CHAPTER-I

INTRODUCTION

1. INTRODUCTION

Fern-allies, the non-fern members, are distinct from the ferns among the Pteridophytes. Fern-allies comprises of five families viz., Psilotaceae, Lycopodiaceae, Selaginellaceae, Equisetaceae and Isoetaceae. The Pteridophytes i.e the seedless vascular plants dominated the earth's vegetation about 280-230 million years ago (Mehra 1967; Bir 1976, 1987a, 1994; Khare 1996). Although the present floral components largely replaced by the seed bearing plants, yet pteridophytes constitute a prominent part of the vegetation of the globe.

Jones and Luchsinger (1986) estimated that globally pteridophytic flora amount to about 13000 species, out of which fern-allies represented by about 1000 and ferns by about 12000 species. While according to Pryer et al. (2004), there are about 10,000 living species of Fern and Fern-allies distributed throughout the world. Kenrick and Crane (1997) quoted that Lycophytes are represented by about 1100-1200 species which include the three primary group of allied ferns viz., Lycopodiales, Selaginellales and Isoetales. Further, Kenrick and Crane (1997) are of opinion that Lycophytes are all relics of a severe extinction in the latter half of the Pennsylvanian, about 296 million years ago. Globally, Psilotaceae Kanitz is represented by 2 species (Jones and Luchsinger 1986) or 12 species (Mabberley 2005; Bierhost 1971); Lycopodiaceae Pallisot de Beauvois ex Mirbel by 300 species (Jones and Luchsinger 1986) or 382 species (Mabberley 2005); Selaginellaceae
Willkomm by 700 species (Jones and Luchsinger 1986; Ghosh et al. 2004; Mabberley 2005); Equisetaceae L.C. Richard ex. A.P. Candolle by 25 species (Jones and Luchsinger 1986), 15 species (Pryer et al. 2004; Mabberley 2005) and Isoetaceae Dumortier by about 65 species (Jones and Luchsinger 1986) or 200-250 species (Hickey 1998).

The rich biodiversity of India is represented by about 15000 species of the vascular plants accounting for 10-12 percent of the world vascular flora (Jain 1984). The Pteridophytic flora greatly contributed to its diversity (Kaur 1979, 1980, 1989; Bir 1987a, 1987b). According to a conservative estimate Pteridophytic flora is represented by about 600 species in India (Bir 1987a). Whereas according to Dixit (1984) and Dixit and Vohra (1984) the Pteridophytic flora in India comprises of 67 families, 191 genera and more than 1000 species. As a constituent of Indian flora of vascular plants, the fern and fern-allies form only 5 percent as far as number of species are concerned (Satija and Bir 1985).

Information on Indian fern can be retrieved from the works of Beddome (1863-1884, 1865-1870, 1876, 1883, 1892), Clarke (1879, 1880a, 1880b), Hope (1899, 1900a, 1900b, 1901, 1902, 1903a, 1903b, 1904), Dixit (1987, 1992), etc. Dixit and Kumar (2002) enumerated a total of 49 families, 105 genera, 444 species, 5 subspecies and 26 varieties of Pteridophytes from Uttaranchal state. Ghosh et al. (2004) reported 810 species and total of 37 subspecies and varieties from Eastern Himalaya. However, information on the allied ferns in India has been remain scanty till today. Information on Pteridophytes in the state can be extracted from the works of Clarke (1880a, 1880b), Beddome (1865-1870, 1883), Kachroo (1953, 1975), Panigrahi (1960, 1968), Panigrahi and Choudhury (1961, 1962), Panigrahi and Patnaik (1961a, 1961b) and Vasudeva et al. (1990). Handique and Konger (1986) and Barua et al. (1989) published enumeration of fern and fern-allies from Guwahati and Kamrup.
Psilotaceae Kanitz includes two genera *viz.*, *Psilotum* Swartz. and *Tmesipteris* Swartz. (Mabberley 2005). The genus *Psilotum* Sw., commonly known as Whisk-fern and this nomination may be due to its broom-like appearance (Qiu and Palmer 1999). The word "psilotum" means naked in Greek and "nudum" means naked in Latin. The name supposed to have been owned due to the absence of distinct leaves. Approximately 30 different species have been named (Reed 1966), but most of the workers believed or approved that the genus consists of two species (Singh et al. 2003; Ghosh et al. 2004; Singh and Panigrahi 2005) and these two species are distributed in tropics (Mabberley 2005). According to Fraser-Jenkins (2008) in India the family is represented by two species *viz.*, *P. nudum* and *P. complanatum*. The genus *Tmesipteris* consists of 10 species (Bierhost 1971) distributed in SE Asia especially in Australia. It is also confined to some Island in the South Pacific Ocean, Australia, New Zealand, TaSmania, Polynesian Island and New Caledonia. So far there is no record of the occurrence of *Tmesipteris* sp. in India.

The monogeneric family Equisetaceae L.C. Richard ex. A.P. Candolle commonly known as “Horsetils” has a lineage with fossil ancestors dating back to the late Devonian period (Brune et al 2008). They are also known as “scouring rush” due to the presence of rough ridged-siliceous stem. Out of about 10,000 living species of Fern and Fern-allies (Pryer et al. 2004), the only genus *Equisetum* L. of Equisetaceae is represented by 15 species (Pryer et al. 2004; Mabberley 2005) distributed throughout the world except in
Australia. Only 10 species occur in Europe (Mabberley 2005). Singh and Panigrahi (2005) reported the occurrence of seven taxa within the genus in Indian subcontinent. However, Fraser-Jenkins (2008) contradicting the occurrence of 7 taxa in Indian subcontinent advocated the opinion that three species viz. *E. debile*, *E. giganteum* and *E. ramosissimum* have been erroneously reported against *E. ramosissimum* and occurrence of only four valid species has been confirmed by him.

The family Lycopodiaceae was first assigned by Mirbel and it was described in French. The Latin name “Lycopodia” to the group was given by him. Earlier, the name Lycopodiaceae has been attributed to Michaux, Palisot de Beauvois, L.C.Richard, De Candolle and Swartz but none of them published validly (Pichi-Sermolli 1970). Subsequently the family was split into two viz. *Lycopodiaceae* and *Huperziaceae* Rothm (Dixit, 1984) or four, the other two being *Urostachyaceae* Rothm (Feddes Reprt, 54. 58. 1994, nom. illeg.) and *Phylloglossaceae* Kunze (Bot. Zeit. 1: 722. 1843). Dostal (1984), Tryon and Tryon (1982), Olgaard (1990) and others recognised only one family Lycopodiaceae Mirb. s. lat. Lycopodiaceae Pal. ex. Mirbel includes four genera viz., *Lycopodium* L., *Lycopodiella* Holub., *Phylloglossum* Kunze and *Huperzia* Bern. *Lycopodium* L., also known as clubmoss, is represented by 40 species (Mabberley 2005). *Lycopodiella* with about 40 species are distributed in the tropics and moist temperate region of the world (Mabberley 2005). *Phylloglossum* with two species is restricted to Australia only. *Huperzia* with about 300 species has sub-coSmopolitan distribution (Mabberley 2005).

The monogeneric family Selaginellaceae Willk. is represented by about 700 species of *Selaginella* Pal. (Ghosh et al. 2004; Mabberley 2005) are distributed throughout the
globe (Mabberley 2005), but mainly in tropical and subtropical regions of the world. In India, the genus is represented by 62 species (Dixit 1992; Ghosh et al. 2004). However, recently Madhusoodanan and Nampy (1994), Antony et al. (2002) and Nampy and Nisha (in press) described three new species from India and thereby increasing the number to 65 species occurring in India. Ghosh et al (2004) reported 28 species from Eastern India. Fraser-Jenkins (2008) while dealing with the complex groups within the Pteridophytes, determining the nomenclature, taxonomy and erroneous records of Indian Pteridophytes mentioned that in India the genus Selaginella is represented by 41 species and one subspecies. The number of species of Selaginella occurring in Assam differs in different works (Alston 1945; Panigrahi and Dixit 1969; Baisya and Rao 1982) because of the fact that these works includes erstwhile Assam and not the present political boundary of the state. In fact, very few species have been reported from the present political boundary of Assam in the above works.

The family Isoetaceae Dumortier with single genus Isoetes L., popularly known as quillworts or Merlin’s Grass or Brachser grass, is a diminutive herbaceous Lycopod and one of the most enigmatic genera of the Pteridophyta. It has survived the ravages of time and space to green the face of the earth even today and is the only representative of the family Isoetaceae typified by I. lacustris L. But during the process of evolution it has to pass through a high reduction pressure to escape extinction. This has resulted into some unprecedented modification leading to the development of a number of abnormal features viz., bipolar growth, formation of secondary meristem, bilateral symmetry of the stem and unusual rooting structures. Further, the presence of certain ancestral characters established its link to the past (Srivastav 1998). The genus is represented by about 150 species (Taylor
and Hickey 1992) or 200-250 species (Hickey 1998) or 200 species (Hoot and Taylor 2001) or 300 species (Hickey et al. 2003) and distributed throughout the world. In India the genus is represented by 14 species (Shukla et al. 2002) or 15 species (Srivastava 1998) or 1-2 species (Fraser-Jenkins 2008). Recently, two new species viz., *I. udupiensis* and *I. divyadarshani* are described from peninsular India (Shukla et al. 2005). So far among Indian species under the genera 26 different taxa have been named (Fraser-Jenkins 2008). But, Fraser-Jenkins (1997, 2008) and Chandra et al. (2008) have raised question on many of the described species as new and strongly opposed the existence of many of those species. Subsequently, Fraser-Jenkins (2008) provided his explanation in support of his view and approved the occurrence of only one good species i.e. *I. coromandelina*. But none of the earlier workers has reported the occurrence of the genus *Isoetes* from Assam.

2. CHOICE OF THE PRESENT STUDY

Majority of Indian floras did not include Vascular Cryptogams, even Beddome's (1892) "Handbook to the ferns of British India" excluded fern-allies. Clarke (1880a) included Lycopods in "Ferns of Northern India" but excluded *Selaginella*. Indian pteridophytic flora contains about 100 species of allied ferns (Bir 1987a). Manickam and Irudayaraj (1992) reported 23 fern-allies and 233 fern taxa from Western Ghats. Among the North eastern states of India, Arunachal Pradesh is represented by 15 species (Singh and Panigrahi 2005), Meghalaya by 21 species (Baisya and Rao 1982) and Tripura by 11 species (Das 2007) of allied fern. Dutta et al. (1980) reported 15 species of fern-allies from North Cachar Hills and Barail Range of Assam. Unfortunately, no detail study on the allied ferns has so far been carried out for NE India. The floristic works done so far in Assam
either deals with the angiosperms and gymnosperms or with the Ferns among the lower vascular plants. The allied ferns remain as a group to be studied in most of the regions of our country including Assam. Occurrence mostly in inaccessible areas, inconspicuous size, microscopic examination for identification and insufficient literature may be the reason for this apathy.

In the light of the above the present study on ‘TAXONOMIC STUDIES ON PTERIDOPHYTES: FERN-ALLIES OF ASSAM’ was taken up during 2010 to 2012 to bridge the gap on our knowledge about the allied fern of the region in general and Assam in particular.

3. AIM AND OBJECTIVES OF THE WORK

The aim of the study is to prepare a consolidated taxonomic account of the fern-allies of the state and the objectives are:

A. To explore and document the occurrence of the fern-allies within the political boundary of Assam.

B. To update the taxonomic and nomenclatural status of the taxa occurring in Assam.

C. To study the morphological as well as anatomical characteristic features of each and every taxa occurring in Assam for determining their identity so as to supplement the morphological attributes for identification of the species and in drawing circumscription among the taxa.

D. To study the details of the reproductive structures and work out their variations to supplement the morphological and anatomical attributes as taxonomic criteria and
E. To determine the conservation status of the taxa of the group and to find out the causes of endangerment.