

DISCUSSION AND CONCLUSION

Based on five years (1992-1996) of field collections and study of flora, a total of 215 species belonging to 87 genera and 43 families of fern have been recorded to be occurring in Assam in the present study.

It is also observed in this work that the terrestrial species constitute more than 75 percent (147 species), while epiphytes constitute approximately 25 percent (53 species) of the total fern flora of Assam (Table-I). There are only 31 species (14.41 percent) of ferns occurring as lithophytes in the state. In addition to the above there are five species of aquatic ferns and seven species of climbers also.

A comparison of five dominant families of ferns in India (Dixit 1984), Meghalaya (Baishya & Rao 1982), Nagaland (Jamir & Rao 1988), Darjeeling and Sikkim (Mehra & Bir 1964), N.W. Himalayas (Dhir 1980) and Western Ghats (Manickam & Irudayaraj 1992) with the present work shows that Polypodiaceae is not only the largest family in India but also in the Northeastern India, while its position becomes third in the N.W. Himalayas and fifth in Western Ghats (Table-II). Pteridaceae which do not find a place in other regions including India as a whole, however, occupies third position in the present study and fifth position in Darjeeling and Sikkim. Likewise, Aspidiaceae occupies fifth position in the present study while it occupies second position in Nagaland and N.W. Himalayas, and third position in Darjeeling and Sikkim. Aspleniaceae and Dryopteridaceae find places among the five dominant families in other regions but do not find any place in the present study.

The comparison of the fern flora of Assam with that of Meghalaya, Nagaland, Darjeeling and Sikkim, N.W. Himalayas and Western Ghats reveals that 120 species (55.55 percent) of ferns of Assam are common to Meghalaya, 143 species (68.83 percent) common to Nagaland, 96 species (44.64 percent) common to Darjeeling and Sikkim, 77 species (35.81 percent) common to N.W. Himalayas and 89 species (41.39 percent) common to Western Ghats (Table-III). It also reveals that only 31 species (14.41 percent) of ferns occurring in Assam are also occurring in all the above regions/states of India. Baishya & Rao (1982) have found that 133 species (53 percent) of Pteridophytic flora of Meghalaya are common to South Indian hills and 140 species (56 percent) are common to Western Himalayas. However, the present study shows that contrary to the findings of Baishya & Rao (1982) in Meghalaya, the fern flora of Assam is similar to South Indian hills than to the Western Himalayas. It also appears that in northeastern India the distribution of fern flora follows more or less uniform pattern. Moreover, Kachroo (1975) has listed 89 species of ferns common to Assam region, Sikkim and Nepal. Of these, 46 species have been recorded in the present study to be occurring within the present political boundary of Assam. However, Kachroo (1975) has also listed another 33 species of ferns common to Sikkim and Nepal but not recorded from Assam region. Curiously enough out those 33 species, nine species (species) viz. *Asplenium normale*, *Coniogramme procera*, *Cheilanthes albomarginata*, *Dennstaedtia scabra*, *Dryopteris marginata*, *Lepisorus nudus*, *Pteris excelsa*, *Pteris wallichiana* and *Vandenboschia auriculata* have been recorded in the present study from Assam.

Assam, as used in most of the studies on Pteridophytes of Assam including even some of the recent works (cf. Satija & Bir 1985, p. 6, 22, 62), includes entire northeastern India now comprising seven states viz. Assam, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura and Meghalaya.

Table I : Ecological classification of ferns of Assam.

Categories	Families	Genera	Species	Percentage
1. Terrestrials	34	61	147	77.04
2. Epiphytes	10	25	53	24.65
3. Lithophytes	13	20	31	14.41
4. Aquatic	4	4	5	2.32
5. Climbers	3	5	7	3.25

* Species occurring in more than one habitats are grouped in more than one category.

Table II : Comparison of five dominant fern families in India, Meghalaya, Nagaland, Darjeeling & Sikkim, N. W. Himalayas and Western Ghats with the present study.

Present study	India (Dixit 1984)	Meghalaya (Baishya & Rao 1982)	Nagaland (Jamir & Rao 1988)	Darjeeling & Sikkim (Mehra & Bir 1964)	N. W. Himalayas (Dhir 1980)	Western Ghats (Manickam & Irudayaraj 1992)
Polypodiaceae (17 : 44)	Polypodiaceae (27 : 132)	Polypodiaceae (23 : 51)	Polypodiaceae (16 : 53)	Polypodiaceae (14 : 51)	Athyriaceae (4 : 41)	Aspleniaceae (1 : 26)
Thelypteridaceae (12 : 33)	Dryopteridaceae (4 : 103)	Dryopteridaceae (6 : 21)	Aspidiaceae (11 : 43)	Athyriaceae (6 : 47)	Aspidiaceae (8 : 39)	Adiantaceae (1 : 25)
Pteridaceae (1 : 15)	Athyriaceae (14 : 85)	Thelypteridaceae (10 : 20)	Thelypteridaceae (15 : 31)	Aspidiaceae (9 : 46)	Polypodiaceae (3 : 38)	Thelypteridaceae (14 : 24)
Athyriaceae (5 : 12)	Thelypteridaceae (21 : 81)	Aspleniaceae (1 : 14)	Athyriaceae (5 : 21)	Thelypteridaceae (4 : 30)	Thelypteridaceae (7 : 22)	Dryopteridaceae (8 : 21)
Aspidiaceae (3 : 9)	Aspleniaceae (4 : 53)	Adiantaceae (5 : 14)	Aspleniaceae (1 : 17)	Pteridaceae (1 : 21)	Aspleniaceae (2 : 19)	Polypodiaceae (12 : 20)

* The numbers in parenthesis relate to the number of genera and species in that family.

Table III : Comparison of total genera and species of ferns in India, Meghalaya, Nagaland, Darjeeling and Sikkim, N.W. Himalayas and Western Ghats together with total number of species and percentage of species of ferns of Assam common to the above regions/ states.

Regions / States	Total Genera	Total Species	No. of Species Common to Assam	Percentage of Species Common to Assam
India (Dixit 1984)	191	More than 1,000	—	—
Assam (Present study)	87	215	—	—
Meghalaya (Baishya & Rao 1982)	88	224	120	55.55
Nagaland (Jamir & Rao 1988)	98	280	143	68.83
Darjeeling & Sikkim (Mehra & Bir 1964)	86	338	96	44.64
N. W. Himalayas (Dhir 1980)	71	264	77	35.81
Western Ghats (Manickam & Irudayaraj 1992)	81	239	89	41.39
Meghalaya, Nagaland, Darjeeling & Sikkim, N. W. Himalayas and Western Ghats	—	—	31	14.41

Therefore, it is not possible to draw a clear picture of fern flora within the present political boundary of Assam from the earliest works. However, a careful scrutiny of earlier literature shows that 17 species encountered in the present study have been recorded for the first time from Assam. These include species so far known to occur in South India viz. *Adiantum aeothiopicum*, *Cyclosorus interruptus*, *Oleandra musifolia*, *Pteris mltiaurita*, *teris scabripes* and *Tectaria wightii*, species so far known to occur in Southwest India viz. *Sphaerostephanos subtruncatus*, species so far known to occur in North and South India viz. *Pronephrium articulatum*, species so far known to occur in South India and Sikkim viz. *Asplenium falcatum*, species so far known to occur in North Western Himalayas viz. *Diplazium lobulosum* and *Ophioglossum vulgatum*, species so far known to occur in Sikkim viz. *Acystopteris tenuisecta* and *Cyathea henryi*, species so far known to occur in Manipur viz. *Phymatopteris crenatopinnata* and *Platycterium alpicorne* and species so far known to occur in Meghalaya viz. *Dipteris wallichii* and *Phymatopteris rhynchophylla*. Moreover, five species viz. *Amphineuron immersum*, *Christella namburensis*, *Christella papyracea*, *Microsorium rubidum* and *Pleocnemia winitii* known to occur in India but restricted to Assam have also been recorded in the present study.

Of the total 215 species recorded from Assam in the present study, six species viz. *Adiantum assamicum*, *Diplazium pinnatifidopinnatum*, *Dipteris wallichii*, *Metathelypteris decipiens*, *Microlepia haflongensis* and *Pronephrium stenopodum* are endemic to India (Chandra 1982 ; Chandra & Kaur 1984 ; Bir 1987 ; Kaur & Chandra 1994). Panigrahi & Patnaik (1968) have, however, mentioned that *Pyrrosia mannii*, which is also recorded in the present study, as an endemic species to Assam and Eastern Himalayas. They further observed that *Pyrrosia mannii* may be considered as neo-endemic with potentiality for wider spread and *Dipteris wallichii* may be considered as relict species. With *Pyrrosia mannii* the total number of endemic species recorded in the present study becomes seven. Chandra (1982) have mentioned that endemic ferns represent about 10 percent of the total number of the known ferns in India. Majority of these endemic elements are centered in the Eastern Himalayan regions (Bir 1987). Satija & Bir (1985), however, have pointed out that speciation is very active in the temperate zone in the Himalayas and for which most of the endemic species are inhabiting in that particular altitudinal zone. The comparatively less number of endemic species encountered in the present study may be due to the absence of temperate zone in the present political boundary of Assam.

Besides these, 16 species viz. *Angiopteris evecta*, *Asplenium nidus*, *Asplenium unilaterale*, *Cibotium barometz*, *Cyathea andersoni*, *Cyathea gigantea*, *Cyathea spinulosa*, *Drynaria propinqua*, *Drynaria quercifolia*, *Microsorium punctatum*, *Ophioglossum petiolatum*, *Ophioglossum vulgatum*, *Osmunda regalis*, *Platycterium alpicorne*, *Pseudodrynaria coronans* and *Stenochlaena palustris* recorded in the present study are known to be rare and endangered species for Northeastern India (Bir 1987). These species together with the endemic elements are in need of conservation, because several of the endemic species are known from single locality (Chandra & Kaur 1984 ; Bir 1987 ; Kaur 1989). The fact that in Assam extensive areas of forests are being cleared during the last two decades as a result forestry operations. The tribal people in the hilly areas every year also used to clear-felled and burnt a sizable percentage of forests for shifting cultivation. Further, the numerous and intensive programmes of development in the state have also largely contribute to the loss of many natural forests. These have resulted in loss of biodiversity in the state, which is accelerated during the last few decades. It is therefore, become essential to take proper steps for conservation of rare species in the state. As pointed out by Bir (1987) ex-situ conservation of fern species in Botanic gardens pose special problems and for which he suggested the establishment of forest conservatories as the best way to conserve fern species.

In the present study the following forest areas viz. Ranga, Subansiri and Simen Reserve Forests in Lakhimpur district, Deopani, Dirak and Dihing Reserve Forests of Tinsukia district, Panidihing Reserve Forest of Sivasagar district, Sonai Reserve Forest of Cachar district, Borail Reserve Forest of N. C. Hills and Mikir Hills Reserve Forest of Karbi-Anglong district have been found to have rich diversity of fern flora in Assam and some of these areas may be considered for establishment of forest conservatories for fern species in the state.

Kachroo (1975) pointed out that the fern flora of Assam region is distinctive in its distributional pattern, coming to limits in four directions : north, west, southwest and east ; northwards it is limited by high, dry and quite dissimilar climate, while west and southwards as rainfall decreases clearings become more common resulting in disappearance of species. He further observed that Assam region occupies an important place on the route of dispersal of fern flora to the northwest and south in the country. Considering the above facts about the fern flora of Assam it can be concluded that unlike other plant groups, the fern flora of Assam have special significance in the phytogeography of the plants as a whole of our country in particular and southeast Asia in general.

The present account on ferns forms the first and nearly a complete fern flora within the present political boundary of Assam. It must be admitted here that some specimens collected during the present study, however, have been confined either as new varieties or new species and it is considered not proper to include these new taxa in the present account before these taxa are effectively published. Therefore, subsequent addendum of these taxa will provide a complete account of fern flora of Assam - an outcome of the present study.