7. Summary:

Pteridophytes occupy the central position in the classification of vegetable kingdom due to its phylogenetic importance. Since its recorded history of origin in the mid Silurian period, pteridophyte has diversified and is represented to-day globally by about 12,000 species of ferns and fern-allies. India represents about 1100 species of pteridophytes in its tropical, subtropical and warm temperate climates. In India, Eastern Himalaya is one of the ‘hot spots’ of the world and harbor a large number of pteridophytes including the endemic ones.

Pioneering work on pteridophytic flora in British India came through the works of Beddome, Clarke and Hope, which though are of century old, but still have relevance as reference for identification due to their wide and masterly coverage. In the meantime, there is a sea change in the names of pteridophytes and to overcome this problem, two publications have come up by Nayar & Kaur (1974) and Chandra & Kaur (1987). Till date, India does not have any published pteridophytic flora of its own. However, in independent India, many floristic works were undertaken both State-wise and Region-wise by many workers from time to time. The State Sikkim has not been adequately surveyed for its pteridophytic flora except the work of Mehra and Bir (1964), which covered a part of Sikkim and Darjeeling Himalayas. After Mehra and Bir (1964), a check list of pteridophytes of Kanchenjungha National Park was published by Maity and Chauhan (2002).

The State Sikkim is geographically situated between 27° 5' N – 28° 10' N Latitudes to 88° 59'E – 89° 56' E Longitudes covering an area of 7096 sq.km. It is a hilly State. It encompasses tropical, subtropical and temperate climatic conditions along with rainfall almost throughout the year. The climatic conditions are very congenial for pteridophytic growth and for these reasons the Sikkim State, particularly the Southern part of Sikkim is very rich in pteridophytes. So, South Sikkim was chosen for the present study, which is almost half of the entire State of Sikkim measuring an area of 3500 sq.km. Though Sikkim ranges in its altitudes from 400m – 8583m, but the study has been restricted for assessing the pteridophytic diversity up to 4300m altitudes. The work was undertaken not only to make an updated comprehensive illustrated list of pteridophytes, but also to provide their ecological status, distributional patterns both in spatial and in vertical (on the host trees) manners to locate the species-rich areas of pteridophytes. These species-rich areas may be
brought under protected areas for conserving pteridophytic biodiversity. Similarity index value of species between the different districts of South Sikkim was also calculated. To find out the reasons for depletion of pteridophytic plants in the study area was also another objective of this study. As Sikkim has three countries like China, Tibet and Nepal lying along its border areas, phytogeographical analyses were made to know the percentage of pteridophytic elements present in South Sikkim from adjoining countries as well as to determine the endemic species present in South Sikkim.

The present work is based on the collections of naturally occurring living pteridophytes and data collected during the period from November 2002 to November 2005. Collections were made from different locations of the study area in three different seasons' viz., pre-monsoon, monsoon and winter of the year. Collected plants were identified following the authenticated materials housed at different herbaria and also with the help of published literatures. These collected plants have been arranged following Pichi Sermolli's system (1977) of classification with some minor changes. A key to the families and where necessary, keys for genera and species have been provided. Genera and species have been arranged alphabetically under a family and genus respectively. Reference to the original literature, 'type' of the family and genus, basionym and synonyms are provided as terms of reference. After each taxon, mentions have been made of their earlier records of distributions and chromosome numbers where known.

For studying pteridophytic species-richness, the technique developed by Parris (1996) was followed. The study area was divided into 6 X 6 km grid cell plots following Bolos and Romo (1991). Extensive field surveys were made to collect pteridophytes from 28 grid cell areas from 420m to an altitude of 3573m. Distributions of pteridophytes in the concerned grid cells were recorded. Rainfall and temperature data were collected from the Meteorological department, Govt. of Sikkim.

For studying vertical distribution of epiphytic pteridophytes, the methods of Johansson (1974) and Cornelisen & Steege (1989) were followed. The epiphytes found in different height sections of the host trees were recorded.

128 pteridophytic species were collected from South Sikkim which belonged to 60 genera and 33 families. Polypodiaceae is the dominant family of South Sikkim and is represented by 12 genera and 35 species, followed by Dryopteridaceae (4
genera and 12 species). *Hypolepis alpina* (Hypolepidaceae) and *Lepisorus ussuriensis* (Polypodiaceae) have been found as new records from Sikkim.

From the study of spatial distribution of pteridophytes, it was found that among the different altitudinal zones of South Sikkim, Upper hill forest zone (1500-2700m) provides the most congenial conditions of temperature, humidity and rainfall for pteridophytic growth and harbors the maximum number of pteridophytic species. It was also found that with increase of altitude, pteridophyte species diversity increases, but up to a certain level after which diversity decreases. Altitude is not the only determinative factor for changing species diversity, but average annual rainfall, average annual temperature (maximum & minimum) and exposure to hill face to sunlight have effects in combination on pteridophytic species diversity of a place. Versey and Maenum, two wildlife sanctuaries present in the southwestern and central parts of the study area respectively, though having almost same altitudes but differ markedly in the number of pteridophytes largely due to the difference in their average annual rainfall.

Out of the four vertical zones of a host tree, the upper foot region harbors the maximum number of pteridophytic species, due to presence of most suitable conditions of temperature, low wind velocity and high humidity in this region. This region is also out of reach of the grazing animals. While, the tree top region harbors the lowest number of pteridophytic species, probably due to presence of adverse conditions like high wind velocity, low humidity and low temperature. From the vertical distributions of epiphytes, it was also found that some species were having very wide distributions (called ‘Generalist species’) on the host trees. While, a few epiphytic species were noted to have restricted distributions (called ‘specialist species’) on the host trees. The generalized species noted are *Pyrrosia lanceolata*, *Oleandra wallichii*, *Polypodioides lachnopus* and *Arthromeris wallichiana*, while the specialist species recorded are *Pseudodrynaria coronans*, *Microsorium punctatum*, *Nephrolepis cordifolia*, *Lepisorus ussuriensis*, *Polypodium argutum*, *Pyrrosia manii*, *Selaginella involvens* and *Ctenopteris subfalcata*.

There are many direct and indirect reasons for depletion of pteridophytes in South Sikkim. These are the increasing pressure of population which has effect on the land use pattern of agriculture, loss of forest areas, increase of tourist pressure, use of pteridophytes as fodder and food, environmental pollution and due to botanical collections. It has been seen that deposition of Pb on the road side soils from
automobile exhaust has direct effect on the germination and growth of gametophytes of pteridophytes.

From the phytogeographical analysis of pteridophytic flora of South Sikkim it is seen that 76.5% of the Western Himalayan elements and 67.9% of the N. Eastern Indian pteridophytic elements are common in the pteridophytic flora of South Sikkim. Among the pteridophytic elements of neighboring countries Chinese and Nepalese elements are more than 60% common with that of South Sikkim. Out of 200 endemic species of Pteridophytes present in India, Eastern Himalayas alone represents 100 species. South Sikkim has only 4 endemic species of its own.

From this study it is seen that Pelling, Maenum, Rabongla and Gangtok possess the maximum number of pteridophytic species and these areas should be brought under protected areas for conservation of pteridophytes.