ECOLOGY OF PTERIDOPHYTES

Most of the pteridophytes (ferns and fern-allies) show their luxuriant and vigorous growth during the rainy season particularly in the hilly regions usually above 1400 m altitude. With the commencement of monsoon about mid June, the ferns and fern-allies start growing vigourously and luxuriantly. This is due to the fact that there has been a prolonged dormancy awaiting the onset of rains. Because of high humidity in the atmosphere during July- mid September, there is a prolific growth and development of ferns and fern-allies all round on all possible habitats. This is particularly true for epiphytic and lithophytic ferns, which cloth the tree trunks, branches, boulders and stony walls with thickly clad felts of mosses and leafy liverworts and retain a considerable amount of moisture and thus providing coverage and protection to the growing rhizomes. Apart from these, there are number of hardy terrestrial species that grow throughout the year. Some species also show a marked differences in altitudinal distribution. On the basis of their broad habitats, the pteridophytic flora of the study area can briefly be divided into following ecological groups.

1. EPiphytes

Epiphytic ferns generally prefer to grow on moist and shady tree trunks, branches, tree tops and large shrubs both in dense and partially and completely open forests. The composition and frequency of these epiphytic ferns vary considerably depending upon the altitudes, climatic conditions and nature of forests i.e. nature of bark and shade or open nature of canopy. Usually conifers do not appear to favour the growth of any epiphytic pteridophytes probably due to resinous bark. But it has been observed at places where sufficient moisture and shade are available, there is a substantial growth of epiphytic mosses and ferns.

Epiphytic ferns like Pyrrosia costata (Wall. ex Presl) Tag. & Iwats., P. flocculosa (D.Don) Ching, P. porosa (Presl) Hovenkamp, Microsorum membranaceum (D.Don) Ching, Lepisorus nudus (Hook.) Ching grow on the tree trunks, branches in forested and open places of several trees especially on Mangifera indica L., Toona ciliata M. Roem., Sapium insigne (Royle) Benth.& Hook. f., Quercus glauca Thunb., Q. leucotrichophora A. Camus, Syzygium cumini (L.) Skeels, Pyrus pashia Buch.-Ham. ex D.Don etc. All
these species also grow equally as lithophytes on well moist and shaded localities between 800 and 1200 m altitudes. While those growing above 1,200 to 2,356 m altitudes are among the majority of epiphytic ferns such as *Loxogramma involuta* (D. Don) Presl, *L. porcata* Price, *Arthromeris lehmanii* (Mett.) Ching, *A. wallichiana* (Spreng.) Ching, *Drynaria mollis* Bedd., *D. propinqua* (Wall. ex Mett.) J. Sm., *Lepisorus mehrae* Fras.-Jenk., *L. scolopendrium* *Phymatopteris oxyloba* (Wall. ex Kunze) Pich. Serm., *Polypodiarium argutum* (Wall. ex Hook.) Ching, *Polypodiodes amoena* (Wall. ex Mett.) Ching, *P. lachnopus* (Wall. ex Hook.) Ching, *P. microrhiza* (Clarke ex Baker) Ching, *Vittaria flexuosa* Fée, *Asplenium ensiforme* Wall. ex Hook.& Grev., *A. laciniatum* D. Don, *Elaphoglossum marginatum* (Wall. ex Fée) Moore, *Oleandra wallichii* (Hook.) C. Presl, *Araioestegia pulchra* (D. Don) Copel. etc. These epiphytic ferns tend to form a dominant and conspicuous epiphytic vegetation on the tree trunks and branches of several species together with large shrubs such as *Lyonia ovalifolia* (Wall.) Drude, *Quercus leucotrichophora* A. Camus, *Rhododendron arboreum* Smith, *Symplocos chinensis* (Lour.) Druce, *Viburnum cotinifolium* D. Don etc. All these ferns also grow lithophytically as facultative epiphytes except *Drynaria mollis* Bedd., *Oleandra wallichii* (Hook.) C. Presl, *Elaphoglossum marginatum* (Wall. ex Fée) T. Moore and *Goniophlebium argutum* (Wall. ex Hoo.) J. Sm., which are obligate epiphytes and can survive without proper hosts. It is interesting to note that *Oleandra wallichii* (Hook.) C. Presl, and *Elaphoglossum marginatum* (Wall. ex Fée) T. Moore have been recorded exclusively on *R. arboreum* Smith, while *D. mollis* Bedd. and *G. argutum* (Wall. ex Hook.) Ching were recorded on *Q. leucotrichophora* A. Camus in addition to *R. arboreum* Smith It is interesting to note that among the epiphytes, polypodiaceous members are the commonest and most dominant in the present study and as well as throughout the Himalayan ranges.

2. LITHOPHYTES


Among the fern-allies, *Selaginella* species usually prefer to grow on rocks and boulders such as *S. chrysocaulos* (Hook. & Grev.) Spring, *S. involvens* (Sw.) Spring, *S. pallidissima* Spring and *S. subdiaphana* (Wall. ex Hook. & Grev.) Spring. Among these species, *S. involvens* grows as foot epiphyte also. All these species are common throughout the study area and they grow extensively forming mats on rocks and walls in the forest, forest margin, waysides and roadsides. They become particularly conspicuous during rainy and autumn seasons.

3. TERRESTRIAL FERNS

4. AQUATIC AND MARSHY FERNS

True aquatic ferns have not been observed in the study area. However ferns growing in wet and muddy places are considered as marshy ferns which commonly grow along the banks of perennial streams, water channels and water falls etc. leading to form a conspicuous and prominent vegetation. They include *Dennstaedtia appendiculata* (Wall. ex Hook.) J.Sm., *Diplazium esculentum* (Retz.) Sw., *D. laxifrons* Rosent., *D. maximum* (D.Don) C.Chr., *D. spectabile* (Wall. ex Mett.) Ching, *D. squamigerum* (Mett.) Matsum. Besides, *Equisetum diffusum* D.Don grows profusely in marshy and wet places covering considerable areas and form big colonies.

5. RAVINE FERNS


6. THICKET FORMING SPECIES

Three species of ferns has been identified in the present study area which are somewhat hardy and robust and grow on more open exposed rocky and gravelly situations. They are usually exposed to a wide range of climatic variations such as high and low wind velocities, marked temperature fluctuations and varied amount of moisture content *i.e. Pteridium revolutum* (Blume) Nakai forms huge colonies in recently exposed ridges, on forest floor, forest edges, grasslands, orchards, on highly rigorously exposed, dry and open situations. Rhizomes are deeply buried under the soil and creep long distances with wide branching. The fronds form tangled mass and thus do not allow
anything to grow. Second one is *Dicranopteris linearis* (Burm.f.) Underw. which also tends to form large and huge colonies or patches on exposed and open rocky localities due to its creeping rhizomes and covers large areas forming thickets in grasslands and forest margin and chir-pine forests. This species grows almost in pure formation and sometimes climbs to a considerable height on neighbouring bushes. Third one is *Pteris wallichian* J.Agardh which is very tall, hardy and robust species and shows its vigorous growth and development in the study area and forms large colonies along open as well as wet places, field border, road banks and forest margin covering considerably a large areas due to its long-creeping rhizomes and thus has become the most successful species.

7. SEASONAL ASPECTS

Climatic variations and fluctuations greatly influence the growth and development of ferns and fern-allies. The ferns of the study area like other parts of Himalayan regions also exhibit a marked seasonality among themselves. It has been noticed that most of the species grow during rainy season between mid June to mid September. With the advent of first showers of rain and early heat of summer (April to June), almost all the species put forth new fronds which grow vigorously and become fertile during August to September. These species gradually cover different habitats till early October.

With the beginning of winter season (November to March), all the epiphytic and lithophytic ferns undergo dormant period after shedding quickly their fronds due to prevailing unfavourable and adverse climatic conditions. During this period, only shrivelled up or enrolled dry, yellowish fronds of certain epiphytic and lithophytic species like *Loxogramme involuta* (D.Don) Presl, *Asplenium yoshinage* subsp. *indicum* (Sledge) Fras.-Jenk., *Pyrrrosia flocculosa* (D.Don) Ching, *P. porosa* (C.Presl) Hovenkamp, *Vittaria flexuosa* Fée, *Lepisorus nudus* (Hook.) Ching etc. can be seen. The aerial parts die off completely or partially giving sudden disappearance of these species. But the undergrown and creeping rhizomes covered by leafy bases, scales and hairs help them to overcome unfavourable conditions during winter season and become active with the commencement of spring season. However, some species of hardy ferns like *Polystichum discretum* (D. Don) J.Sm., *P. squarrosum* (D.Don) Fée, *Cytromium caryotideum* (Wall. ex Hook. & Grev.) C. Presl, *Dryopteris chrysocoma* (Christ) C.Chr., *D. cochlleata* (Buch.-Ham. ex D. Don) C.Chr., *D. redactopinnata* S.K.Basu & Panigrahi, *D. wallichiana* (Spreng.) Hyl., *Pteridium revolutum* (Blume) Nakai, *Diplazium esculentum* (Retz.) Sw., *D. laxifrons*

During winter months, the aerial parts of almost all terrestrial species are killed completely or partially by snow and frost above 1,500 m altitude, but species growing on walls and other protected situations remain green throughout the winter season. With the advent of spring together with summer heat and pre-monsoon showers, the area resumes its dense growth of vegetation throughout the area.

8. **ASSESSMENT OF RARE AND ENDANGERED SPECIES**

Like the other parts of world, the flora of the Himalayan region including the present study area is also under direct biotic pressure due to selective removal as well as habitat clearance for cultivation. The habitat fragmentation particularly in areas where most of the plants grow has probably caused their being rare and endangered. The depletion and disappearance of these plants have largely been due to road construction, dam building and establishment of industries on a large scale in recent past. The bulk of collections of medicinal and useful plants has also played an vital role in the depletion and disappearance of plants. A large area once occupied by dense forests have been converted into grazing and scrub lands owing to destruction of natural habitats on exponential scale, indiscriminate deforestation and over grazing leading to disturbed ecological balance. Besides floods, soil erosion and landslides also convert considerable areas into stony deserts. Thus the destruction of natural habitat by any one factor results in entirely different habitat invaded by other groups of plants and making the conditions unfavourable and unsuitable for their existence and survival. With the result, some plants have become threatened and endangered, while the rare ones are on the verge of depletion. If these conditions continue to operate for some more years, these threatened, endangered and rare species are bound to disappear from this area in near future.

Based on field observations in the study area indicate that majority of species fall in the rare and endangered categories. All these plants have been collected only once or
Goniophlebium argutum

Lepisorus scolopendrium

Phymatopteris oxyloba

Phymatopteris stewartii
**Polypodiodes microrhizoma**

**Cheilanthes leptolepis**

**Onychium cryptogrammoides**

**Hypolepis polypodioides**
Pteris wallichiana

Adiantum venustum

Coniogramme intermedia
Vittaria flexuosa

Dennstaedtia appendiculata

Asplenium filipes

Athyrium fimbriatum
Thelypteris erubescens

Thelypteris nudata

Thelypteris pyrrhorhachis

Cyrtomium caryotideum
Dryopteris barbigera

Dryopteris chrysocoma

Dryopteris redactopinnata

Dryopteris wallichiana
Polystichum nepalense

Polystichum stimulans

Araioestgia pulchra

Woodwardia unigemmata
Author studying ferns in the field