Chapter No. I

INTRODUCTION
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Ascomycetes constitute the largest known group of fungi comprising 72% and 60% of the accepted known genera and species respectively of the estimated 1.7 million fungal species to be exists in the world (Kirk et al 2001, Gonzalez and Hanlin, 2008). They are the most fascinating and heterogeneous group of higher fungi which produce a sac like structure called as ascus (hence also known as sac fungi) with a typical number of eight spores produced in it as a result of meiosis. They exhibit large variations in occurrence, distribution and morphological characters which often confuses ascomycetologists with regard to taxonomic arrangement. However, presence of asci and ascospores is the only character that binds these diverse genera and species together in one group. The asci may remain naked or enclosed in fruit body called as the ascocarp.

The character of fruit body, ascus and ascospores has been of taxonomic significance. The morphology and structure of the fruit bodies are the main criteria used for the further classification of this group into the classes, Plectomycetes, Pyrenomycetes, Loculoascomycetes and Discomycetes. According to Minter (1988a, b), ascus structure is outstandingly important. Until recently mycologists believed that there were only two fundamental types of asci, the unitunicate and the bitunicate. Recent researches have shown that there are species with three, four and five layered ascus walls which can be detected with TEM only.

Ascomycetes have two distinctive reproductive phases, the teleomorph (sexual or meiotic state) and the anamorph (asexual or mitotic state). The latter represent the Deuteromycetes (Alexopolous et al 2004). In nature fungi are usually encountered in only one of these states. Several anamorphic and teleomorphic connections have been established (Huhndorf and Fernandez, 2005). Members of the Ascomycotina have a series of orders with increasing complexity starting from yeast like forms to the Discomycetes having macroscopic ascocarps. They are distributed worldwide from poles to the tropics as saprophytes, parasites and symbionts in aquatic and terrestrial habitats (Gonzalez and Hanlin, 2008).
Fresh water ascomycetes are defined in an ecological sense rather than taxonomic sense and include those ascomycetes occurring on submerged or partially submerged substrates mostly leaves and wood which complete part or whole of their life in fresh water environments. (Wong et al 1998). According to Thomas (1996), any species depending on water to complete some part of their life cycle or colonizing substrates in aquatic or semi aquatic situations is called as fresh water fungus. However some ascomycetes reported from fresh water habitats have also been found in terrestrial habitats(Tsui et al 2003). Some transient and terrestrial Ascomycetes whose spores are dispersed in water are also called fresh water Ascomycetes (Luo et al 2004). The fresh water bodies in the tropics support a distinctive ascomycetes community (Hyde et al 1997a,b.) and there is a possibility of existence of many new species or genera and the record of number of ascomycetes from tropics will be more than those from tropical regions (Vijaykrishna et al 2006).

According Shearer (1993), three categories of fresh water ascomycetes are recognized. They are:

1. Obligate fresh water ascomycetes which are also known as “indwellers” (Park, 1972), which are totally adapted to aquatic environment. They grow, sporulate and adapted for spore dispersal in water.

2. Facultative fresh water ascomycetes which are also termed as “immigrants” (Park, 1972) are from other habitats but immigrate to water.

3. Amphibious fresh water ascomycetes that occur in the interface between land and water.

The numbers of fresh water ascomycetes described are far less than those described from terrestrial habitats. Since the early discoveries (Ingold, 1951, 1954) around 700 species with very few from tropical regions have been discovered from woody substrates (Wong et al 1998). Only 3.82% of the fresh water Ascomycetes reported by Shearer(1993) were from tropics.
The biodiversity studies of fresh water ascomycetes have been a few in the past (Tsui et al. 2003). Only during the last couple of decades flora from fresh water habitats particularly those from tropics were greatly explored and the percentage of known forms from tropics has gone up to 34.6 from earlier 3.82 (Cai et al. 2003a). Out of 228 species reported (Shearer 1993) only 11 were from tropics. But in about ten years, 511 species of which 177 from tropics have been recorded (Shearer 2001, Cai et al 2003a). 44 genera belonging to Discomycetes, 54 belonging to Loculoascomycetes and 98 belonging to Pyrenomycetes have been reported from fresh water environment (Cai et al. 2003b). New genera and species have been described in recent years (Vijaykrishna et al. 2006). This shows rich diversity of Ascomycetes in tropical fresh water environments which need to be explored.

Terrestrial ascomycetes are found as saprophytes in soil, on the leaf litter, twigs, wood, bark, dung or as parasites on plant parts. A great amount of research work has been done resulting in the discovery of several new genera and species all over the world.

Fungi which grow on wood are sometimes called as "Lignicolous" fungi. Lignicolous fungi include ascomycetes and basidiomycetes with large number of classes and orders within each of these groups. Being lignicolous does not define a taxonomic category. The key focus on the biological activity holding this otherwise disparate group of fungi together is their ability to degrade lignin and cellulose, the major components of wood. The degradation of lignocelluloses by ascomycetes, a process called as soft rot is an important route for recycling carbon in the environment (Dix and Webster 1995). The lignicolous ascomycete's aid in the decomposition of dead plant material and recycling of the nutrients through their enzymatic activities in the terrestrial and aquatic ecosystem.

Lignicolous fresh water Ascomycetes inhabit submerged woody material in lentic and lotic water bodies (Wong et al 1998; Luo et al 2004). Based on their occurrence, the genera from fresh water habitats can be grouped into four viz. genera exclusively found in fresh water, genera found both in fresh water and terrestrial habitats, genera with fresh water and marine species and genera known from fresh water, marine and terrestrial habitats (Vijaykrishna et al 2006).

Forest trees landscape trees and, twigs, wood in water can be infected and rotted by these fungi. Different species are associated with different amount of decay in the tree; some species are restricted to sapwood and will not affect the merchantable volume of heartwood. Some fungi can decay sound wood; others decay only decaying wood and bark. Most of the lignicolous forms can be collected during dry weather and arid conditions.

The taxonomic arrangement of the Ascomycetes fungi is one of the biggest problems confusing ascomycetologists. A switch over from the artificial system, based on morphology, to a system based on the ontogeny of ascomata, morphology and dehiscence of asci and release of ascospores, came into existence. Recent studies includes SEM, TEM, Fluorescence microscopy, screening of metabolites and even studies on nucleic acid sequences. There are reports about the molecular phylogeny of Ascomycetes being analyzed by rapid RNA and DNA sequencing.
It is rather difficult to classify the ascomycetes, because our knowledge about their origin and phylogenetic pathways is too meager, because our knowledge about the morphology and ontogeny of large number of extant genera is very little and because there are difficulties in interpreting the data correctly.

However the taxonomic studies are based mainly on the large number of research results. Where these are taken into consideration the systems of various mycological schools are becoming more and more alike. We still are far from the ideal—the natural system of classification.

For classifying Ascomycetes, it is necessary that the significant taxonomic characters ascomatal anatomy, internal development of the ascoma (especially the packing material between the asci), life-cycle patterns, the form and development of conidial stages, etc. are reviewed (Minter 1988a).

According to Minter (1988b) some broad themes are emerging. Multiple character classifications are replacing the old single character ones. Ascus structure may probably form the basis of many orders if they can be correlated with other characters. About 240 families in 46 orders are now accepted.

From all over the world several new genera and species are being described. Some of the previously described forms are merged, re-established or transferred to other groups; still there are sexual genera and species to be described and assessed to their taxonomic position. Still the knowledge is fragmentary and continuous investigation is warranted for better and firm understanding of the flora.

Taxonomic studies are few in India. Ascomycetes have received little attention, though the fungal flora of India is very rich and diverse. Even though number of genera and species have been reported from various parts of India (Bilgrami et al 1991, Pande, 2008) still many remain to be explored. Despite the enormous work put in, the mycoflora of India is only partly investigated and wide scope lies before the Ascomyologist to tackle various aspects and problems of this interesting group.
It was therefore, decided to investigate the diversity of lignicolous ascomycetes belonging to the major classes, Pyrenomycetes and Loculoascomycetes and Discomycetes from various terrestrial and freshwater habitats in Ahmednagar district of Maharashtra state with a view to understand occurrence, morphology and report new taxa and new records, if any. Since this area has never been explored so far, this work will be first of its kind in the district and helps to understand the local ascomycete's flora.

- **Study Area:**

The state of Maharashtra covers a large part of Indian peninsula, lying between latitude 22.1'-16.4' North and longitude 72.6'-89.9' East (Map-I) with a total area of 307,690 Sq Km. The state is limited on the West by the Arabian Sea. Ahmednagar district lying between 18° 2' and 19° 9' north latitude and 73° 9' and 75° 5' East longitude is in the central part of the state and areawise. It is the largest district in the State with varied topography and climatic conditions shows different types of vegetation the district is divided for convenience into Northern and Southern regions. The Northern region is mainly of hilly Sahyadri ranges and low land areas and constitute Mula, Pravara and Godavari river basin. The south region is in the Ghod, Bhima and Sina river basin. The North-west part of the district is rugged by Sahyadri ranges with dense forests form continuous natural boundaries between Ahmednagar, Thane and Nasik districts. The Western Ghats is the Mega biodiversity and hot spot region in India. Being a part of Western ghat, Sahyadri hills run along eastward direction of the Ahmednagar district and give rise to three offshoots namely Kalsubai hill ranges, Baleshwar range hill ranges and Harischandragad hill ranges dominated by deciduous and semi-evergreen forests.

Three seasons, winter, summer and monsoon are distinct with a maximum of 34°C and minimum of 18°C. Temperature and an average rainfall of 583.50 mm are during south west and retreating monsoon period.

There are two major rivulets Pravara and Mula which flow through the central part of the district and join the river Godavari at Pravarasangam. Two
Major dams (Bhandardara and Mula) and number of minor dams and lakes are constructed across these rivulets. (Study Areas Map-Collection Site.)

- **Forests:**

  The forests in the district fall in the 'Southern tropical dry deciduous' type and are mostly situated in Akola, Sangamner, Ahmadnagar, Shrigonda, Parner and Rahuri talukas. The forest area in the district falls under two categories, i.e., reserved and protected. The major portion of this area is in charge of the Forest Department and the Revenue Department.


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COLLECTION SITES IN THE STUDY AREA.

1. Kalsubai.
2. Bhandardara.
3. Rajur.
4. Akole.
5. Nizarneshwar.
7. Mula dam.
8. Shrirampur.
11. Vrudeshwar.
Study Area Map

Maharashtra State

Ahmednagar District

Kopargaon

Akole Sangamner Rahuri Shrigonda

Parner A. Nagar

Newasa Shevgaon Pathardi

Jamkhed

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Collection sites

Ghatghar area

Bhandardara area

Kalsubai area
Collection sites

Rajuri Stream

Pravara River

Pravara Sangam
Collection sites

Bhandardara

Takalibhan

Pravara River