus* spp. etc.

Temperate forests

The temperate forest can be divided in to two subtypes viz. temperate broad leaved forests and temperate conifer forests.

**Temperate broad-leaved forest**

The number of dominant species is limited; in fact, more or less pure crops are more frequent than mixed ones, and the species distribution depends mainly on altitude and aspect. Common species in these forests are *Castanopsis indica*, *Phoebe cooperiana*, *Quercus lemellosa*, *Castanopsis hystiix*, *Rhododendron grande* and *Syzygium tetragona*. This type of forest is found in the higher reaches beyond 1800 m elevation and is comparatively less disturbed, because of its inaccessibility and complex nature of the terrain. Total area covered by this forest is 3592.7 sq km.

**Coniferous forest**

Under this type, all the conifers like temperate, subalpine and alpine have been classified together, as they impart almost similar spectral signature on the satellite image. But field samplings which has been done separately have indicated minute differences. Total area covered by this forest is 587.776 sq km.
Alpine forests

This type of vegetation occurs on the peaks of higher hills above an altitude of 4000 m up to 5500 m above timber line. For major part of the year, the area is covered by snow and plant activity is restricted to a few months when snow melts. There are no tall trees but dwarf branches and shrubs and mainly herbs with deep root and cushioned leaves and branches are present. The profusion of bright coloured flowers which is purely seasonal for a brief period makes the area highly attractive. Plants like *Rhododendron nivale*, *R. anthopogon*, *R. thomsonii*, *Sedum* spp., *Festuca* spp., *Rhodids* spp. *Saxifrega* spp., *Saussaurea* spp., *Arenaria* spp., and *Rheum* spp. from the major constituent of this peculiar vegetation.

Degraded forests

The common trees seen are *Machranga denticulata*, *Mallotus tetracoccus*, *Callicarpa arborea*, *C. vestita*, *Bauhinia* spp., *Glochidium* spp. and shrubs like *Clerodendron* spp., *Randia* spp., *Rubus* spp., *Viburnum* spp. *Croton caudatus*, *Capparis* spp., *Eurya acuminale*, *Dalbergia* spp. etc and also obnoxious weeds like *Milkania micrantha*, *Eupatorium odoratum* etc.

Bamboo forest

Bamboo grows mostly in pure stands with very less of associated species. Normally bamboos appear in areas abandoned after shifting cultivation, where they colonize fast. The common species of bamboo in the state are *Bambusa tulda*, *B. pallida*, *Dendrocalamus hamitonii*, *D. hookeri*, *Pseudostachyum polymorphum*, *Chimonobambusa* spp., *Cephalostachyum* spp. and *Arundinaria* spp., *Phyllostachys* spp. (both single stem bamboos) occur in higher elevation between 1000 m-2000 m.
Grasslands

The Grasslands form a main feature of vegetation in reverine plains and at higher elevations. The seral type is maintained through recurring-annual fires at higher elevation and excessive grazing at lower elevations. This vegetation is continuous and differs only in having a shorter snow-free period and in floristic detail. The meadows are composed mostly of perennial mesophytic herbs, with very little grass. These are confined to the upper reaches of the district, near the China border. Total area covered by this vegetation type is 458.71 sq km.

People’s participation in forestry management

To encourage peoples participation in management of forestry related activities several schemes have been introduced in the state. Apnavan is one of such popular schemes. Some other plantation schemes in the state are Aided Natural Regeneration, Minimum Need programme, Minor Forest produce, Area Oriented fuel wood and Fodder project and Integrated Wasteland Development project. To meet the demand of high class timber Department of Environment and Forests has taken up several plantation of high value timber species in the state.

Climate/ Vegetation

The climate is highly hot and humid at the lower altitudes and in the valleys covered by swampy dense forests particularly in the eastern section, while it becomes exceedingly cold in the higher altitudes. The rainfall is amongst the heaviest in the country. The annual average rainfall in Arunachal Pradesh is more than 300 cm. The rainfall varies from 450 cm in the foothill areas of 80cm in the upper reaches. The vegetation of the whole of Arunachal varies gently in relation to the elevation of the
different regions. It ranges from a wide belt of swampy rain forest along the foothills and the low lying areas to tropical and sub tropical. There is a great variety of plantation to be found. There are climbers, and an abundance of cane, bamboo and orchids. The lower altitudes are remarkable for their deciduous forests with patches of evergreen tropical vegetation. In the jungles of Arunachal, a large variety of medicinal plants are also available. The natives utilize these plants for treatment and cure of a large number of diseases.

Floristic diversity in Arunachal Pradesh

Arunachal Pradesh is the largest north eastern state and comprises more than three fourth of total area of the eastern biogeographic zone within Indian Territory and one of the world's biodiversity hotspots. It harbors a wide spectrum of floristic diversity comprising ca 5000 species of flowering plants which represent about 23.52% (Chowdhary et al, 1996) of the total flowering plants of India. The state has contributed to higher endemism with 238 endemic taxa (Chowdhary, 1999). A larger number of species from the state falls in rare, threatened and vulnerable category. The flora also possesses certain interesting and botanically curious plant species such as Balanophora dioica, Boschniakia himalaica, Sapria himalayana, some of the root parasites and some saprophytes like Epipogium roseum, E. indicum, Monotropastrum humile and Galeada facloneri, which is one of the tallest orchids. Saussurea obvallata and Rheum nobile are the plants with flowers enclosed within large transparent leafy bracts giving shelter to pollinating insects occur in the barren hilly slopes near the snowline.

Arunachal Pradesh has been referred as “Hindustan center of origin of cultivated plants” (Vavilov, 1926) and forms one of the major centres of origin of many of the crop plants through natural selection from wild species. The state has also rich crop plant
diversity. The region is rich in *Musa* and *Citrus* germplasm. A number of allied species of *Thea* have been recorded in the state. There are over 45 in 46 important timber yielding tree species along with number of useful bamboo and cane species while orchids are considered to be the most beautiful ornamental plants today, only Arunachal Pradesh itself harbors 545 orchid species (Chowdhary, 1998).

*Rhododendrons* are considered horticulturally equally important of which the state possess 61 species (Baishya *et al.*, 2002). Arunachal has the largest germplasm of beautiful healy chiums which are popularly known as garland flowers. The spectacular flora of Arunachal Pradesh includes 40 species of beautiful wild ornamental plants having great horticultural potentiality which can be cultivated, improved and popularized as garden ornamental plants and can be commercially exploited (Mahapatra, 2004). It also includes 37 natural dye yielding plants which are being utilized for extraction and preparation of dyes by indigenous process developed by ethnic tribes for application in textiles, for making hand made paper, for painting and writing scripts in monasteries (Mahanta *et al.*, 2005).

Arunachal Pradesh can be termed as natural repository of medicinal plants (Deori *et al.*, 1988). The ethnic groups inhabiting different areas of the state have indigenous Knowledge systems and have evolved methods of utilizing the vast plant resources available (Sarma *et al.*, 2000). A number of plants with highly toxic properties are used for catching fish and poisoning arrows in hunting by local peoples.

Arunachal Pradesh is also a precious treasure house of a large number of plant species which are collectively known as non timber forest products or the timber forest products. The localities of a particular area can be assessed disturbed or undisturbed based on the type of lichen species encountered. Based on the sensitivity and tolerance of lichens to pollution, different growth forms and type of lichens are categorized as
sensitive and tolerant species. Most of the crustose forms of lichens are considered as pollution tolerant than the foliose while fruticose lichens are the most sensitive to pollution and change in environment. Once the sensitive species are removed / vanished from the site after the advent of polluted environment the tolerant species exhibit an aggressive behavior and dominates the habitat to a greater extent than its normal growth. The phenomenon of recolonization of the sensitive species in the area is an important feature to know the change in environmental condition. The population of an individual sensitive / tolerant species can be measured applying the ecological parameters.

Out of the 25 biodiversity hotspots recognized by Myers et al (2000) 16 occur in the tropics, in the developing countries where threats are greatest and conservation resources are scarce. Since bioprospecting is considered as a vital component of an effective conservation strategy to achieve sustainable development, studies on the tropical lichens is solely needed and the lichen diversity of Arunachal Pradesh is still remains unexplored goldmine that would provide new avenues and opportunities. As few ecological studies in Indian lichens in general and the study of Arunachal Pradesh in particular are known therefore the research work in the present thesis was initiated with the following objectives:

1. To survey and collect the lichens from the different localities in and around Along town
2. To identify the lichen taxa and preparation of inventories
3. To quantify the existing level of lichen diversity in an around Along town
4. To study the effect of bark pH and water-holding capacity of phorophytes on lichens
5. To conduct ecological studies utilizing different ecological parameters
6. To compare the lichen species collected from disturbed and undisturbed areas.

7. To list few sensitive or tolerant indicator species, that can be used for rapid assessment of change of environmental condition

8. To collect information on lichen utilized by the different ethnic groups of the area.