The freshwater ecosystems are the dynamic systems in which the living organisms not only interact but also influence the habitat intensely. The study of freshwater habitats is of great importance because it occupies only 0.8 per cent of earth’s surface (WRI, 2000) and their significance to man is far greater than other areas as they are the most suitable and cheapest source of water for the domestic and industrial needs.

The organisms determine the community structure of freshwater ecosystems (Moss, 2000). There are no global estimates for rates of change in the extent of freshwater habitats or for overall changes in their condition. We are uncertain about total species richness and precise rates of species loss, but the combination of high biodiversity and the magnitude of anthropogenic threats make the inland waters the most endangered ecosystems on earth (Dudgeon, 2003).

The biological diversity serves as an impetus for the future business of biotechnology (Swaminathan, 2003). There appears to be a paucity of published research on the conservation of freshwater biodiversity. The limited information available indicates that population declines, range reductions and species losses are ongoing. The conservation of freshwater biodiversity is hamstrung by the lack of information (Dudgeon, 2003).
Chapter 1

All over the world, significantly large areas of wetlands have been lost or are degraded to different degrees, due to various anthropogenic activities which primarily cause hydrological changes (Junk, 2002; Gopal, 2003). Threats to the freshwater biodiversity of Asian wetlands include water pollution, salinization and over harvesting (Dudgeon, 1992, 2000).

Anthropogenic changes have been, and continue to be, rapid, resulting in instability of the freshwater ecosystems. Consequently biota that do not readily adapt to changing conditions may not survive (Beeton, 2002; Brinson and Ines-Malvarez, 2002; Bronmark and Hansson, 2002; Junk, 2002; Malmqvist and Rundle, 2002; Tockner and Stanford, 2002).

Hydrological conditions can directly modify or change chemical and physical properties such as pH, nutrient availability, salinity and sediment properties. These modifications of the physico-chemical environment, in turn, have a direct impact on the biotic response in the wetlands (Ramachandra et al., 2002). When hydrological conditions in wetlands change even slightly, the biota may respond with massive changes in species composition and richness.

The algae form the main component of aquatic flora and play a vital role in maintaining suitable equilibrium of abiotic and biotic components of aquatic ecosystem. The micro-algae play an important role in solving the environmental problems (Kurano and Miyachi, 2004; Wan-Loy et al., 2009) and they have vast industrial and economic potential (Rai et al., 2000) as valuable sources for pharmaceuticals, health foods, carotenoids (Lui et al., 2000), restriction endonucleases (Saravanan et al., 2003) and in the bioremediation of industrial effluent (Muthukumaran et al., 2005; Kamaleswari and Sivasubramanian, 2011). Algae are also used as biological indicators of water pollution (Palmer, 1969; Prasad and Singh, 1982).
The knowledge of the freshwater biodiversity is incomplete, and advanced national or regional inventories are deficient. The scientific reports under freshwater ecology, limnology and conservation biology of tropical Asia was few (Dudgeon, 2003). Living organisms and their nonliving environment are inseparably interrelated and interact upon each other.

The United Nations Conference on Environment and Development (UNCED), 1992 as well as many global conservation organizations, including Ramsar convention, 1971 have identified the aquatic biodiversity to be the most threatened of all biodiversities. Realizing the importance of wetlands, the Ramsar convention on wetlands has urged the member countries to designate noted wetlands as Ramsar sites or wetlands of International significance.

Freshwater habitats are among the most threatened and valuable ecosystems we have. They are the fragile ecosystems that are susceptible to damage even with only a little change in the composition of biotic and abiotic factors. The wetlands are threatened due to inadequate water holding capacity, excessive withdrawal and pollution due to raw sewage, industrial effluents, eutrophication, leached fertilizers and insecticides (Ramachandra, 2005).

The aquatic systems get polluted due to modernization, industrialization and swelling human population. The degradation of water bodies is due to discharge of domestic sewage, industrial effluents, agricultural run off water and dumping of solid wastes (Behura, 1989; Ghosh, 1989). These factors lead to a luxuriant growth of organisms especially the algae, in the water bodies (Hynes, 1978; Varshney, 1991).
The total area under wetlands in the world is estimated as 8.6 million km², which is about 6.4% of the total earth’s surface area. The wetlands of India occupied 58.2 million hectares or 18.4% of India’s total geographical area (excluding rivers), of which 40.9 million hectares (70%) were under paddy cultivation (MOEF, 1990). India presently has 25 Ramsar sites designated as wetlands of international importance, of which three are in Kerala namely Ashtamudi Lake, Sasthamkotta Lake and Vembanad-Kol. The total wetland area in Kerala consists of 127,930 hectares (Nair and Sankar, 2002).

Most of the natural wetlands of Kerala are brackish but few freshwater lakes are also present in Kerala. The most important ones are Vellayani, Sasthamkotta, Pookkot, Enammackal, Manakkodi, Muriyad, Eravikulam, Devikulam and Elephant Lake. The wetlands are under greater threat in Kerala than in any of the other states. It can be attributed to very high population density and the homestead mode of habitation (Nayar and Nayar, 1997). The real estate business is also having a role in the destruction of the wetland ecosystems in Kerala state (Nikhilraj and Azeez, 2009).

The biodiversity is the total of species richness occurring in a habitat. A complete knowledge of the world flora and fauna is not available because the life on earth still remains unexplored at the species and intra species levels. The biologists estimated that there exists 10 to 30 million species of living forms on earth (Agrawal, 2000; Astana and Astana, 2001; Purohit and Ranjan, 2003). Of these, only 1.8 million species have been identified so far. At global level the number of species of lower plants reported was 166,750. Out of this, the number of species of algae reported was 40,000.
General Introduction

Inland aquatic ecosystems and their biodiversity in Asia represent a wide spectrum along a complex continuum of interacting ecological, economic, socio-cultural and political gradients all of which determine their present and future (Gopal, 2005a). Biodiversity is rapidly declining throughout the world due to various reasons like destruction of habitat, over exploitation, pollution, climate change, global warming, population pressure, massive deforestation etc. and as a result several thousands of species are now facing the threat of extinction.

In India the richness in biodiversity is due to immense variety of climatic and altitudinal conditions coupled with varied ecological habitats (Trisal, 2000). India is one of the twelve mega biodiversity countries of the world having about 49,000 species of plants (Myers et al., 2000), of which 15,000 are flowering plants. In India 126,656 species of plants and animals are already identified and described, which contain 27,864 lower plants. The number of algae reported from India was 6,500.

1.1 Review of Literature

During the past two decades, taxonomic studies have gradually become unattractive and taxonomists themselves have become ‘endangered species’. Field studies on aquatic communities generally identify the taxa at the generic level only. This puts the assessments of biodiversity to ridicule, and renders the evaluation of changes in diversity due to anthropogenic stresses and habitat modifications meaningless (Gopal and Zutshi, 1998).

Due to declining interest in taxonomy even the correct assessment of the organisms could not be prepared and most of the data and projections made in this connection are mere evaluation based on enumeration of species existing on land (Bilgrami, 1995). Khoshoo (1994) had tried to
establish a relationship between biodiversity and biotechnology on global basis.

1.1.1 Taxonomic work on algae

There has been an increasing concern for the substantial decline of traditional taxonomic studies. The taxonomy ought to be an area of focus, but is being neglected due to the ignorance about its importance in achieving the global requirements of the human society (Nair, 2004). The recent decline in taxonomic studies is well recognized by Irfanullah (2006) and described the limitations of taxonomy in algal studies. In addition, the journals publishing taxonomic papers have lower impact factors as recognized by Valdecasas et al. (2000). Limnological studies involving only algae have decreased markedly over the last three decades, whereas, studies covering other aquatic groups in addition to algae have mounted gradually in recent years (Irfanullah, 2006).

1.1.2 Indian scenario of phycological research

M.O.P. Iyengar, K. Biswas, M.S. Randhawa, T.V. Desikachary and F.E. Fritsch made significant contribution to the field of phycology in India. The Indian Council of Agricultural Research (ICAR) started publishing a series of algal flora of India (Desikachary, 1959; Randhawa, 1959; Venkataraman, 1961; Ramanathan, 1964; Philipose, 1967; Gonzalves, 1981; Iyengar and Desikachary, 1981), and these monographs have formed the basis of algal research to all phycologists in India and the world.

Turner (1892) reported the freshwater algae principally Desmidieae of East India incorporating twenty two species of blue green algae and six hundred green algae including five hundred and thirty six desmids. West and West (1907) described 276 species and sixteen varieties of the
freshwater algae belonging to seventy one genera from Burma, Bengal and Madras. Biswas (1949) listed the common fresh and brackish water algal flora of India and Burma.

Sarma and Khan (1980) have listed 4269 algal species belonging to 653 genera described by various researchers of India. Of these 3023 species are recorded from freshwater and 1222 from marine habitats. Twenty four species are found to be common in freshwater and marine habitats. Habitat wise richness of freshwater algae in India had 390 genera and 4500 species coming under different families except brown and red algae (Rao and Gupta, 1997).

Kant and Gupta (1998) reported 848 species, 155 varieties, 27 forms and 6 combinations belonging to 286 genera from Ladakh, Jammu and Kashmir under nine classes of algae. Forty two forms of blue green algae and nine forms of green algae were reported from the rice field soils of Jammu and Kashmir (Goyal et al., 1984).

Algal flora of paddy fields of Ludhiana and its adjacent areas were studied by Grover and Pandhol (1975) and listed forty three forms out of which twenty six were blue greens and the remaining were the members of Chlorophyceae. The algal flora of Ludhiana and its adjacent areas were also reported by Pandhol and Grover (1976) and listed ninety algal species.

The algal flora of Karnataka was listed by Somashekar (1983a) and reported one hundred and four blue green algae, thirty five Chlorococcales and fifty species of desmids. Somashekar (1984a) also enumerated one hundred and ten blue green algae, forty three Chlorococcales and eighty two species of desmids from Karnataka.
Basavarajappa et al. (2010) reported twenty nine algal species from Hadhinaru Lake, Karnataka. Bongale and Bharati (1980a) listed 377 species of algae including 244 Cyanophyceae, 80 Chlorophyceae and 53 Bacillariophyceae from the cultivated soils of Karnataka. Freshwater algae of Karnataka belonged to Chlorococcales, Desmidiales, Euglenophyceae and Dinophyceae are reported by Hegde and Isaacs (1988b).

The soil algae from the paddy fields of Goa and Karnataka were reported by Bongale (1981). They enumerated forty three Cyanophyceae, six Chlorophyceae and five Bacillariophyceae. Nafeesa and Narayana (2006) reported eighty five phytoplankton species from four lentic water bodies in and around Davangarere city, Karnataka.

Isaacs and Hegde (1986, 1987, 1989) reported freshwater algae from Uttara Kannada district of Karnataka state. The freshwater algae of Davanagere and Raichur of Karnataka state was described and illustrated by Bongale and Bharati (1980b) and they reported Cyanophyceae, Chlorophyceae, Euglenophyceae and Bacillariophyceae. Sixty one taxa of freshwater algae from Bijapur district, Karnataka state are listed by Hegde and Bharati (1983a) which belong to twenty six genera representing the orders Chroococcales, Hormogoniales, Chlorococcales, Oedogoniales, Desmidiales and Euglenales. Bharati (1965) reported forty six species of algae belonging to twenty three genera from Kumta, North Kanara.

Prasad and Misra (1992) and Prasad and Srivastava (1992) described and illustrated freshwater algal flora of Andaman and Nicobar islands. They described 587 taxa, of which 114 are blue greens, 203 diatoms and 270 green algae. Five filamentous green algae were reported from Andaman and Nicobar islands by Prasad and Misra (1984a).
The algal forms of Bihar were reported by Patralekh (1991a, 1991b, 1993a, 1994) and Kargupta and Ahmad (1991). Nineteen freshwater taxa grouped under fourteen genera from Chandra Lake, Himachal Pradesh, was reported by Misra et al. (2009) which belongs to Cyanophyceae, Chlorophyceae and Bacillariophyceae.

Freshwater algae of Chattisgarh, Madhya Pradesh were reported by Roy and Sen (1985) and they enumerated seventy three taxa of freshwater algae representing Cyanophyta, Bacillariophyta, Xanthophyta, Euglenophyta and Chlorophyta. Thirty two algal forms of Madhya Pradesh were enumerated by Mahajan (1987).

Bhosale et al. (2010a) reported phytoplankton diversity in four lakes of Satara district, Maharashtra and illustrated sixty eight phytoplankton taxa belonging to five classes of algae. Phytoplankton of the lakes in and around Kolhapur city, Maharashtra were enumerated and illustrated by Bhosale et al. (2010c) and reported one hundred and seventy four taxa of algae belonging to seven classes. Bhosale et al. (2010d) enumerated and illustrated forty four phytoplankton species belonging to thirty genera from five classes of algae from the water bodies of Maharashtra.

The phytoplankton diversity of Parola dam, Maharashtra revealed the presence of forty three phytoplankton species belonging to four major groups namely Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae (Jayabhaye et al., 2007). Earlier Kamat (1968a) reported two hundred and twenty one algal taxa belonging to five classes namely Chlorophyceae, Charophyceae, Euglenophyceae, Chrysophyceae and Cyanophyceae from Maharashtra. From Vidarbh, Maharashtra, Kamat (1975a) reported three hundred and ninety one taxa of Chlorophyceae,
ninety six taxa of Euglenophyceae, two taxa of Xanthophyceae, eleven taxa of Dinophyceae and one hundred and thirty six taxa of Cyanophyceae.

Algal flora of the freshwater aquatic systems of Orissa was reported by Padhi et al. (2010) and fifty eight species of micro-algae were enumerated belonging to Cyanophyceae, Chlorophyceae and Bacillariophyceae. Adhikary et al. (2009) reported 307 taxa belonging to 87 genera from Orissa state.

Trivedy (1982) listed sixty two algal forms comprising of thirty four Chlorophyceae, fifteen Cyanophyceae and thirteen Bacillariophyceae from Jaipur, Rajasthan. Freshwater Euglenoides and Dinophyceae were reported by Chaudhary and Meena (2007) from Udaipur district, Rajasthan. Makandar and Bhatnagar (2010) reported the biodiversity of micro-algae and Cyanobacteria from the freshwater bodies of Jodhpur, Rajasthan and they reported twenty six green algae, nine diatoms and forty eight blue green algae.

Fifty freshwater algal taxa were reported and illustrated from Sikkim which belongs to Cyanophyta, Chlorophyta and Bacillariophyta (Bhakta et al., 2010). Kamat (1968b) reported seventy eight taxa belonging to Chlorophyceae, Charophyceae, Xanthophyceae, Euglenophyceae and Cyanophyceae from Simla.

Perumal and Anand (2008a) reported 389 taxa of algae from the freshwater habitats of Tamil Nadu and of these 252 belong to Chlorophyceae, 55 to Bacillariophyceae, 2 to Dinophyceae, 51 to Euglenophyceae and 29 to Cyanophyceae. Thirugnanamoorthy and Selvaraju (2009) reported fourteen phytoplankton genera of which four belonging to Cyanophyceae, four to Chlorophyceae, three to Bacillariophyceae and three to Euglenophyceae from Tamil Nadu. Phytoplankton from the Perumal Lake, Tamil Nadu was
recently listed by Ramadosu and Sivakumar (2010) and one hundred and thirty six species of phytoplankton belonging to Bacillariophyceae (62 species), Chlorophyceae (39 species), Cyanophyceae (30 species) and Euglenophyceae (5 species) were recorded.

Shukla and Shukla (1987) enumerated forty two taxa of algae belonging to Euglenophyceae, Dinophyceae, Bacillariophyceae and Rhodophyceae from Kanpur. Sharan and Sinha (2010) reported fifty one species of algae from the Hatia Dam of Ranchi. Khan (1985) studied seventy three taxa belonging to forty genera of freshwater algae from Sultanpur, Uttar Pradesh representing Cyanophyta, Rhodophyta, Xanthophyta, Chlorophyta, Charophyta and Euglenophyta. The blue green and green algae from Uttar Pradesh were also reported by Chaturvedi and Pandey (1976) and Pandey and Chaturvedi (1979).

Chakraborty et al. (2010) reported the micro-algal diversity of West Bengal including fifty four taxa of Cyanophyceae belonging to eighteen genera, seventeen taxa of Chlorophyceae belonging to eleven genera, three species of Euglenophyceae belonging to two genera and one species of Rhodophyceae. Shah et al. (1992) studied Xanthophyceae and reported four taxa of Ophiocytium and one taxon of Vaucheria from Rajasthan. The morphology, reproduction and cytology of two species of freshwater dinoflagellates belonging to the genera Gymnodinium are described from Uttar Pradesh by Sarma and Shyam (1974). Srivastava and Odhwani (1990c) reported Peridinium from Jodhpur, Rajasthan.

Madhya Pradesh (Sinha and Naik, 1997), Maharashtra (Bhosale et al., 2010b), Meghalaya (Gupta, 2002), Orissa (Dey et al., 2008), Pune (Zaware and Pingle, 2003; Pingle, 2005), Sikkim Himalayas (Suseela and Toppo, 2004), Tamil Nadu (Suxena, 1983; Kavitha and Balasingh, 2007), Uttaranchal (Khare and Suseela, 2004; Suseela, 2005), Uttar Pradesh (Misra et al., 2004, 2005, 2008b) and West Bengal (Pal and Santra, 1984) are also contributions to the algal flora of India.


The Chlorophyceae with 36 taxa representing 18 genera was listed by Kamat and Freitas (1976) from Nagpur, Maharashtra. Barhate and Tarar (1981) enumerated forty one algal taxa, out of which one belonging to Cyanophyceae, eight to Chlorophyceae and thirty two to Bacillariophyceae from Maharashtra. Barhate and Tarar (1985a) reported thirty one algal taxa of Chlorophyceae from Maharashtra belonging to Volvocales, Chlorococcales, Ulotrichales, Chaetophorales, Oedogoniales and Conjugales.

Chlorophycean algae of Ahmednagar district, Maharashtra were enumerated by Deshmukh and Pingle (2006) and a total of one hundred and fifty five taxa belonging to fifty six genera were reported. Jawale et al. (2009) reported twenty six taxa of freshwater unicellular Volvocales from Jalgaon district, Maharashtra and Jawale et al. (2010) reported fifteen taxa of Volvocales from Jalgaon and Dhule districts, Maharashtra. Chlorophycean
species are reported from Agra by Tiwari and Chauhan (2007a) and from Tamil Nadu by Murugesan and Sivasubramanian (2008a).

Keshri (2009) reported eleven members of the freshwater filamentous green algae belonging to the order Chaetophorales of West Bengal. Thirteen species of Ulotrichales belonging to five genera namely Cylindrocapsa, Microspora, Schizomeris, Ulothrix and Uronema are reported by Keshri (2010a) from West Bengal. Eleven taxa of the genus Coleochaete and two taxa Chaetosphaeridium belonging to the order Coleochaetales have been recorded by Keshri (2010b).

From Bihar forty taxa belonging to sixteen genera of Chlorococcales were reported (Singh and Saha, 1982a). Sixty one species of Chlorococcales belonging to twenty eight genera was listed by Jha et al. (1985) from Gobindsagar reservoir, Himachal Pradesh. Pandey and Gangwar (1986) studied thirty taxa of freshwater planktonic Chlorococcales from Bareilly.

Tiwari and Chauhan (2004) described eighteen taxa of Chlorococcales from the crop fields of Bichpuri, Agra and Tiwari et al. (2001) listed the Chlorococcales from Kitham Lake, Agra. Patel and Isabella (1980) reported sixteen species and one variety of Chlorococcales belonging to fifteen genera from western India. Jena and Adhikary (2007) described and illustrated fifty six taxa of Chlorococcales belonging to twenty one genera from eastern and north-eastern states of India. They reported Chlorococcales from different water bodies of Orissa, West Bengal, Assam, Meghalaya, Nagaland and Manipur.

Isabella and Patel (1985) described seventeen taxa of Chlorococcales representing five genera from Gujarat. The Chlorococcales of Gujarat belonging to the genera Pediastrum, Sorastrum and Hydrodictyon were
reported by Patel and Isabella (1977). Patel et al. (1980) reported fifteen genera of Chlorococcales from Gujarat and they reported thirty species, eleven varieties and three forms. Conococcus elongatus Carter belonging to Chlorococcales was reported by Patel et al. (1981) from Gujarat. Pediastrum integrum Naegeli var. undulatum, a new variety of Pediastrum was reported by Patel and Isabella (1982) from Gujarat. Patel and Daniel (1990) reported eighteen taxa belonging to Dictyosphaerium, Tetrastrum and Scenedesmus of Chlorococcales from different localities of Gujarat.

Freitas (1980) listed eighty one taxa representing twenty nine genera belonging to seven families of the order Chlorococcales from Maharashtra. Ashtekar and Kamat (1980b) reported forty nine taxa belonging to twenty genera of Chlorococcales from Maharashtra. Tarar and Bodkhe (1998) listed fifty two species of Chlorococcales belonging to fifteen genera from Nagpur, Maharashtra. The systematic account of fifty four taxa of Chlorococcales from Ahmednagar district, Maharashtra was reported by Deshmukh and Gunale (2007). Twenty two taxa of freshwater Chlorococcalean algae representing six genera from Jayakwadi bird sanctuary of Maharashtra was reported by Andhale and Papdiwal (2010).

Systematic account of thirty two species of Chlorococcales of Hassan district, Karnataka was given by Bharati and Hegde (1979). Mathur and Pathak (1990) reported forty four taxa belonging to twenty two genera of Chlorococcales from Hoshangabad, Madhya Pradesh. Twenty two species of Chlorococcales belonging to eleven genera were taxonomically enumerated by Dey and Bastia (2010) from the rice field soils of northern Orissa.

Sarma et al. (1983) reported Chlorococcales from Patiala, Punjab and they described twenty six taxa belonging to eight genera namely
Chlorococcum, Characium, Tetraedron, Pediastrum, Hydrodictyon, Oocystis, Ankistrodesmus and Scenedesmus. The Chlorococcalean flora of Jodhpur, Rajasthan was reported by Srivastava and Odhwani (1990b) and they described twenty six taxa belonging to eighteen genera.

Twenty one taxa of freshwater algae belonging to nine genera of the order Chlorococcales collected from different aquatic habitats of Uttaranchal and Uttar Pradesh were reported by Shukla et al. (2007). Systematic account of twenty five taxa of Chlorococcales representing ten genera from Uttaranchal was reported by Habib et al. (1998). Chadha and Pandey (1977, 1978) and Pandey et al. (1983b) reported Chlorococcales from Allahabad, Uttar Pradesh.

Systematic account of twenty eight taxa of Chlorococcalean algae belonging to twelve genera from Uttar Pradesh were reported by Habib (1996). Thirty two taxa of Chlorococcalean algae were reported from Uttar Pradesh by Habib and Chaturvedi (2001). The report of Chlorococcales from Agra by Sengar and Sharma (1982) was also contributions to the algal flora of India.

Pediastrum duplex Meyen var. asperum (A. Braun) Hansgirg f. denticulatum was reported by Isabella and Patel (1988a) from Gujarat. Twenty two taxa of Scenedesmus species was reported by Rawla and Rattan (1989) from Punjab, Himachal Pradesh and Chandigarh. Patel and Isabella (1984) described seven varieties of Scenedesmus from Gujarat. Later eight taxa of Scenedesmus was reported and illustrated by Isabella and Patel (1988b) from Gujarat. Kant and Anand (1978) reported seventeen species of Scenedesmus from Jammu.
Prasad and Misra (1984b, 1984c, 1984d, 1985) described desmids from Andaman Islands. Forty two taxa of desmids from Kashmir were illustrated and described with their distribution in India by Suxena and Venkateswarlu (1968). Fifty two species of desmids belonging to seven genera were illustrated and described with their distribution in India by Suxena and Venkateswarlu (1966) from Pakhal Lake, Andhra Pradesh. Twenty six taxa belonging to seven genera of desmids were illustrated and described by Suxena and Venkateswarlu (1970) from Andhra Pradesh.

Patel and Asokakumar (1979) reported forty six taxa of Closterium and Asokakumar and Patel (1990b) reported twenty five taxa of Staurastrum from Gujarat. Asokakumar and Patel (1988) reported forty eight taxa of Cosmarium from Gujarat which includes 28 species, 18 varieties and 2 forms. Asokakumar and Patel (1990a) also reported thirty two taxa of Cosmarium from different freshwater habitats of Gujarat.

Bharati and Hegde (1982a) described forty seven desmid taxa belonging to Mesotaeniaceae, Gonatozygaceae and Desmidiaceae from Karnataka and Goa. Bharati and Hegde (1982b) reported sixty three species of Staurastrum and one species of Staurodesmus from different water bodies of Karnataka state and Goa region. Bharati and Hegde (1983) described twenty five taxa of Euastrum and ten taxa of Micrasterias from Karnataka state and Goa.

Gurudeva et al. (1983), Hegde (1986b), Hegde and Isaacs (1988a, 1989) and Bongale (1987) reported desmids from Karnataka. Zygospore formation in twenty four desmid taxa from North Kanara district of Karnataka was reported by Hegde and Bharati (1983b). Zygospore formations of seven desmid taxa were also reported by Hegde (1987) from Karnataka.
Three new taxa of *Cosmarium spinuliferum* West et West was described by Bongale (1986) from Karnataka State. Hegde (1986a) reported five taxa of *Cosmarium* and Hegde (1986c) reported thirty taxa of *Cosmarium* from Shimoga district of Karnataka State. Hegde (1986d) described *Xanthidium croasdalimum* Hegde and *Xanthidium sexmamillatum* W. et G.S. West var. *pulneyensis* Iyengar et Vimla Bai fa. *simplex* Hegde from Karnataka state.

Agarkar (1969) described fifty two forms of desmids belonging to eleven genera and Agarkar (1971) described sixty four taxa of desmids belonging to ten genera from Gwalior, Madhya Pradesh. 68 desmids from Pachmarhi (Agarker and Agarkar, 1977), 71 desmids from Bandhavgarh (Agarkar et al., 1979) and 129 desmids from Jabalpur (Agarkar et al., 1983) are other reports of desmids from Madhya Pradesh.

Forty five taxa of desmids belonging to eight genera were recorded from different water bodies of Orissa state and its neighboring regions of India (Jena et al., 2006a). Twenty seven taxa of desmids belonging to *Closterium*, *Euastrum*, *Pleurotaenium*, *Cosmarium* and *Staurastrum* from Ranchi were enumerated by Das and Purty (1990). Desmid studies by Kamat (1975b) and Ashtekar and Kamat (1979) from Maharashtra, Hegde (1986e, 1986f) from Karnataka, Tarar et al., (1998) from Nagpur, Dwivedi et al. (2004) from Uttar Pradesh and Pandey and Pandey (1980, 1983) from Allahabad are also significant contributions to the desmid flora of India.

The desmids of Kodaiikanal Lake were illustrated and described by Bharati and Pai (1972) and they described forty two taxa belonging to fifteen genera. Suxena (1979) reported *Xanthidium prescottii* from Kodaiikanal. From Tamil Nadu, Perumal and Anand (2008b) reported
twenty seven taxa of desmids belonging to nine genera. The desmids from Haridwar and Dehradun districts of Garhwal region of Uttarakhand were illustrated and described by Misra et al., (2008a) and they described forty two taxa belonging to seven genera.

Forty six taxa of desmids belonging to four genera namely Pleurotaenium, Euastrum, Cosmarium and Staurastrum were described by Chaturvedi et al. (1987) from Bareilly district, Uttar Pradesh. Prakash et al. (2005) described ten taxa of freshwater desmids belonging to six genera namely Euastrum, Cosmarium, Staurastrum, Micrasterias, Pleurotaenium and Desmidium from Uttar Pradesh. The species diversity and seasonal variation of desmids in Agra was reported by Tiwari and Chauhan (2007b). They described and illustrated thirty four species. Pandey et al. (1987) described fifty six taxa of Closterium from Bareilly district, Uttar Pradesh.

Forty eight taxa of desmids collected from from the foothills of Western Himalaya, Uttaranchal and Uttar Pradesh were reported by Shukla et al. (2008). Prasad and Mehrotra (1977a, 1977b) reported desmids from the North Indian paddy fields. Dhande and Jawale (2009) described twenty three taxa of Cosmarium from Hartala Lake, Maharashtra and four taxa of Cosmarium from Bareilly, Uttar Pradesh by Habib and Pandey (1990a). Das et al. (1990) reported forty two taxa of Cosmarium from Bihar and Toppo and Suseela (2009) described twenty eight species of Cosmarium from Chhattisgarh.

Reports of eighty two taxa of desmids from Nagpur (Freitas and Kamat, 1979), twenty nine taxa of desmids from Uttar Pradesh (Habib, 1995), and forty two species from Bihar (Saha and Choudhary, 1984) are also important contributions to the knowledge of Indian freshwater
desmids. Mallick (2010) reported four taxa of desmid *Mesotaenium* from West Bengal. Recently 38 taxa of planktonic desmids were reported from the north eastern states of India by Yasmin *et al.* (2011). Deka *et al.*, (2011) reported 91 species of desmids belonging to 14 genera from Assam.

Twenty three taxa of *Phacus* belonging to Euglenophyceae were described and illustrated by Patel and Waghodekar (1981) from different localities of Gujarat. Later Waghodekar and Patel (1991) reported six species of *Heteronema* and two species of *Anisonema* belonging to Euglenophyceae from Gujarat.

Forty two taxa of Euglenineae belonging to five genera were described by Hosmani and Bharati (1983) from Karnataka. Hosmani (2008) enumerated and illustrated thirty five species of Euglenophyceae belonging to five genera from Karnataka. The Euglenophyceae with thirty four taxa representing four genera was listed by Kamat and Freitas (1976) from Nagpur, Maharashtra. Euglenophyceae from Jalgaon region, Maharashtra were reported by Bhoge and Ragothaman (1986b) and they described six taxa of *Phacus* and fourteen taxa of *Euglena*.

Fifty eight taxa of Euglenophyceae belonging to five genera were reported by Ashtekar (1982) from Maharashtra. Barhate and Tarar (1985b) listed twenty one species of Euglenophyceae from Khandesh, Maharashtra and out of these ten belong to *Euglena*, seven to *Phacus* and four to *Trachelomonas*.

Pandey (1985) reported fourteen species of Euglenineae of Bareilly, Uttar Pradesh belonging to *Euglena, Lepocinclis, Phacus* and *Trachelomonas*. Prasad and Chaudhary (1986) reported *Trachelomonas godwardii* and *Lepocinclis sarmii* from Uttar Pradesh. Habib and Pandey (1990b) reported
twenty nine taxa of Euglenineae belonging to *Euglena* and *Phacus* from Bareilly, Uttar Pradesh.

Ratha *et al.* (2006) described sixty taxa of Euglenaceae belonging to nineteen species of *Euglena*, one species of *Cokacium*, eight species of *Lepocinclis*, twenty two species of *Phacus* and ten species of *Trachelomonas* from Orissa. The studies of Euglenophyceae from Karnataka by Hegde and Bharati (1986), thirteen species of the genus *Trachelomonas* from Rajastan by Srivastava and Odhwani (1990a) and eighteen taxa of *Euglena* from Bihar by Gupta and Srivastava (1993) are also contributions to the algal flora of India.

The earlier studies on Cyanobacteria of rice fields deal with the beneficial effect of blue green algae on rice plants due to nitrogen fixation. Significant studies on the distribution of nitrogen fixing blue green algae in the paddy fields of India were reported from West Bengal (Chatterjee and Chatterjee, 1983) and Maharashtra (Kolte and Goyal, 1985; Patil and Satav, 1986; Sardeshpande and Goyal, 1981). The studies on the Cyanobacteria of rice fields of south India have been very much restricted and they report on the occurrence of a few taxa from selected localities (Anand, 1989).

Prasad and Srivastava (1984a) reported ten taxa of genus *Scytonema* from the fresh waters of Andaman and Nicobar Islands. Later seven taxa of Cyanophyceae were reported from the fresh waters of Andaman and Nicobar Islands belonging to six genera (Prasad and Srivastava, 1986). Sixty blue green algae belonging to twenty one genera were reported from the rice field soils of of Pusa and its adjoining areas of Bihar (Jha *et al.*, 1986). The freshwater blue green algae were also reported from Goa (Kerkar and Madkaiker, 2003), Kanpur (Tripathi and Pandey, 1991), Bihar (Saha, 1984; Patralekh, 1993b), Tamil Nadu (Ramakrishnan and Kannan, 1992),
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Uttar Pradesh (Habib et al., 1992) and Sikkim (Santra, 1984) and are contributions to the knowledge of Indian blue green algae.

Eighty nine blue green algae belonging to twenty eight genera were enumerated by Rao et al. (2008) from the rice fields of south Telangana region, Andhra Pradesh. Thirty six species belonging to six genera of Cyanophyceae are enumerated from Bhubaneswar and its adjoining regions by Mohanty (1982). Later fifteen species of blue green algae was also reported from Bhubaneswar (Mohanty, 1984). Cyanophycean flora of southern Himanchal Pradesh was reported by Dwivedi et al. (2008).

A qualitative assessment of the blue green algae from the rice fields of Assam was made by Deka and Bordoloi (1991) and they enumerated forty seven nonheterocystous and thirty five heterocystous species. Thirty three forms of blue green algae of cultivated soils from Maharashtra were enumerated by Chaporkar and Gangawane (1984).

Studies on blue green algae of rice field soils of Orissa were conducted by Padhy et al. (1992) and Sahu (2000) reported the distribution and monthly succession of blue green algae in the rice fields of Orissa. Choudhary (2009) reported the occurrence of twenty eight species representing nine genera of Chroococcaceae during rice cultivation from north Bihar. Blue green algae from the paddy fields of north Bihar were reported by Verma et al. (1990) and they enumerated twenty seven taxa belonging to nineteen genera. Dhingra and Ahluwalia (2007) illustrated thirty two species of Phormidium from various habitats of Punjab. Barhate and Tarar (1983b) reported one hundred and one taxa of Cyanophyceae from Khandesh, Maharashtra. The Cyanophyceae from the Jalgaon region,
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Maharashtra was studied by Bhoge and Ragothaman (1986a) and they listed a total of sixty three taxa.

Patil and Chaugule (2009) reported 79 species of blue green algae from the paddy fields of Maharashtra. Patil and Deore (2010a) reported three species of the genus *Dichothrix* belonging to the family Rivulariaceae from Dhule district of north Maharashtra. The blue green algae belonging to family Scytonemataceae of order Nostocales from Maharashtra were reported by Patil and Deore (2010b) and they described nine species belonging to four genera. Recently Mahajan (2012) reported twenty seven species belonging to the family Nostocaceae from Jalgaon, North Maharashtra.

Sixty three taxa of blue green algae from the paddy fields of Tamil Nadu were reported by Anand and Subramanian (1994). Anand and Revathi (1987) reported thirty five taxa of blue green algae from the rice fields of Tamil Nadu of which seven are coccoid, twelve are non-heterocystous filamentous and sixteen are heterocystous filamentous.

The Cyanophyceae from the paddy fields of West Bengal was studied by Mukhopadhyay and Chatterjee (1981) and they listed fifty seven taxa belonging to twenty one genera. Twenty five species of blue green algae belonging to nineteen genera were reported from Murshidabad, West Bengal (Pal and Santra, 1982). Forty species of blue green algae were reported from Midnapore, West Bengal (Pal and Santra, 1985). Forty six species of blue green algae belonging to twenty five genera were reported from West Bengal (Maity and Santra, 1985). Blue green algae from the rice fields of West Bengal were also reported by by Sinha and Mukherjee (1975a, 1975b, 1984).
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The Cyanophyceae of Meerut was studied by Bendre and Kumar (1975) and they enumerated one hundred and thirty one species belonging to twenty seven genera. The systematic account of Cyanophyceae from Pathiala was reported by Sarma and Kanta (1978) and Sarma et al. (1979). Reddy et al. (1986) reported fifty two species of blue green algae from the north east India.


Abdul-Majeed (1935) had illustrated sixty two freshwater diatoms from Punjab. Later Venkataraman (1939) described ninety eight forms of diatoms representing thirty three genera from Madras. Krishnamurthy (1954) reported fifty eight species of diatoms from south India. There are reports of diatoms from Rajasthan (Gandhi, 1955), Mysore (Gandhi, 1957, 1958a, 1959a), Kolhapur (Gandhi, 1956, 1958b, 1959b) and Ahmedabad (Gandhi, 1960, 1961).
From Bihar sixteen species belonging to eight genera of Bacillariophyceae were reported (Singh and Saha, 1982b). Eighty nine species belonging to twenty genera of Bacillariophyceae was reported by Saha (1986) from Bhagalpur, Bihar. Prasad and Jaitly (1985) reported twelve taxa of diatoms from Ladakh, Jammu and Kashmir belonging to eight genera.

From Andaman and Nicobar islands four taxa of *Eunotia* (Prasad and Srivastava, 1981), two taxa of *Synedra* (Prasad and Srivastava, 1983), six taxa of diatoms belonging to the genera *Nitzschia* and *Surirella* (Prasad and Srivastava, 1984b) and twenty taxa of freshwater diatoms belonging to twelve genera (Prasad and Srivastava, 1985) were reported.

The diatom flora of Karnataka was listed by Somashekar (1983b) and reported forty six species belonging to seventeen genera. Somashekar (1984b) also enumerated seventy two taxa of diatoms belonging to nineteen genera from Karnataka. Systematic accounts of forty seven taxa of diatoms belonging to thirteen genera from the cultivated soils of Karnataka State were given and illustrated by Bongale (1985).


Dhande and Jawale (2008) described eleven taxa of diatoms of which eight taxa belong to the genus *Fragillaria* and three to genus *Synedra* from
Hartala Lake, Maharashtra. Narkhede (2006a) reported nine taxa of *Nitzschia* and three taxa of *Surirella* from Maharashtra. Narkhede (2006b) reported fifteen taxa of diatoms belonging to three genera namely *Punnularia* (six taxa), *Amphora* (two taxa) and *Cymbella* (seven taxa) of Suki dam in Maharashtra.

The diatoms from Orissa State and neighbouring regions in the eastern part of India were reported by Jena *et al.* (2006b). A total of seventy eight taxa of freshwater diatoms belonging to twenty six genera were recorded by this study. Misra *et al.* (2007) reported eighteen taxa belonging to nine genera of freshwater diatoms from Uttaranchal.

From Lucknow, Uttar Pradesh Prasad *et al.* (1981) reported and illustrated twenty five taxa of freshwater diatoms belonging to eight genera. Fourteen taxa of freshwater diatoms belonging to ten genera were listed from Shahjahanpur, Uttar Pradesh by Pandey (1982a). Fifty two species belonging to twenty two genera of diatoms were reported from Uttar Pradesh by Chaturvedi (1985). Sixteen taxa of freshwater diatoms belonging to fourteen genera of the order Bacillariales were described from Faizabad and Balrampur districts, Uttar Pradesh (Srivastava, 2010).

Fifteen planktonic diatoms of Senchal Lake, Darjeeling in West Bengal were listed by Das and Santra (1982). Kamat and Aggarwal (1975) reported seventeen diatoms belonging to seven genera from Nainital. Reports of diatoms from Allahabad (Pandey *et al*., 1983a), Hyderabad (Venkateswarlu, 1983), Kashmir (Mam, 1995), Tamil Nadu (Rajakumar, 2005; Murugesan and Sivasubramanian, 2008b), Uttar Pradesh (Suseela and Dwivedi, 2002) and West Bengal (Pal and Santra, 1990; Bhattacharya *et al*., 2011) are also contributions to the knowledge of Indian freshwater diatom flora.
1.1.3 Phycological research in Kerala

Information on the algal biodiversity and related aspects pertaining to the water bodies occurring in Kerala state of peninsular India is scanty or lacking (Pushpangadan et al., 1997; Mohanan and Nair, 1999; Bijukumar, 2004). From Kerala the total number of algae reported was eight hundred and thirty four as compiled by Easa (2004), of which 503 taxa belong to Chlorophyta, 186 taxa belong to Cyanophyta, 52 to Euglenophyta, 3 to Xanthophyta, 22 to Phaeophyta and 68 to Rhodophyta.

The study of the algal flora of Kuttanad soils of Kerala state was conducted by Amma et al. (1966). Mary et al., (2008) reported the presence of thirty nine taxa of Chlorophyceae and fifteen taxa of Bacillariophyceae from Alappuzha-Changanassery canal in Kuttanad wetland ecosystem. Arulmurugan et al. (2010) reported sixty one algal taxa belonging to Chlorophyceae, Bacillariophyceae, Euglenophyceae and Cyanophyceae from the temple tanks of Palakkad and Thrissur districts of Kerala.

Chaudhary and Pillai (2010) studied the diversity of phytoplankton at Sasthamcottah Lake, Kollam. Joseph and Prakasam (2002) recorded thirty nine genera of phytoplankton from the Sasthamcotta Lake of Kerala, of which twenty six genera belongs to Chlorophyceae, seven genera to Bacillariophyceae, five genera to Cyanophyceae and one genus of Dinoflagellate. The phytoplankton of Kayamkulam wetland, Kerala was composed of fourteen genera of green algae, thirteen genera of blue green algae, one genus of yellow brown algae, nine genera of desmids, twenty four genera of diatoms and six genera of dinoflagellates (Bijoy and Usha, 2005).

Jithesh (2010) identified fifty nine taxa of phytoplankton from Mullaperiyar in the Western Ghats, Idukki district, Kerala. The algal flora...
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of Thodupuzha thaluk, Idukki district was reported by Jose and Francis (2007) and they described sixty seven taxa. Jose and Francis (2008) made a systematic study on the freshwater algal flora of Idukki district and reported four hundred and ninety four taxa. Wetland algal resources of Idukki district, Kerala was reported by Jose and Francis (2010) and they described thirty three taxa.


Panikkar and Ampili (1992), Sindhu and Panikkar (1993) and Ushadevi and Panikkar (1993a) described the species of Oedogonium and Ushadevi and Panikkar (1991, 1994a, 1994b) reported Spirogyra from Kerala. Ten taxa of Mougeotia (Ushadevi and Panikkar, 1993c), eleven species of Zygnema (Ushadevi and Panikkar, 1993e), six species of Bulbochaete (Ushadevi and Panikkar, 1993b), seven taxa of Sirogonium (Ushadevi and Panikkar, 1994c), four species of Zygmemopsis (Panikkar et al., 1997a) and two species of Coleochaete (Sindhu and Panikkar, 1994b) are collected and described systematically from the different habitats of Kerala. Two taxa of the order Chaetophorales, Iwanoffia terrestris (Iwan) Pascher and Trichodiscus elegans Welsford are reported for the first time from Kerala (Sindhu and Panikkar, 1994a). Panikkar et al. (1997b)
collected and described *Mougeotia ravii* from an uncultivated paddy field of Kollam.

The systematic account of Chlorococcales of Kerala was reported by Jose and Patel (1992) and they reported twenty taxa belonging to seven genera. Cherian (2006) reported fourteen taxa of *Scenedesmus* from Thrissakara, Kochi.

Shaji *et al.* (1988, 1989), Shaji and Patel (1990, 1991a) and Sindhu and Panikkar (1995a) described desmids from various freshwater bodies of Kerala. Twelve species of *Pleurotaenium* (Sindhu and Panikkar, 1994c), twenty one species of *Closterium* (Sindhu and Panikkar, 1994d), seven taxa of *Netrium* (Sindhu and Panikkar, 1994e), twenty six species of *Cosmarium* (Sindhu and Panikkar, 1994f) and twenty two taxa of *Staurastrum* (Sindhu and Panikkar, 1995b) were described from Kerala.

Shaji (2004) described *Pleurotaenium kayei* (Arch.) Rab. var. *major* from a paddy field in Kollam district, Kerala. Panikkar and Sreeja (2005, 2006) and Ushadevi and Panikkar (1993d) reported the different stages of zygospore formations of desmids collected from paddy fields, ditches and ponds from Kerala. From Kerala the total number of desmids reported was one hundred and twenty six as compiled by Easa (2004) which belong to fourteen genera.

Shaji and Patel (1991b) and Shaji *et al.* (1995) described and illustrated Euglenoids collected from different habitats of Quillon district of Kerala state. From Kerala the total number of Euglenoids reported was fifty two which belong to eight genera namely *Euglena* (6 taxa), *Lepocinclis* (1), *Phacus* (28), *Trachelomonas* (12), *Astasia* (1), *Petalomonas* (2), *Pealomonas* (1) and *Notosolenus* (1) as compiled by Easa (2004).
The large scale use of blue green algae as a biofertilizer is yet to become a common practice among farmers of Kerala due to its poor response under field conditions (Anand, 1989). This is because the soils of Kerala are generally acidic in nature and the species of blue green algae are sensitive to low pH for normal growth and nitrogen fixation (Nair et al., 1993).

The earlier studies on blue green algae of Kerala have been reported by John (1963), Aiyer (1965) and Amma et al. (1966). Anand and Hopper (1987) made a survey of blue green algae occurring in the rice fields of Kerala State and thirty taxa identified and described. Nair et al. (1993) reported that a near neutral pH condition is essential for normal growth and multiplication of blue green algae. Anand and Hopper (1995) reported an account of blue green algae of the rice fields of Kerala state and one hundred and fifty eight taxa of blue green algae assigned to thirty three genera were recorded.

Madhusoodanan and Dominic (1996a, 1999) reported the Cyanobacteria from the extreme acidic environments. Twelve species of epiphytic Cyanobacteria under five genera growing on the mosses from Western Ghats of Kerala are described by Madhusoodanan and Dominic (1996b). Shaji and Panikkar (1994, 1996) described Cyanophyceae collected from different parts of Kerala. *Anabaena flos-aquae* (Lyngb.) Breb. ex Born. et Flah. was recorded from Kerala by Teresa and Rekha (2002). From Kerala the total number of blue green algae reported was one hundred and eighty six which belong to thirty six genera (Easa, 2004).

The freshwater diatom flora of Kerala was studied and reported twenty nine taxa belonging to nine genera namely *Eunotia, Cocconeis,
Stauroneis, Neidium, Navicula, Cymbella, Gomphonema, Pinnularia and Surirella by Jose and Patel (1989).

1.1.4 Algal research in Thrissur district, Kerala state

There is lack of exhaustive data on the biodiversity of the Thrissur district, Kerala State especially with regard to the data on the lower plant groups including algae (Nair et al., 2005). Nair (2005) compiled the available literature on the biodiversity of algae in Thrissur district of Kerala, of which thirty seven species belong to Cyanophyta, eight species belong to Chlorophyta and four species belong to Rhodophyta. In fact, there is no information available on the total algal flora of the Thrissur district of Kerala, as the areas are not surveyed and remain under explored for the algae.

The blue green algae reported from the paddy fields of Talappally Taluk of Thrissur district are Chlamydomonas elliptica, Chlorococcum humicola, Uronema terrestris, Plectonema nostocorum, Calothrix brevissima, Aulosira fertilissima, Charcium ornithocephalum, Oscillatoria sancta, Cylindrospermum musicola and Nostoc punctiforme (Aiyer, 1965). A systematic survey of the algae from Cranganore had done by Suxena et al. (1973) which illustrated one hundred and nineteen taxa of algae. Arulmurugan et al. (2010) reported forty six algal taxa from the temple tanks of Thrissur district.

The taxonomic assessment of a lotic wetland was done by Amitha and Tessy (2005) and seventy six genera of algae were identified that belong to six taxonomic groups. The preliminary systematic survey of Cyanophyceae conducted in three aquatic habitats in Thrissur district identified fifty six species of blue green algae under fourteen genera (Nisha
and Tessy, 2005). From Chalakudy river Rincy and Tessy (2009) reported one hundred and seventeen species of phytoplankton under fifty three genera and Leenamol and Tessy (2009) reported eighty three algal species belonging to forty eight genera.

Tessy and Saritha (2010) enumerated thirty six algal species belonging to Bacillariophyceae and two taxa belonging to Cyanophyceae from Poyya, Thrissur district. Tessy and Shubha (2011) reported eighty two algal species belonging to forty two genera from the coconut husk retting area in Talikulam, Thrissur district.

1.1.5 Research in the Kole lands of Thrissur district, Kerala

The scientific studies of the Kole lands of Kerala are still inadequate and there is a scarcity of research data except for some project reports or isolated research papers based on agriculture (Johnkutty and Venugopal, 1993). No specific information is available on the distribution, diversity and species composition of the algal flora of Thrissur Kole lands (Annie, 2003).

Hameed (1975) investigated the chemical characteristics of Kole land soil and reported that the organic matter content of the soil was very high. Chemically the soil was acidic with pH 2.6 to 6.3 and the pH decreases with increasing depth. Based on the textural analysis Kole land soil has been classified into clay, sandy loam, sandy clay loam, and clay loam (Sheela, 1988).

The study of Anand and Hopper (1995) reported eight blue green algae from the Kole of Thrissur. The diversity and seasonal variation of seventy nine species algae in Muriyad wetland was reported by Sanilkumar and Thomas (2006). Preliminary assessment of phytoplankton diversity and
the hydrographic parameters in Thrissur Kole lands were reported by Tessy (2007) and Tessy and Sreekumar (2008b, 2009).

Fifteen taxa of desmid *Micrasterias* (Tessy and Sreekumar, 2007), fifty nine taxa of blue green algae belonging to twenty three genera (Tessy and Sreekumar, 2010) and twenty three taxa of desmid *Pleurotaenium* (Tessy and Sreekumar, 2011a) were reported from the Kole lands of Thrissur. Tessy and Sreekumar (2008a) reported the presence of the pollution tolerant algae from the Thrissur Kole lands. Tessy and Sreekumar (2011b) reported freshwater algal taxa belonging to Xanthophyceae, Chrysophyceae and Dinophyceae from the Kole lands of Thrissur district.

Nameer (2002), Thomas *et al.* (2003) and Thomas and Sreekumar (2010) reported that serious and irreversible changes are taking place in several parts of the Kol wetlands of Kerala due to clay mining, indiscriminate sand mining, disposal of organic wastes from chicken farms, non-biodegradable plastic wastes, conversion of paddy fields into brick kilns, reclamation of paddy fields for crops other than paddy and also for the construction of permanent bunds and roads.

### 1.2 Objectives of Investigation

The main objectives of the present investigation are:

1) To gather information regarding the diversity of freshwater algae in the Kole lands of Thrissur district up to the species level.

2) To evaluate the seasonal and spatial variation of algal flora and to assess the relative abundance of algae in the study area.
3) To compare the physico-chemical aspects of water in relation to the diversity of algae of the Kole lands of Thrissur.

4) To analyze the community structure, pigment composition and productivity of the area studied.

1.3 Significance of the Present Investigation

The freshwater biodiversity of Kerala received very little attention from the researchers, planners and policy makers. The freshwater habitats in Kerala are under severe stress due to anthropogenic interventions like deforestation, sand and clay mining, monoculture plantations and intensive agriculture. The Kerala flora comprises a total of 11,840 taxa of plants which includes 866 species of algae (KSCSTE, 2007).

The freshwater biodiversity of Kerala State is not well documented and the rate of possible biodiversity loss is not yet quantified in Kerala (Bijukumar, 2004). The compilation of the bibliography on the Ramsar sites of Kerala shows that the knowledge of flora and fauna is meager (Annie, 2003). There is no work done either on taxonomic account of algae or on the quantitative account of plankton present in the Kole lands of Kerala and hence the present work was undertaken. The species composition and distribution of algal flora would give more information regarding the species richness of Kerala.

A perusal of the existing literature reveals that very few limnological investigations related to algal biodiversity had been done in Thrissur district. Practically no work has been done on the taxonomy, species diversity, seasonal and spatial variation of algae in the Kole lands of Kerala. The quantitative estimation of phytoplankton and hydrographic parameters of the present study would highlight the present status of algal diversity of Kole lands.
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and the probable involvement of phytoplankton to the total organic production in Thrissur Kole lands. The present study therefore will undoubtedly furnish valuable information on the algal flora of Kerala State.

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