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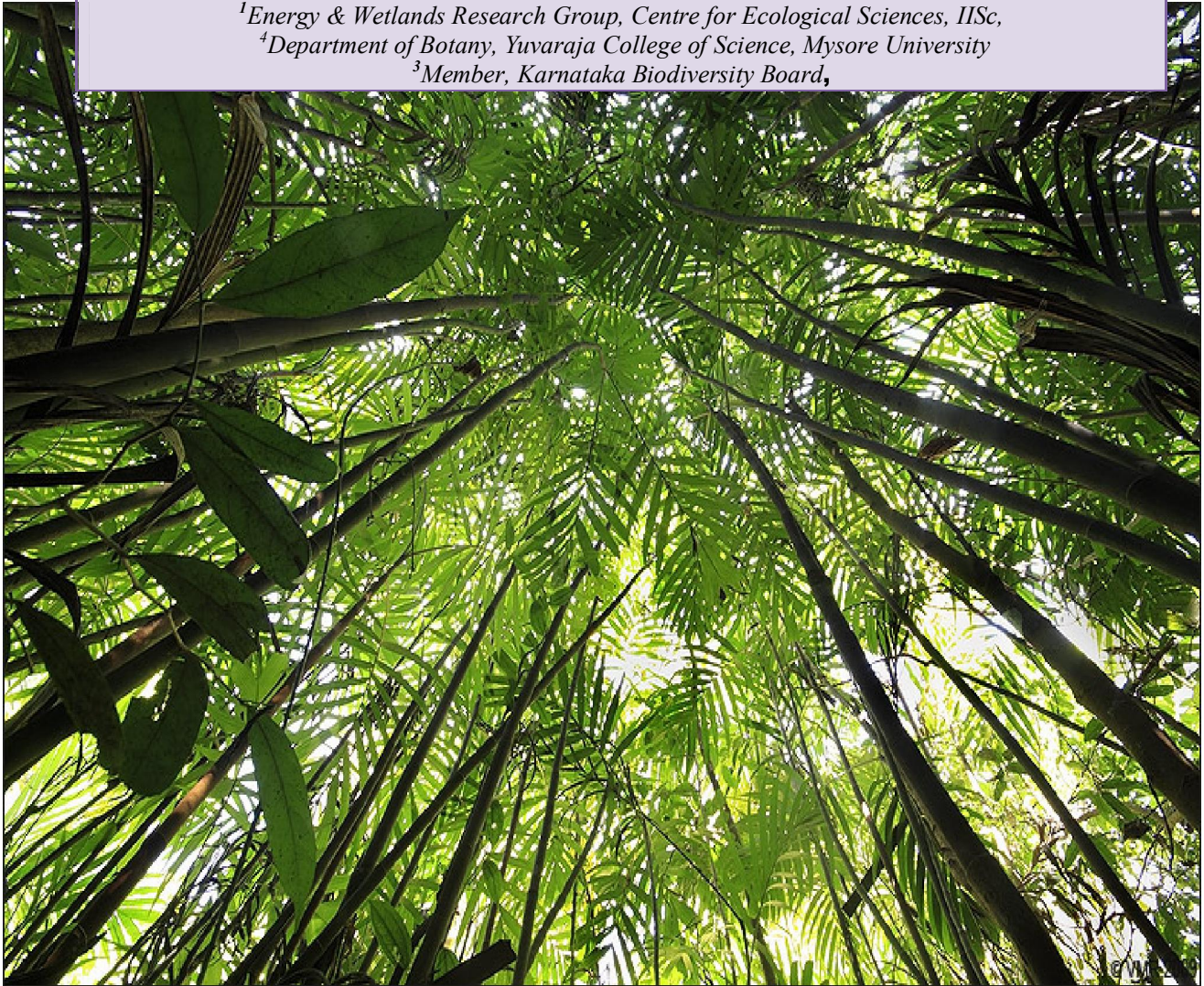
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## AN APPRAISAL AND CONSERVATION STRATEGIES FOR THE PTERIDOPHYTES OF UTTARA KANNADA

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### SUMMARY

Pteridophytes, including ferns and fern-allies, are the earliest of all the land plants which originated during the Silurian period and went on to become the dominant vegetation of earth's surface during the Carboniferous period. They became the first ever group of plants on earth's surface showing the presence of well-developed vascular system, thereby, playing an important link in the evolution from cryptogams (algae and bryophytes) to phanerogams (gymnosperms and angiosperms). Though they have largely been replaced by seed plants in the course of evolution, they continue to form an important part of vegetation today and can be found distributed in a wide range of habitats in the moist tropical and temperate forests in the world. Due to its diversified topography, variable climatic conditions and its strategic geographical position, India has a rich pteridophytic flora with about 1000 species of which around 320 species find their abode in the Western Ghats Biodiversity hotspot. The southern Western Ghats has the highest pteridophytes diversity (239 species) followed by central Western Ghats (174 species) and northern Western Ghats (64 species). The Uttara Kannada district is one of the important districts encompassing a significant portion of central Western Ghats and having more than 70% of its area covered with forest. Based on our ongoing studies and available literatures, altogether 67 species of ferns and fern-allies are found to be distributed in various taluks of the district. The highest number of pteridophytes species is found to be distributed in Joida taluk (41 species) followed by Siddapur (30 species), Karwar (25 species) and Kumta (15 species). The semi-evergreen to evergreen forests of Castle rock, Kaiga and Yana and the primeval evergreen forests of Gerusoppa Ghats are the richest spots in the district in terms of pteridophytes diversity and luxuriance. The presence of endemic and threatened tree fern species – *Cyathea nilgirensis* in Kathalekan sacred forests in Gerusoppa Ghats (which is the northernmost limit for this species in Western Ghats) signifies the ecological sensitivity of the forests in the district and emphasizes the need for conservation of the biodiversity and habitat before such species tend to decline and disappear from the nature. The pteridophytes being moisture and shade loving plants congregate at places where humid and damp conditions prevail. However, such habitats are being prioritized by humans for settlements, farming, power generation, setting up of industries etc. posing a threat, especially to the sensitive pteridophytes to vanish from such regions. Hence, for saving the pteridophytes from en-mass destruction, their habitat conservation is of paramount importance along with awareness programmes as knowledge on pteridophytes as such is sorely lacking among the public in general, making conservation of these wonderful group of plants a challenging affair.

Keywords: Central western Ghats, Pteridophytes, conservation,

## Introduction

Pteridophyta (*pteron* = feather, *phyton* = plants) are the most primitive vascular plants and are also known as 'vascular cryptogams'. They appeared on the earth, in the mid-Paleozoic Era during the Silurian Period which began 438 million years ago. The earliest pteridophytes like *Rhynia* and *Psilophyton* were leafless and rootless plants, their sole plant body composed of green stem anchored to the soil by hair-like rhizoids which functioned like roots. The stem performed most vital functions, especially photosynthesis and transpiration. The pteridophytes diversified and evolved in their physical complexity and reproductive methods during the next 100 million years well into the Carboniferous Period, when Horsetails, Lycopods, Lepidodendrales and Psilophytales dominated the land. Many had grown into the proportions of gigantic trees that constituted the primitive Carboniferous forests, which existed before birds, and mammals and arrived and flowers bloomed on the earth. By Late Carboniferous, 300 mya, ferns with seeds (Cycadofilicales or seed ferns) had evolved. These early gymnosperms that appeared during the Carboniferous period resembled so much with the ferns that the period is often called 'Age of Ferns'. Cordaitales, ancestors of modern conifers and Gnetales, had also appeared around the same time. The end of Palaeozoic Era, during the Permian Period (286 mya) the tree forms of Carboniferous pteridophytes perished creating extensive coal deposits of the planet. The Mesozoic Era (248-144 mya) saw Cycads dominating the land along with other early gymnosperms. The primitive carboniferous arborescent Lycopods and Horsetails were replaced by the ancestors of herbaceous forms.

The pteridophytes probably attained their peak of luxuriance during the carboniferous and started declining in diversity and richness thereafter. This decline continued with the so much so what is left of the pteridophytes today, apart from the fern group, are merely seven living genera: *Psilotum*, *Tmesipteris*, *Equisetum*, *Lycopodium*, *Phylloglossum*, *Selaginella* and *Isoetes*). The rest are extinct and represented by only by fossils. The Carboniferous had witnessed Lycopod dominated forests, some of which attained even 30 m height. Today's coal deposits of the world are mainly from the Carboniferous Period forests. Ironically the seven genera that survive, the descendants of the Lycopods and Equisetums of the Palaeozoic, are miniatures of their past, mostly herbaceous forms to be searched amidst flowering plant dominated landscapes.

## CHARACTERIZATION OF PTERIDOPHYTES

The pteridophytes which include the ferns and fern allies such as the Selaginellas, Lycopodium, Isoetes, Equisetum etc. are characterized by the following features:

- The pteridophytes heralded the era of ‘vascular cryptogams’ on the earth as they are the first group of plants ever evolved on the earth showing the presence of a well-developed vascular system named xylem for water and phloem for food transport respectively. Hence
- The xylem consists of mainly of a conducting element called tracheid, which are elongate narrow tubules with pores on lateral end walls, through which water passes from one tubule into another. On the other hand in the flowering plants the conduction is mainly through ‘vessels’ which are tubules connected end to end with their cross walls broken down to facilitate easier transport as if through a pipe.
- The phloem or food conducting tissue in pteridophytes also is of the primitive kind compared to that of the flowering plants.
- The reproduction of pteridophytes is mainly by spores and not seeds. The spores are a loose mass of powdery cells produced within special containers called sporangia of varied kinds.
- A group of ferns called ‘pteridosperms’, now represented by fossils, had very primitive kind of seeds. Hence the pteridophytes may be considered as a crucial link between the modern seed plants (the gymnosperms and angiosperms) with well developed vascular tissues and ancient land cryptogams, the bryophytes, without xylem and phloem and seeds.
- In the life cycle of every pteridophyte are two separate individuals, one a short living flimsy and small gamete producing one resembling a rootless, stemless, bryophyte without also organized vascular system and the other a larger plant, with a longer life span, differentiated often into roots, stems and leaves and reproducing asexually through spores. This dimorphism of plant body, of two totally different looking generations

alternately appearing in the life cycle of the same species is known as 'heteromorphic life cycle' (Dudani *et al*, 2011).

## HABIT AND HABITATS

Pteridophytes grow luxuriantly in moist tropical forests and temperate forests and their occurrence in different eco-geographically threatened regions from sea level to the highest mountains are of much interest (Dixit, 2000). Though they have been largely replaced by the seed plants in the modern day flora, they continue to occupy an important and crucial position in the evolutionary history of the plant kingdom. India has a rich and varied pteridophytic flora due to its origin during the break-up of the Gondwanaland, its drift from south of the Equator towards Eurasia far north, carrying the progenitors of today's pteridophytes from Australia, Africa, Madagascar etc. as well as probable endemics of its own and after joining with Eurasia its diversified topography, variable climatic conditions and its strategic geographical position facilitated several migration-flows of species of different phytogeographical elements meeting in different parts of the Country. They occur today in a variety of habit like terrestrial (*Equisetum*, *Selaginella*), aquatic (*Azolla*, *Marsilea*), epiphytic (*Lepisorus*, *Drynaria*) and lithophytic (*Psilotum*, *Adiantum*). Today, among the vascular plants, pteridophytes form a major part next only to the angiosperms in India.

The pteridophytes themselves do not constitute any major vegetation type in India. They are, however, associated with a variety of habitats and micro-habitats found in this country. For their healthy life and continuation, it is very important to protect these special environmental conditions that have preserved them through various geological ages. Each fern species has its own preferences for temperature, humidity, soil type, moisture, etc. although much work needs to be carried out to ascertain these special micro-climatic conditions (Shaikh & Dongare, 2009). The range of habitats sheltering pteridophytes include moist or dry rocks and boulders, tree trunks, fresh water bodies, including marshes and swamps, even mangrove swamps, forest floors and edges, alongside perennial streams, deep ravines and gorges, grasslands and cultivation areas of various crops, specially of tea, coffee and cardamom.

## LIFE CYCLE OF PTERIDOPHYTES

The life cycle of the fern differs from both higher plants (Gymnosperm, Angiosperm) and Bryophytes. In bryophytes the gametophytic generation is the dominant phase in the life cycle and the sporophyte phase is dependent upon it whereas in angiosperms, the sporophyte is the dominant phase and the gametophyte is dependent upon it. However, in pteridophytes, both the sporophytic phase and gametophytic phase in the life cycle are independent of each other. The reproduction in pteridophytes takes place with the help of spores. Some pteridophytes give rise to two different types of spores – large, female spores called as megaspores and small, male spores called as microspores. Such pteridophytes are referred to as ‘Heterosporous’ pteridophytes. The living species of Heterosporous pteridophytes are small herbaceous perennials usually not more than a few inches high and fall into six genera namely *Azolla*, *Salvinia*, *Marsilea*, *Pilularia*, *Isoetes*, and *Selaginella* (Schaffner, 1905). Those pteridophytes which possess only one kind of non-sexual reproductive spores are referred to as ‘Homosporous’ pteridophytes. These pteridophytes possess true fibro-vascular system, true roots and leaves and fall naturally into three distinct classes – Ferns or Filicales, Horsetails or Equisetaceae and Lycopods or Lycopodiaceae (Schaffner, 1906).

The sporophyte of the pteridophyte produces spores inside the sporangia after meiosis. The sporangia develop either on the ventral surface of leaves (as in case of ferns) or in the axil of stem and leaves (*Lycopodium*, *Selaginella*). The sporangia bearing leaves are called as ‘sporophylls’. The development of the pteridophytes is of two different types:

1. Eusporangiate development – wherein the sporangium develops from a group of superficial cells. Examples – *Lycopodium*, *Selaginella*, *Equisetum*
2. Leptosporangiate development – wherein the sporangium develops from a single initial cell. Examples – *Pteris*, *Polypodium*

The spores germinate to give rise to the gametophyte known as prothallus which is green and bears sex organs – antheridia and archegonia. The homosporous pteridophytes form monoecious prothallus whereas the heterosporous pteridophytes form the dioecious prothallus. The

antheridium gives rise to numerous antherozoids which are ciliated. Water is essential for the fertilization process as the antherozoids travel to the archegonia in the presence of water. The fertilization between the male and female gametes results in the formation of zygote which gives rise to the sporophyte.

Figure 1: Life cycle of a Homosporous Pteridophyte (eg: *Equisetum*)

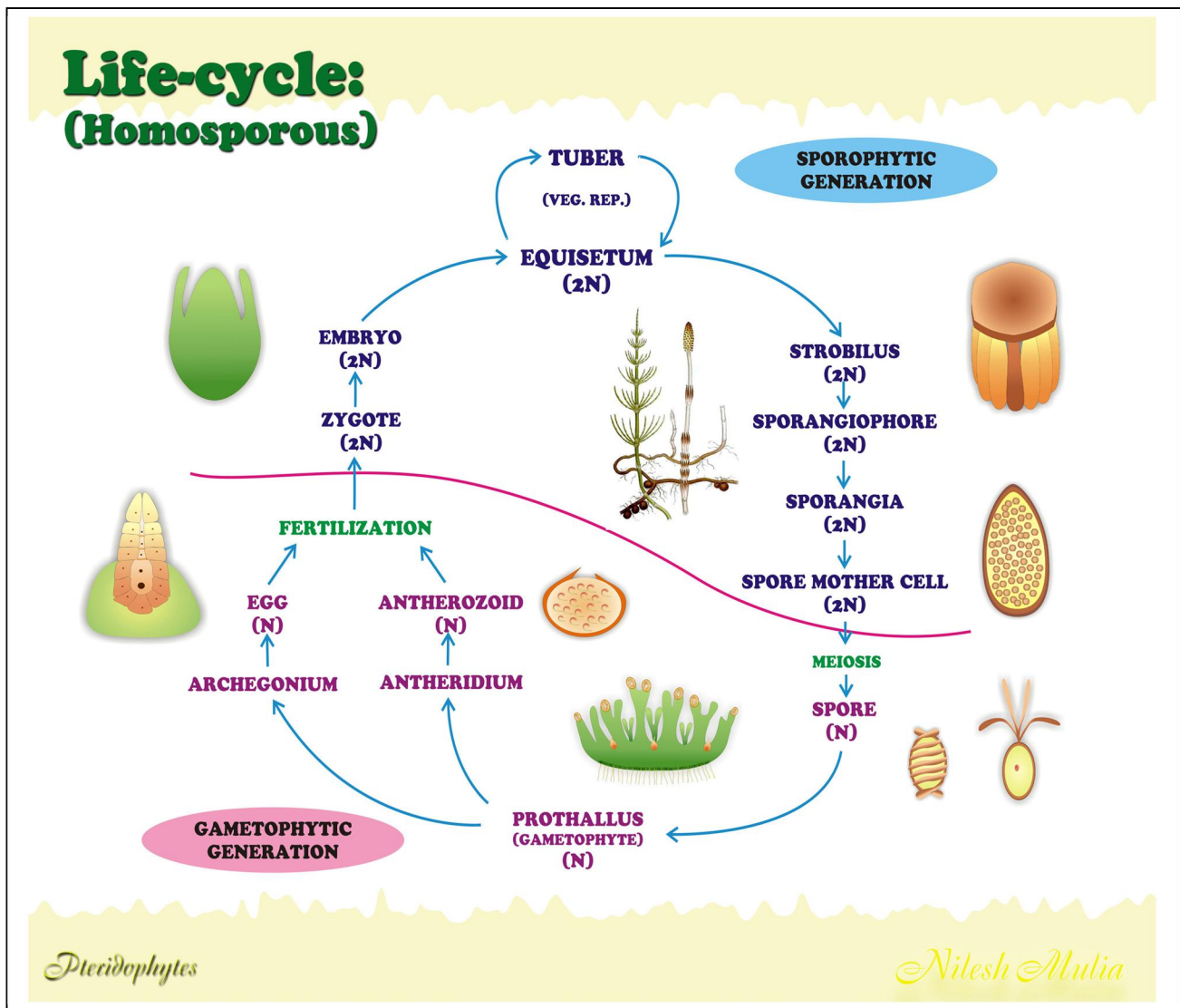
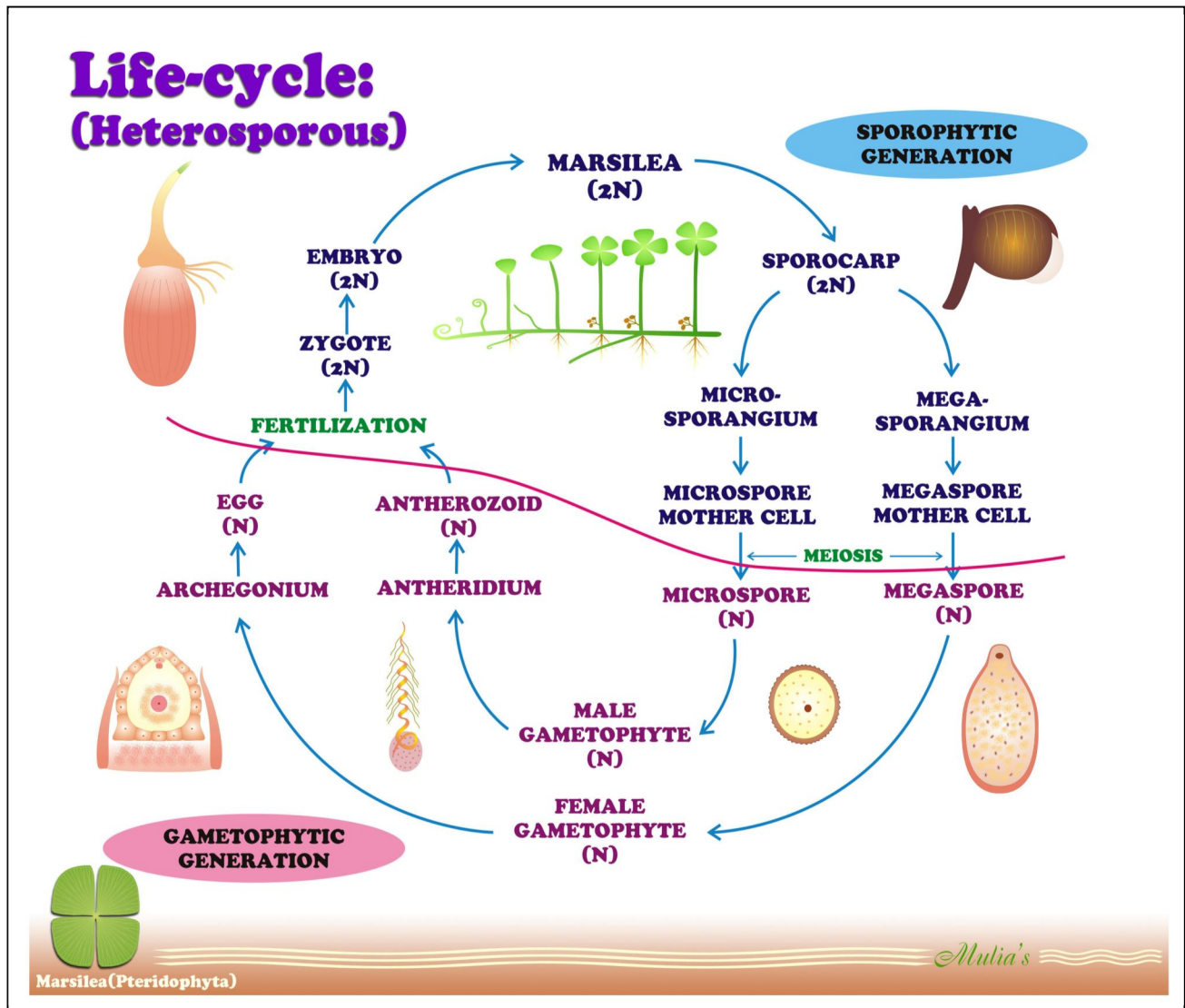


Figure 2: Life cycle of a Heterosporous Pteridophyte (eg: *Marsilea*)





Contributed by: Nilesh Mulia, Department of Botany, M.G. Science Institute, Ahmedabad

## PTERIDOPHYTES OF WESTERN GHATS

The Western Ghats of the Indian peninsula constitute one of the 34 global biodiversity hotspots along with Sri Lanka, on account of exceptional levels of plant endemism and by serious levels of habitat loss (Conservation International, 2005). The rugged range of hills stretching for about 1600 km along the west coast from south of Gujarat to the end of the peninsula (lat. 8° and 21° N and long. 73° and 78° E), is interrupted only by a 30 km break in Kerala, the Palghat Gap (Radhakrishna, 2001). Covering a geographical area of about 160,000 km<sup>2</sup>, the Western Ghats have an average height of 900 m, with several cliffs rising over 1000 m. The Nilgiri Plateau to

the north and Anamalais to the south of the Palghat Gap exceed 2000 m in many places. Towards the eastern side the Ghats merge with the Deccan Plateau which gradually slopes towards the Bay of Bengal. The Western Ghats of Karnataka state encompasses the areas of Uttara Kannada, Shimoga, Chikmagalur, Hassan, Kodagu and Dakshina Kannada. These areas together form the Central Western Ghats, a region endowed with a wide range of vegetation types and extremely rich biodiversity.

The flora of Western Ghats comprises about 12,000 known species ranging from unicellular cyanobacteria to angiosperms. Of this spectrum the flowering plants with over 4000 species, with about 1,500 endemics, constitute about 27% of Indian flora. The Western Ghats also supports a diverse fauna which include 508 species of birds, followed by fishes (218 species), reptiles (157 species), mammals (137 species), and amphibians (126 species). Many faunal species are also endemic to the Western Ghats with the amphibians ranking highest (78%) followed by reptiles (62%), fishes (53%), mammals (12%) and birds (4%). (Daniels, 2003; Gururaja, 2004; Sreekantha, et al., 2007).

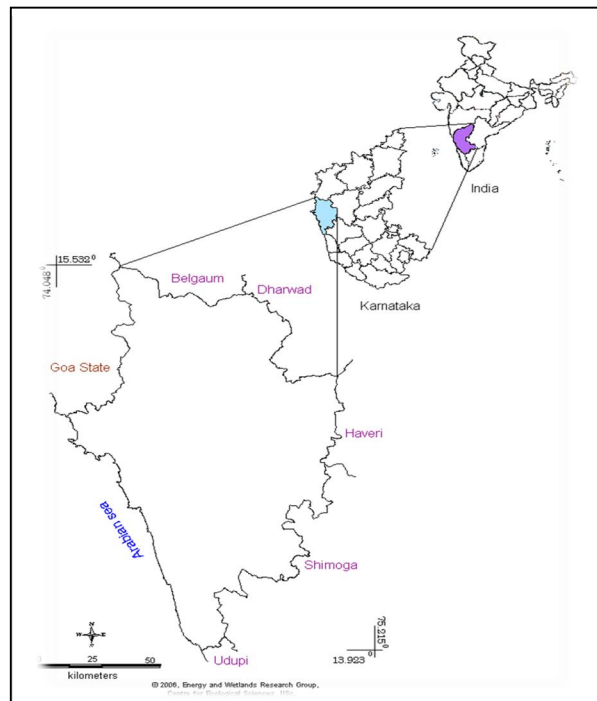
The Western Ghats form one of the important habitats for pteridophytes due to the presence of perennial streams, evergreen forests, grasslands and many other habitats which support a luxuriant growth of ferns and fern-allies. Approximately 320 species of ferns and fern-allies have found their abode in the varied habitats of Western Ghats with their diversity increasing in the north-south direction, obviously due to the more number of rainy months and higher altitudes with cooler climate that the south has. As one proceeds towards the northern part of the escarpment, the number of rainy days decrease leading to the decrease in the extent of evergreen forests, perennality of streams and decline in overall moisture in the climate.

The major families of the pteridophytes of the Western Ghats are Thelypteridaceae, Aspleniaceae, Pteridaceae, Selaginellaceae, Polypodiaceae, etc. Western Ghats also support luxuriant growth of important endemic species such as *Cyathea nilgirensis*, *Polystichum manickamii*, *Bolbitis semicordata*, *Osmuda huegeliana*, etc. and endangered species such as *Helminthostachys zeylanica*, *Grammitis medialis*, *Tectaria zeylanica*, *Psilotum nudum*, etc. in their preferred microclimates.

## PTERIDOPHYTE DIVERSITY IN UTTARA KANNADA DISTRICT

Uttara Kannada is the northernmost coastal district of Karnataka covering an area of 10,291 km<sup>2</sup>. It extends from north south to a maximum of 180 km, and from west to east a maximum width of 110 km. The Arabian Sea borders it on the west creating a long continuous, though narrow, coastline of 120 km running north-south. Towards its north are Goa and Belgaum, to the east are Dharwad and Haveri and to the south are situated Shimoga and Udupi. The district comprises of 11 taluks namely, Joida, Haliyal, Mundgod, Yellapur, Karwar, Ankola, Sirsi, Siddapur, Honavar, Kumta and Bhatkal. Topographically, the district can be divided into 3 distinct zones namely narrow and flat coastal zone, abruptly rising ridge zone and elevated flatter eastern zone. The coastal zone is thickly populated with coconut clad villages. Ridge zone is a part of the main range of Western Ghats, which runs north to south, parallel to the coast. The flat eastern zone joins the Deccan plateau. The taluks, which comprises the narrow flat coastal zone, are: Karwar, Ankola, Kumta, Honnavar and Bhatkal. A significant portion of central Western Ghats is spread in the district and more than 70% of the district is covered by forest area. These forests harbor excellent diversity of flora and fauna with the presence of some highly endemic and endangered species.

**Figure 3: Study area – Uttara Kannada district, Karnataka state, India**



The earliest record referring to ferns in this region was by Matchperson (1890) who collected and listed 75 species of ferns from North Kanara district. Later, Blatter and Almeida (1992) included 90 species of ferns from Uttara Kannada district, then a part of Bombay Presidency, in their “Ferns of Bombay”. The most comprehensive study of ferns and fern allies of central Western Ghats of Karnataka were carried out by Rajagopal and Bhat (1998); this work includes 64 species of pteridophytes collected from Uttara Kannada district. Our study in the district added three more species taking the total to 67 species. These species include both ferns and fern-allies belonging to 28 different families. The details of the plants such as botanical names, families, habitat and ecology along with their distribution in the district (talukwise) are explained in Table.1.

The major families represented in the district are Selaginellaceae, Pteridaceae, Thelypteridaceae, Woodsiaceae and Polypodiaceae. The species which are distributed widely and grow luxuriantly in the district include *Lycopodiella cernua*, *Lygodium flexuosum*, *Pteris quadriaurita*, *Pityrogramma calomelanos*, *Adiantum philippense*, *Pteridium revolutum*, *Dicranopteris linearis*, *Thelypteris (Christella) dentata*, *Tectaria coadunata*, *Bolbitis subcrenatooides*, *Blechnum orientale* and *Drynaria quercifolia*. Four fern species namely *Cyathea nilgirensis*, *Osmunda huegeliana*, *Bolbitis semicordata* and *Bolbitis subcrenatooides* are endemic to South India (Fraser-Jenkins, 2008b) and are also present in the district. Of these, *Bolbitis semicordata* is a rare species in South India whereas *Cyathea nilgirensis* is Near-threatened implying a high conservation status to them (Chandra *et al*, 2008).

67 species of ferns and fern-allies are found to be distributed across various taluks of Uttara Kannada district. Majority of the species are found to be concentrated in the Joida (41 species), Karwar (25 species), Siddapur (30 species), Yellapur (12 species), Sirsi (10 species) and Kumta (15 species) taluks of the district. The forests in Castle rock (Joida taluk) and Kaiga (Karwar taluk) together were found to be harboring maximum species of ferns and fern-allies in Uttara Kannada district. The Gerusoppa Ghat, spread in the Siddapur and Honnavar forest divisions, with primeval evergreen forests was also found to be a rich spot beaming with luxuriant growth of pteridophytes. The endemic and threatened tree fern species – *Cyathea nilgirensis* was located to be present in Kathalekan sacred forests in Gerusoppa Ghat. Our studies are ongoing and

within another year we will be in a position to report more number of localities of occurrences for most ferns reported from the district.

**Figure 4: Endemic pteridophytes of Uttara Kannada district – (a) *Cyathea nilgirensis*; (b) *Osmunda huegeliana*; (c) *Bolbitis semicordata*; (d) *Bolbitis subcrenatoides***



The most common and widespread fern species which were found to be present in maximum taluks of the district are *Dicranopteris linearis* and *Blechnum orientale*. These ferns can be found growing along road cuttings in partial shade or open places. The most common and widespread epiphytic ferns is *Drynaria quercifolia* which grows on the bark of different trees in moist deciduous and semi evergreen forests and even on old roadside trees. *Pteridium revolutum* is an alien invasive fern which was initially cultivated in various parts of Western Ghats, but has now escaped into the wild and grows prolifically as terrestrials on fully exposed grassy slopes on the forest edge, roadsides and clearings. Another noteworthy fern species in the district is *Acrostichum aureum* which grows gregariously in the tidal backwaters in the costal taluks of the district. This is the only species of fern known so far to grow in the brackish water environs of the region. The two aquatic ferns namely *Marsilea minuta* and *Azolla pinnata* are found growing in ponds, paddy fields and other such marshy places in the plains of the district.

#### **ECONOMIC AND MEDICINAL IMPORTANCE OF PTERIDOPHYTES**

Humans have been dependent upon the plants as an important source of medicine since ancient times. Even today, many tribal communities and rural populations are dependent heavily upon the natural resources obtained from the surrounding forest regions for treatment of various ailments and diseases. The Indian traditional medicine is based on different systems such as Ayurveda, Siddha and Unani used by various tribal communities (Gadgil, 1996). Though, lot of studies focusing on the medicinal properties of plants, especially on angiosperms, are available, unfortunately limited amount of studies have been done to explore the medicinal potentialities of the pteridophytes. The medicinal qualities of ferns are mentioned as early as 300 B.C. by the Greek philosopher Theophrastus (Corne, 1924a) and by his Indian contemporaries Sushrut and Charak. The medicinal uses of some ferns and pteridophytes of India have also been described in some of the recent studies (Caius, 1935; Nair, 1959). The best of the compendium on medicinal uses of 61 different ferns and fern-allies of Western Ghats has been prepared by Benjamin and Manickam, 2007.

The leaf and root decoction of commonly occurring *Adiantum lunulatum* syn. *Adiantum philippense* has been found to be very effective in the treatment of chest complaints (Nair, 1959;

Rout *et al*, 2009). The fresh fronds of *Blechnum orientale* are used as a poultice for boils in Malaya; the rhizome is used as an anthelmintic in China, eaten during scarcity of food in Malaya, as cure for intestinal worms, bladder complaints in India, Polynesia and as diaphoretic, aromatic in Philippines (Dixit and Vohra, 1984). The rhizome and roots of *Cheilanthes tenuifolia* are used by the tribals as general tonic (Dixit, 1959). In the case of *Dicranopteris linearis*, the rhizome is used as anthelmintic in Assam while the fronds are used for asthma in Madagascar (Manickam and Irudayaraj, 1992). The rhizome of *Drynaria quercifolia* is bitter and is used as antibacterial, anti-inflammatory, for treating constipation, diarrhea, ulcers and other inflammations. The decoction of plant is used in typhoid fever and fronds are useful in treating swellings (Dixit and Vohra, 1984; Warriar *et al*, 1996). The young shoots of *Lygodium flexuosum*, a common climbing fern species, are used as vegetables whereas the rhizome of the plants is boiled with mustard oil and locally applied in rheumatism, sprains, scabies, ulcers, eczema and cuts (Dixit, 1959; Dixit and Vohra, 1984).

Besides having various medicinal properties, the pteridophytes are also employed for a variety of commercial and environmental purposes. One of the noteworthy aquatic ferns *Azolla pinnata* has a symbiotic association with nitrogen-fixing, blue-green algae namely – *Anabaena azollae* Strasburger. Due to this property, the agronomic potential of *Azolla* as biofertilizer for rice has been recognized in many countries including India, Philippines, USA, Sri Lanka and Thailand (Ahluwalia *et al*, 2002). It has been also found that by applying *Azolla* the soil fertility is improved by increasing total nitrogen, available organic carbon, phosphorous and potassium (Mandal *et al*, 1999; Sharma *et al*, 1999). *Azolla* has also been used as food supplement in fresh or dried or silage form for a variety of animals including pigs, cattle, rabbits, ducks, chicken and fish (Ahluwalia *et al*, 2002). Other uses of *Azolla* include hydrogen production, biogas production, as an ingredient in soap production and to certain extent as human food (Ahluwalia *et al*, 2002).

The ferns have also shown to be having an important role in bioremediation of wastewater. Ma *et al*. (2001) found the Chinese Bracken fern namely *Pteris vittata* L. to be a hyperaccumulator of the toxic metal arsenic. Besides producing large biomass, they also found this fern to be efficient in Ar accumulation with the concentrations as high as 2.3% in the aerial portions of the fern. Later on, many researchers provided the reports of the hyperaccumulation properties of *Pteris* as

well as many other ferns also. Tu *et al.* (2002) suggested that *P. vittata* could be an excellent model to study arsenic uptake and for phytoremediation of arsenic contaminated soil and water.

Among the ferns known so far, perhaps the bracken fern (*Pteridium revolutum* syn. *P. aquilinum*) has the most varied economic and medicinal uses owing to its wide distribution. The rhizome of the plant is astringent, anthelmintic and is useful in diarrhea and inflammation of gastric and intestinal mucous membranes. The decoction of rhizome and fronds is given in chronic disorders of viscera and spleen. In times of scarcity the rhizomes are boiled or roasted and eaten or ground into powder for making bread. The rhizomes mixed with malt are used for brewing a kind of beer and are also employed as a feed for stock, especially pigs. The tender fronds of the fern are used as vegetables and also employed in soups. The dried fronds are employed as packaging materials and have also been tried as a source of paper pulp. The bracken ferns have also served as dye yielding plants across the world. The colonists in Plymouth made an olive green dye out of bracken tops mordanted with alum and copper whereas the boiled roots of the ferns, which turn black, have been used as chief black pattern material by the Washo, Mono and Yokut Indians (Manickam and Irudayaraj, 1992).

Besides having all these wonderful properties, the pteridophytes are also greatly valued as ornamentals. Prior to the discovery of these benefits obtained from this group of plants, ferns were used to enhance the beauty of the landscape and are continued to be used so till now. *Nephrolepis cordifolia* also commonly known as 'Sword fern' is one of the most commonly used ornamental fern species. Other ferns like *Asplenium sp.*, *Selaginella sp.*, *Lygodium sp.*, *Pteris sp.*, etc. are also grown in the gardens or in the pots. Many nurseries grow these ferns and sell them off for a good price and these ferns are then used as ornamentals either as garden plants or during functions to beautify the place.

### **THREATS AND CONSERVATION**

The pteridophytes are moisture and shade loving plants and dependent upon the microclimatic conditions of the region for their successful survival in that region. Any kind of disturbance in these microclimatic conditions can hinder the growth and evolutionary processes occurring naturally in these plants thereby, leading to decline in their populations. Thus, factors like climate change, increasing urbanization, industrialization, encroachment of forest lands,



unplanned developmental activities, over exploitation of natural resources, pose a major threat to the survival of these groups of plants. Due to unplanned felling of trees in the forests the members of epiphytic pteridophytes belonging to the families Polypodiaceae, Davalliaceae, Aspleniaceae, Vittariaceae, have been reduced day-by-day (Dixit, 2000). Large scale collection of ferns from the forests by the visitors and local people for ornamental purpose, medicinal purpose and during excursions also increases the pressure on these plants.

Biodiversity conservation is the need of time and hence, it has become imperative to develop *in situ* and *ex situ* conservation methods for conservation of the diminishing biodiversity. The *in situ* conservation is very beneficial as it allows the evolution of the species to continue within the area of natural occurrence. Hence, the steps for conserving the ferns *in situ* should be focused upon. The *ex situ* conservation includes development of botanical gardens or conservatories, germplasm banks, DNA banks, seed banks and involve the use of techniques such as tissue culture, cryopreservation; incorporation of disease, pest and stress tolerance traits through genetic transformation and ecological restoration of rare plant species and their populations (Kapai *et al*, 2010). The conservation of flowering plants has been achieved to good extent by developing conservatories and botanical gardens which also help in creating awareness among the local people. However, developing a fern conservatory or fern garden is not preferred much and hence, such steps should be considered and implemented for conserving the rare and endangered species. The tissue culture is a very useful technique for the mass multiplication of the plant species in a short time and hence, researches focusing on developing a protocol for *in vitro* regeneration of ferns and fern-allies should be encouraged. Parts of areas rich in abundant pteridophyte diversity can be declared as pteridophyte biosphere reserves or small gene sanctuaries can be established to save the epiphytic pteridophytes.

## REFERENCES

1. Ahluwalia A.S., Pabby A. and Dua S. (2002), *Azolla*: A green gold mine with diversified applications. *Indian Fern Journal*, 19: 1 – 9.
2. Benjamin A. and Manickam V.S. (2007), Medicinal pteridophytes from the Western Ghats. *Indian Journal of Traditional Knowledge*, 6(4): 611-618.

3. Caius J.F. (1935), The medicinal and poisonous ferns of India. *J Bombay Nat His Soc*, 341 – 361.
4. Chandra S., Fraser-Jenkins C.R., Kumari A. and Srivastava A. (2008), A summary of the status of threatened pteridophytes of India. *Taiwania*, 53(2): 170 – 209.
5. Conservation International (2005), Hotspots Revisited: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions. *CI, US*, 392 pp.
6. Daniels, R.J.R. 2003, Biodiversity of the Western Ghats: An overview. In *ENVIS Bulletin: Wildlife and Protected Areas, Conservation of Rainforests in India*, A.K. Gupta, Ajith Kumar and V. Ramakantha (editors), Vol. 4, No. 1, 25 – 40.
7. Dixit R.D. (1959), Medicinal ferns of India. *Bull. Natl. Bot. Gard. Lucknow*, 29: 1 – 36.
8. Dixit R.D. and Vohra J.N. (1984), A dictionary of the pteridophytes of India. *Botanical Survey of India, Howrah*.
9. Dudani S.N., Chandran M.D.S., Mahesh M.K. and Ramachandra T.V. (2011), Diversity of Pteridophytes of Western Ghats. *Sahyadri E-News Issue-33*.
10. Fraser-Jenkins C.R. (2008a), Taxonomic revision of three hundred Indian sub-continental pteridophytes with a revised census list – a new picture of fern-taxonomy and nomenclature in the Indian subcontinent. *Bishen Singh Mahendra Pal Singh Publishers, Dehradun*.
11. Fraser-Jenkins C.R. (2008b), Endemics and pseudo-endemics in relation to the distribution patterns of Indian pteridophytes. *Taiwania*, 53(3): 264 – 292.
12. Gadgil M. (1996), Western Ghats: A Lifescape. *Journal of the Indian Institute of Sciences*, 76: 495-504.
13. Gururaja, K.V. 2004. Sahyadri Mandooka,  
<http://wgbis.ces.iisc.ernet.in/biodiversity/newsletter/issue6/index.htm>
14. Kirtkar K.R. and Basu B.O. (1935), Indian Medicinal Plants Vol.4. *Bishen Singh and Mahendra Pal Singh Publishers, Dehradun*.
15. Lindsay S. and Middleton D.J. (2012 onwards). Ferns of Thailand. <http://rbg-web2.rbge.org.uk/thaiferns/>
16. Ma L.Q., Komar K.M., Tu C., Zhang W., Cai, Y., and Xennelly E.D. (2001), A Fern That Hyperaccumulate Arsenic, *Nature*, vol. 409, p. 579.

17. Mandal B., Vlek P.L.G. and Mandal L.N. (1999), Beneficial effect of blue green algae and *Azolla* excluding supplying nitrogen on wetland rice fields: a review. *Biol Fertil Soils*, 28: 329 – 342.
18. Manickam V.S. and Irudayaraj V. (1992), Pteridophyte flora of the Western Ghats – South India. *B.I. Publications Pvt Ltd, New Delhi*.
19. Nair B.K. (1959), Medicinal ferns of India. *Bull Nat Bot Gard, Lucknow*, 29: 1 – 36.
20. Radhakrishna B.P. (2001), The Western Ghats of the Indian peninsula. *Memoir Geological Society of India* 47: 133 – 144.
21. Rajagopal P.K. and Gopalkrishna Bhat K. (1998), Pteridophytic flora of Karnataka state, India. *Indian Fern Journal*, 15: 1 – 28.
22. Rout S.D., Panda T. and Mishra N. (2009), Ethnomedicinal studies on some pteridophytes of Simlipal Biosphere Reserve, Orissa, India. *International Journal of Medicine and Medicinal Sciences*, 1(5): 192 – 197.
23. Schaffner J.H. (1905), The life cycle of a Heterosporous pteridophyte. *The Ohio Naturalist*, 5(3): 255-260.
24. Schaffner J.H. (1906), The life cycle of a Homosporous pteridophyte. *The Ohio Naturalist*, 6(5): 483-488.
25. Sharma M.P., Singh R. and Singh R. (1999), Effect of *Azolla* on Wheat (*Triticum aestivum*) yield and soil properties. *Indian J Agri Sci*, 69: 55 – 57.
26. Sreekantha, Chandran M.D.S., Mesta D.K., Rao G.R., Gururaja K.V., Ramachandra T.V. (2007), Fish diversity in relation to landscape and vegetation in Central Western Ghats, India. *Current Science* 92, 1592-1603.
27. Tu C., Ma L.Q., and Bondada B. (2002), Arsenic Accumulation in the Hyper Accumulator Chinese Brake and Its Utilization Potential for Phytoremediation. *Journal of Environmental Quality*, vol. 31, pp. 1671–1675.
28. Warriar P.K., Nambiar V.P.K., and Raman Kutty C. (1996), Indian Medicinal Plants 5 Vols. *Orient Longman Ltd*.

**Table 1: Distribution of Pteridophytes in various taluks of Uttara Kannada district**

Sr. No.	Botanical name	Jo	Ka	Ye	Sir	Ku	Sid	Habitat and Ecology
1.	<i>Huperzia hamiltonii</i> (Spreng) Trev. (Lycopodiaceae)						+	Usually growing as epiphytes along shaded stream banks and road sides.
2.	<i>Lycopodiella cernua</i> (L.) Pic. Ser. (Lycopodiaceae)		+			+		Commonest species of Lycopodiaceae found usually along fully exposed road sides, road cuttings and on mud walls.
3.	<i>Selaginella delicatula</i> (Desv.) Alston (Selaginellaceae)	+						Common on stone walls or rock crevices along road sides.
4.	<i>Selaginella miniatospora</i> (Dalz.) Baken (Selaginellaceae)	+						Usually growing on moist, shady soils.
5.	<i>Selaginella proniflora</i> (Lam.) Baker (Selaginellaceae)		+					
6.	<i>Selaginella tenera</i> (Hook. & Grev.) Spring (Selaginellaceae)		+		+			Usually growing as terrestrials on the forest floor in shade and rarely seen along shaded roadsides.
7.	<i>Ophioglossum costatum</i> R. Br. (Ophioglossaceae)		+	+	+	+		Terrestrials in mixed deciduous forests.
8.	<i>Ophioglossum reticulatum</i> L. (Ophioglossaceae)		+					Gregarious on a swampy, grassy spot in a shrub-savanna.
9.	<i>Angiopteris indica</i> Desv. (Marattiaceae)	+						Usually common along shaded stream banks.
10.	<i>Osmunda huegeliana</i> Presl. (Osmundaceae)	+				+	+	Terrestrial plants growing as large colonies or bushes in fully exposed in fully exposed marshy places near streams or lakes.
11.	<i>Lygodium flexuosum</i> (L.) Sw. (Schizaeaceae)	+	+	+	+	+	+	Terrestrial, growing as climbers along fully or partially exposed roadsides.
12.	<i>Lygodium microphyllum</i> (Cav.) R. Br. (Schizaeaceae)	+						Growing as climbers on trees in fully exposed marshy places.
13.	<i>Acrostichum aureum</i> L. (Pteridaceae)		+			+		Gregarious in tidal backwaters in fully exposed places.
14.	<i>Pteris biaurita</i> L. (Pteridaceae)	+						Usually seen along roadsides in fully exposed places.

15.	<i>Pteris linearis</i> L.* (Pteridaceae)	+						Usually found on stream banks
16.	<i>Pteris pellucida</i> Presl. (Pteridaceae)	+	+	+			+	Normally growing inside the forests in fully shaded places, rarely seen on roadsides and partially exposed places.
17.	<i>Pteris quadriaurita</i> Retz. (Pteridaceae)	+				+	+	Very common species of <i>Pteris</i> distributed in variety of habitats.
18.	<i>Pteris semipinnata</i> L.** (Pteridaceae)	+						Found distributed in evergreen forests.
19.	<i>Pteris vittata</i> L. (Pteridaceae)	+		+			+	Usually grows along fully exposed roadsides on stone crevices.
20.	<i>Cheilanthes tenuifolia</i> (Burm. f.) Sw. (Sinopteridaceae)	+	+				+	Gregarious in fully exposed canals at foothills or paddy fields, ponds or other such marshy places.
21.	<i>Ceratopteris thalictroides</i> (L.) Brongn. (Parkeriaceae)	+	+				+	Gregarious in fully exposed canals at foothills or paddy fields, ponds or other such marshy places.
22.	<i>Pityrogramma calomelanos</i> (L.) Link. (Hemionitidaceae)	+		+			+	Usually terrestrials, rarely lithophytes along roadsides in fully exposed dry places; rarely along stream banks.
23.	<i>Adiantum philippense</i> L. subsp. <i>philippense</i> (Adiantaceae)	+	+	+	+	+	+	Terrestrial plants usually seen along partially or fully exposed roadsides.
24.	<i>Vittaria elongata</i> Sw. (Vittariaceae)			+				Growing as epiphytes from sea level to 1200 m height.
25.	<i>Microlepia speluncae</i> (L.) Moore (Dennstaedtiaceae)						+	Grow as terrestrials on forest floor or along shaded stream banks.
26.	<i>Pteridium revolutum</i> (Blume) Nakai Syn. <i>P. aquilinum</i> (L.) Kuhn. (Dennstaedtiaceae)	+						Gregariously growing on fully exposed grassy slopes on the forest edge, roadsides and clearings.
27.	<i>Lindsaea ensifolia</i> Sw. (Lindsaeaceae)	+				+		Terrestrials, commonly seen on fully exposed dry places, seen rarely on fully shaded places.
28.	<i>Lindsaea heterophylla</i> Beddome (Lindsaeaceae)	+					+	Commonly found on dry slopes in evergreen forests.
29.	<i>Leucostegia truncata</i> (D. Don) Fras-Jenk. syn.: <i>Leucostegia immersa</i> C. Presl. (Davalliaceae)						+	Terrestrial or lithophytes on fully or partially exposed dry places along roadsides, clearings or forest edges between 800 – 1300 m.
30.	<i>Hymenophyllum polyanthos</i> Sw. (Hymenophyllaceae)	+						Epiphytes on tree trunks or mossy rocks in partial or full shade.

31.	<i>Trichomanes intramarginale</i> Hook. & Grev. (Hymenophyllaceae)		+					Epiphytes or lithophytes along shaded stream banks.
32.	<i>Dicranopteris linearis</i> (Burm. F.) Underwood (Gleicheniaceae)	+	+	+	+	+	+	Found extensively growing along the road cuttings in shaded or open areas.
33.	<i>Cyathea gigantea</i> (Wall. ex Hook.) Holttum (Cyatheaceae)	+					+	Found abundantly growing as terrestrial plants along the shaded stream banks.
34.	<i>Cyathea nilgirensis</i> Holttum (Cyatheaceae)						+	This is endemic to South India and is found distributed in central and southern Western Ghats.
35.	<i>Thelypteris (Ampelopteris) prolifera</i> (Retz.) Copel. (Thelypteridaceae)		+					Often found scrambling amongst tall grasses, sedges or shrubs in freshwater swamps, or beside rivers, ponds and lakes.
36.	<i>Thelypteris (Amphineuron) terminans</i> (Hook.) Holttum (Thelypteridaceae)			+				Seen as a colony in forests along partially exposed roadsides and forest edges.
37.	<i>Thelypteris (Christella) dentata</i> (Forssk) E.P.St.John (Thelypteridaceae)	+	+					This is the most common fern in South India. It is found throughout the Western Ghats, along roadsides, clearings and along stream banks in partially or fully exposed places.
38.	<i>Thelypteris (Christella) hispidula</i> (Decne) Holttum (Thelypteridaceae)		+					Growing inside the forest.
39.	<i>Thelypteris (Christella) papilio</i> (Hope) Holttum (Thelypteridaceae)						+	Distributed along stream banks.
40.	<i>Thelypteris (Christella) parasitica</i> (L.) Tardieu (Thelypteridaceae)	+	+	+			+	Very common in partially shaded places in the evergreen forests.
41.	<i>Thelypteris (Cyclosorus) interruptus</i> (Willd.) H. Ito (Thelypteridaceae)	+	+					Usually seen frequently as large colonies in open marshy places, lakes, walls and border of paddy fields from sea level upto 1400 m height.
42.	<i>Asplenium inequilaterale</i> Willd. (Aspleniaceae)						+	Terrestrial on fully shaded or partially exposed streams and stream banks.
43.	<i>Asplenium phyllitidis</i> subsp. <i>phyllitidis</i> D. Don				+			Common in moist deciduous forests growing as epiphytes on trees.

	(Aspleniaceae)						
44.	<i>Anisocampium cumingianum</i> Presl. (Woodsiaceae)					+	Low altitude terrestrial plants, seen along partially exposed road sides or fully shaded forest floors.
45.	<i>Athyrium anisopterum</i> Christ (Woodsiaceae)	+				+	On humus rich floor of dense evergreen forests.
46.	<i>Athyrium hohenackerianum</i> (Kuntze) T. Moore (Woodsiaceae)	+	+				Less frequent species found to be growing as terrestrials or lithophytes on rock crevices along fully or partially shaded roadsides.
47.	<i>Athyrium solenopteris</i> (Kuntze) T. Moore (Woodsiaceae)					+	This is the most common species of <i>Athyrium</i> and is commonly found along fully shaded stream banks. They also grow on forest floor and in fully exposed marshy places between 1300-2200 m.
48.	<i>Diplazium esculentum</i> (Retz.) Sw. (Woodsiaceae)	+				+	Terrestrial ferns growing as large colonies in open marshy places along streams and canals.
49.	<i>Dryopteris cochleata</i> (Buch. Ham. ex D. Don) C. Chr. (Dryopteridaceae)	+					Terrestrial plants frequently growing along fully exposed roadsides, dry places or clearings.
50.	<i>Tectaria coadunata</i> (J. Sm.) C. Chr. (Dryopteridaceae)	+	+				Frequent along fully or partially shaded roadsides, along waysides inside the forest or on forest floor.
51.	<i>Tectaria polymorpha</i> (Wallich. Ex Hook.) Copel. (Dryopteridaceae)	+				+	On mountain slopes, usually in dry places in dense forests.
52.	<i>Bolbitis appendiculata</i> (Willd.) K. Iwatz (Lomariopsidaceae)	+					Usually growing as lithophytes in large colonies along fully or partially shaded streams or stream banks.
53.	<i>Bolbitis lancea</i> (Copel.) Ching (Lomariopsidaceae)	+	+				
54.	<i>Bolbitis presliana</i> (Fee) Ching (Lomariopsidaceae)	+	+			+	Growing as terrestrials near water bodies and other moist places.
55.	<i>Bolbitis prolifera</i> (Bory) C. Chr. (Lomariopsidaceae)	+					Lithophytes on shaded rocks on the forest floor usually along stream banks.
56.	<i>Bolbitis semicordata</i> (Bak.) Ching (Lomariopsidaceae)	+				+	Usually found as lithophytes growing along shaded stream banks. Endemic to south India.

57.	<i>Bolbitis subcrenatooides</i> Fras.-Jenk. new name for <i>Bolbitis subcrenata</i> (Benth & Hook.) var. <i>prolifera</i> (Rev.) (Lomariopsidaceae)	+	+				+	Occurs in partially shaded or open road side cuttings in semi-evergreen and evergreen forests. Endemic to South India
58.	<i>Blechnum orientale</i> L. (Blechnaceae)	+	+	+	+	+	+	Terrestrial plants, growing on fully exposed dry places and clearing along roadsides and road cuttings.
59.	<i>Stenochlaena palustris</i> (Burm.) Beddome (Blechnaceae)					+		Usually found along partially shaded roadsides or inside the forest in fully shaded places.
60.	<i>Drynaria quercifolia</i> (L.) J. Sm. (Polypodiaceae)		+	+	+	+		They occur as epiphytes on the bark of trees in partly or fully shaded places.
61.	<i>Lepisorus nudus</i> (Hook.) Ching (Polypodiaceae)	+					+	Commonly seen as epiphytes on shola trees and sometimes also grow as lithophytes along stream banks or on forest floor.
62.	<i>Leptochilus decurrens</i> Blume (Polypodiaceae)		+				+	Terrestrials or lithophytes along fully shaded streams or stream banks.
63.	<i>Loxogramme involuta</i> (D. Don) Presl (Polypodiaceae)						+	Epiphytes or lithophytes growing inside the forest.
64.	<i>Microsorium membranaceum</i> (D. Don) Ching (Polypodiaceae)						+	Epiphytes on fully shaded shola trees inside the forest or on forest edges.
65.	<i>Microsorium punctatum</i> (L.) Copel. (Polypodiaceae)						+	Epiphytes along fully or partially shaded stream banks.
66.	<i>Marsilea minuta</i> L. (Marsileaceae)	+				+		Aquatic or semi-aquatic in ponds, paddy fields and marshy places.
67.	<i>Azolla pinnata</i> R. Br. (Azollaceae)	+				+		Free floating aquatic plants at sea level and plains.

Jo – Joida; Ka – Karwar; Ye – Yellapur; Sir – Sirsi; Ku – Kumta; Sid – Siddapur;

\*A very rare species. Included in the list on the basis of herbarium sheet at BLAT collected by MacCann.

\*\*No specimen has been collected by Rajagopal & Bhat (1998) and in current investigations, information based on earlier literatures.



**Botanical name:** *Huperzia hamiltonii* (Spreng) Trev.

**Family:** Lycopodiaceae

**Botanical description:** Small plants; stem pendulous, entire plant up to 28 cm long, 4mm thick without leaves; isodichotomously branched; one to three times; leaves numerous, spirally arranged, spreading, oblong or elliptic, margin entire; texture coriaceous; leaves dark green and glabrous. Sporangia borne at the axis of sporophylls towards 5cm long distal-most part of main stem. Sporangia yellowish-brown; spores numerous, trilete.

**Distribution and ecology:** Growing as epiphytes on shoal trees along shaded stream banks or roadsides.

**Botanical name:** *Lycopodiella cernua* (L.) Pic. Ser.

**Family:** Lycopodiaceae

**Botanical description:** Main stem erect, terete, bearing branching roots at the base; entire branching system above the unbranched main stem; main branches subopposite, forked two to three times into secondary branches which bear upto 5 times forked tertiary branches. Leaves sparse on main stem, dense on the rest, acuminate, entire, pale green, herbaceous. Cones terminal on the ultimate branches, pendant, cylindrical; sporophylls yellowish-green, thin. Spores trilete, pale green.

**Distribution and ecology:** Commonly occurring plant, found along fully exposed road sides, on road cuttings and on muddy walls.

**Uses:** It is cultivated as an ornamental plant. In Malaysia, decoction of the plant is used as a lotion in beri-beri and also for coughs and uneasiness in the chests (Manickam & Irudayaraj, 1992).



**Botanical name:** *Selaginella delicatula* (Desv.) Alston

**Family:** Selaginellaceae

**Botanical description:** Stem erect or suberect, rooting at the base, upto 4mm thick without leaves; lateral branches many, alternate, tripinnate; leaves oblique and scattered on main stem, arranged in four rows on lateral branches. Spikes borne on ultimate branches, quadrangular; sporophylls uniform, ovate; microspores green, megaspores pale brown.

**Distribution and ecology:** Common on stone walls or rock crevices along road sides.



**Botanical name:** *Selaginella miniatospora* (Dalz.) Baker

**Family:** Selaginellaceae

**Botanical description:** Stem about 30 cm long, yellowish-green, branched from the base and rooting at base only. Leaves dimorphic throughout and distant on the main stem; lateral and median leaves ovate and dentate. Sporophylls of spike dimorphic; smaller sporophylls fertile, ovate; larger sporophylls sterile, oblong-ovate. Microspores trilete, pyramidal.

**Distribution and ecology:** Usually growing on moist, shady soils.

**Botanical name:** *Selaginella proniflora* (Lam.) Baker

**Family:** Selaginellaceae

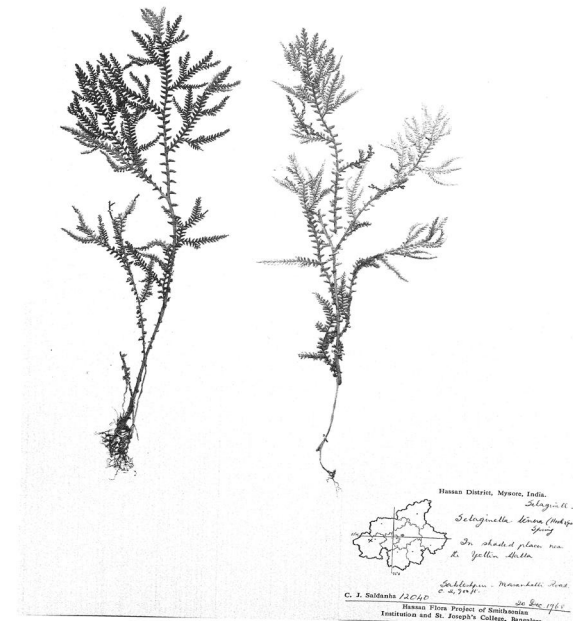
**Botanical description:** Trailing herbs; stem erect-decumbent. Leaves contiguous but obliquely horizontal on main stem; lateral leaves with ciliate margins; arista of median leaves half as long as leaf lamina. Megasporephylls oblong-lanceolate; megaspore reticulate; microspore reticulate with spines.

**Botanical name:** *Selaginella tenera* (Hook. & Grev.) Spring

**Family:** Selaginellaceae

**Botanical description:** Stem erect, up to 3mm thick without leaves, up to 8 mm wide with leaves, green to pink colour when fresh. Leaves dimorphic throughout, contiguous on main stem and on axis of primary branches; lateral leaves oblong-ovate; median leaves ovate; sporophylls dimorphic, lateral sporophylls bearing megasporangia, others with microsporangia.

**Distribution and ecology:** Terrestrials on the forest floor in shade. Rarely seen along road sides and waysides.



**Botanical name:** *Ophioglossum costatum* R. Br.

**Family:** Ophioglossaceae

**Botanical description:** Rhizome tuberous to 1cm in diameter, bearing numerous fleshy roots. Fronds about 18 cm long; oblong-lanceolate, acute at apex, narrowly cuneate at base; texture rather fleshy, soft herbaceous. Sporophyll simple, with stalks of about 10 cm in length; spikes to 4.5 cm long. Sporangia about 0.5 mm in diameter; spores dark, with rather roughly reticulate exospores.

**Distribution and ecology:** Terrestrials in mixed deciduous forests.

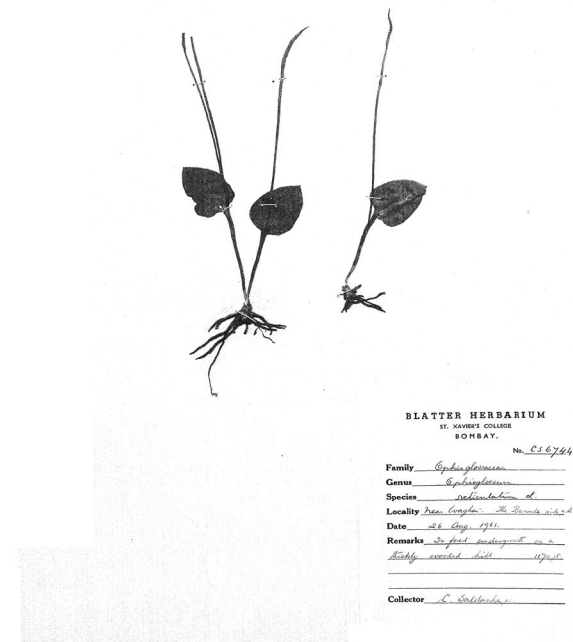
**Botanical name:** *Ophioglossum reticulatum* L.

**Family:** Ophioglossaceae

**Botanical description:** Rhizome erect, cylindrical, tuberous, bearing long, thick, fleshy roots. Petiole dark green, terete, fleshy; blade simple, usually cordate, rarely ovate, entire; distinct midrib absent; blade dark green, glabrous above and below; texture herbaceous. Spike arising from the base of sterile blade. Spore sacs arranged in two alternate compact rows, dehisced by horizontal splits; spores spherical, trilete, colourless with pale green nuclear content.

**Distribution and ecology:** Terrestrial as small colonies on fully or partially exposed grassy slopes or clearings of *Pteridium revolutum*.

**Uses:** Fleshy fronds are eaten as vegetable curry (Dixit & Vohra, 1984). *Ophioglossum* in general is used as a cooling agent and in treatment of inflammations and wounds (Manickam and Irudayaraj, 1992).



**Botanical name:** *Angiopteris indica* Desv.

**Family:** Marattiaceae

**Botanical description:** Rhizome erect, cylindrical, apex densely covered by dark brown hairs. Lamina deltoid, bipinnate; pinnae up to 16 pairs, sub-opposite, oblong-lanceolate; lamina dark coloured, texture herbaceous, recurrent false veins reaching the soral line. Soral line close to or at the margin and generally has smaller segments with prominent teeth near their tips.

**Distribution and ecology:** Common along shaded stream banks.



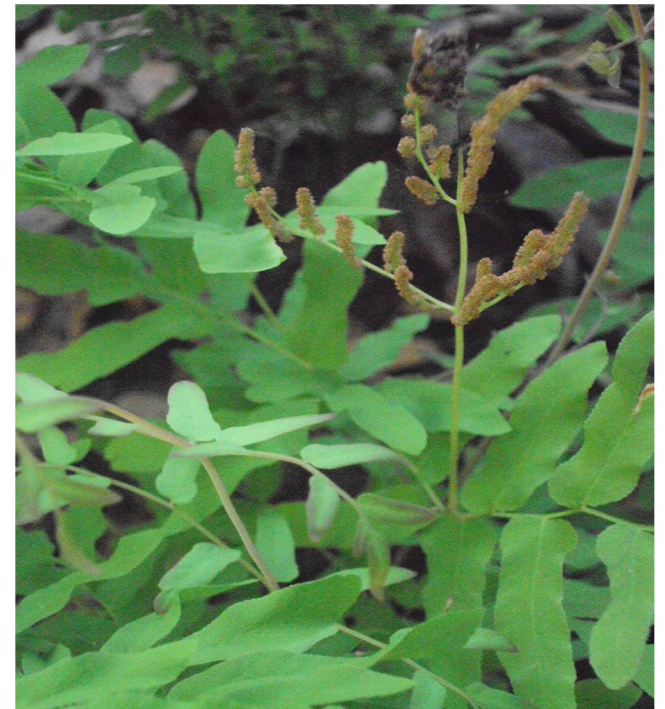
**Botanical name:** *Osmunda huegeliana* Presl.

**Family:** Osmundaceae

**Botanical description:** Rhizome erect or sub-erect, scales absent; stipes tufted, numerous. Lamina lanceolate, bipinnate, distal one-fourth to one-sixth part bearing sporangia; sterile pinnae up to seven pairs, shortly stalked, ascending. Pinnae pale green to rufous brown, glabrous, texture coriaceous; fertile pinnules compressed, panicle forming, cylindrical, bearing large spherical sporangia all over the branches; spores trilete, globose.

**Distribution and ecology:** Terrestrial plants growing as large colonies or bushes in fully exposed marshy places near streams or lakes.

**Uses:** Fronds are used as tonic and also for rickets, rheumatism and for intestinal gripping (Dixit, 1959; Dixit and Vohra, 1984).



**Botanical name:** *Lygodium flexuosum* (L.) Sw.

**Family:** Schizaeaceae

**Botanical description:** Rhizome short creeping, upto 0.5 cm thick, densely covered by about 1 mm long, dark brown, multicellular, uniseriate, tubular hairs all over. Fronds oblong-lanceolate, tripinnate, primary pinna alternate; pinnules oblong-lanceolate, simple or forked; pinnae pale green, texture herbaceous. Sporangia arranged adaxially, finger-like spikes along the margin of the pinnules; sporangia about five pairs; protected by indusium; spores yellowish-green.

**Distribution and ecology:** Terrestrials, climber along fully or partially exposed roadsides.

**Uses:** Young shoots used as leafy vegetables, plants used as an expectorant; rhizome boiled with mustard oil and locally applied in rheumatism, sprains, scabies, ulcers, eczema and cuts (Dixit, 1959; Dixit and Vohra, 1984).



**Botanical name:** *Lygodium microphyllum* (Cav.) R. Br.

**Family:** Schizaeaceae

**Botanical description:** Climber; rhizome long, creeping, covered by dark hairs. Fronds 2-3 m tall; stipe and rachis brown. Primary branches borne up to 10 cm apart on adaxial side of rachis, a pair of secondary branches borne subapically; secondary rachis and stalk of the pinnules narrowly winged above; lateral pinnules up to four pairs, alternate; pinnules pale green, glabrous above and below; texture herbaceous. Sporangia borne on the surfaces of the finger-like lobes all around the margins of the pinnules except at the cordate base.

**Distribution and ecology:** Not very commonly occurring. Climber on trees in fully exposed marshy places.

**Uses:** Cultivated in gardens. Young leaves are eaten in Java. Decoction of leaves is given in dysentery. Leaves applied in form of poultices for skin diseases and swellings (Manickam and Irudayaraj, 1992).



**Botanical name:** *Acrostichum aureum* L.

**Family:** Pteridaceae

**Botanical description:** Rhizome erect, 5 cm thick, densely covered by scales all over. Scales lanceolate, dark brown, thin. Lamina simply pinnate; pinnae up to 11 cm; costa slightly raised, rounded below; pinnae glabrous all over above and below, yellowish-green when fresh, brownish when dry, texture coriaceous; up to six pairs of pinnae in distal part of lamina are fertile; sori acrostichoid, spores trilete.

**Distribution and ecology:** Gregariously growing in tidal backwaters in fully exposed places.

**Uses:** In Malaya and Borneo, the rhizome is pounded and grated and applied as a paste to wounds and boils. Rhizome is also used for worms and bladder complaints in China.



**Botanical name:** *Pteris biaurita* L.

**Family:** Pteridaceae

**Botanical description:** Rhizome erect, upto 3 cm in diameter, densely covered by scales at the apex. Lamina lanceolate, bipinnatifid; pinnae upto 12 pairs, subopposite, shortly stalked, apex acuminate, base broadly cuneate; pinnae pale green, texture subcoriaceous. Sori borne all along the margin except at the base of the sinus and at the apex of the lobe; spores dark brown, exine with dense reticulate thickenings.

**Distribution and ecology:** Usually seen along roadsides on fully exposed places.



**Botanical name:** *Pteris pellucida* Presl.

**Family:** Pteridaceae

**Botanical description:** Rhizome erect, up to 3cm thick, densely scaly at apex. Stipe up to 45 cm long, abaxially rounded, adaxially grooved, glossy and glabrous all over. Lamina broadly obovate, simply pinnate with ternate apex; pinnae pale green, glabrous above and below, often glossy on the upper surface; texture coriaceous. Sori linear marginal except at the apex and base, indusiate; indusial dark brown, entire, glabrous; spores trilete, tetrahedral, yellowish-brown.

**Distribution and ecology:** Growing normally inside the forest, in fully shaded places, rarely seen on the forest edges or roadsides in partially exposed places.



**Botanical name:** *Pteris quadriaurita* Retz.

**Family:** Pteridaceae

**Botanical description:** Rhizome erect or suberect, 2.5 cm thick; scales lanceolate; stipes pale brown, glabrous, glossy above. Lamina deltoid or broadly ovate, bipinnatifid; pinnae 5-10 pairs, opposite, 5 cm apart, lanceolate; basal pinnae forked once at the base; pinnae dark green; texture thick, herbaceous to subcoriaceous.

**Distribution and ecology:** Most common species of *Pteris* distributed in all kinds of habitats.





**Botanical name:** *Pteris vittata* L.

**Family:** Pteridaceae

**Botanical description:** Rhizome suberect, 5 cm thick, covered by scales at apex. Stipes tufted, 20 cm long, pale brown, scaly at base. Lamina lanceolate, simply pinnate; pinnae opposite or sub-opposite, sessile, linear lanceolate margin serrate in distal non-soral part, entire in the rest; pinnae pale green, glabrous; texture herbaceous; sori all along the margin upto the base. Spores yellowish-green.

**Distribution and ecology:** Growing along fully exposed roadsides in stone crevices.



**Botanical name:** *Cheilanthes tenuifolia* (Burm. f.) Sw.

**Family:** Sinopteridaceae

**Botanical description:** Rhizome short creeping, about 1 cm thick, densely scaly at the apex. Lamina ovate-lanceolate, quadripinnate below, tripinnate at the middle, bipinnate above, apex acuminate, base cuneate; primary pinnae about 5 pairs, ascending, upto 9 cm apart, distinctly stalked; pinnae dark green, glabrous above and below. Sori marginal on each ultimate lobe; protected by reflexed margin; spores dark brown; exine granulose.

**Distribution and ecology:** Gregarious in fully exposed canals or paddy fields, ponds or other such marshy places between sea level to 100 m.

**Uses:** Rhizome and roots are used by the tribals as a general tonic (Dixit, 1959).



**Botanical name:** *Ceratopteris thalictroides* (L.) Brongn.

**Family:** Parkeriaceae

**Botanical description:** Aquatic plants; stock erect or sub-erect, bearing thick, fibrous, fleshy roots densely on abaxial side, apex covered by scales. Fronds arranged in a rosette; stipes fleshy, pale green. Lamina dimorphous, primary pinnae about five pairs, slightly ascending, alternate, shortly stalked. Lamina glabrous above and below, pale green; texture soft, herbaceous. Fertile lamina ovate, tripinnate, margin reflexed and completely covering lower surface on which two rows of larger sporangia are borne; spores trilete, pale green.

**Distribution and ecology:** Gregarious in fully exposed canals at foothills, paddy fields, ponds and other such marshy places.

**Uses:** Fronds are used as poultice in skin complaints and in China as tonic. Fresh leaves are used as vegetable curry (Dixit and Vohra, 1984).



**Botanical name:** *Pityrogramma calomelanos* (L.) Link.

**Family:** Hemionitidaceae

**Botanical description:** Rhizome erect, about 3 cm thick, densely scaly at apex; scales lanceolate. Lamina lanceolate, bipinnate, apex acute or acuminate, base broadly cuneate, pinnae about 12 pairs, progressively reduced towards the apex, dark green, glabrous and glossy above, covered by silver coloured waxy powder below, texture thin or thick herbaceous. Sori along veins, covered by entire surface when mature; spores trilete, honey coloured, exine densely, minutely papillose.

**Distribution and ecology:** Usually terrestrial, rarely lithophytes along roadsides in fully exposed dry places.

**Uses:** Widely cultivated as an ornamental pot plant.



**Botanical name:** *Adiantum philippense* L. subsp. *philippense*

**Family:** Adiantaceae

**Botanical description:** Rhizome erect or sub-erect, scales oval shaped, pale brown at periphery while dark brown in centre part; Leaf lamina lens shaped, simply pinnate with 10-17 pairs of fan shaped pinnae; margin entire or subcrenate in sterile pinnae, pale green coloured pinnae and herbaceous texture. Sori along the edge of the lobe in continuity. Spores triangular shaped.

**Distribution and ecology:** This species is more or less uniformly distributed across the Western Ghats from the southern to northern parts. These are terrestrial plants commonly seen along partially or fully exposed roadsides.

**Uses:** The leaf and root decoction is used effectively for the treatment of chest complaints in Malaya (Benjamin & Manickam, 2007).



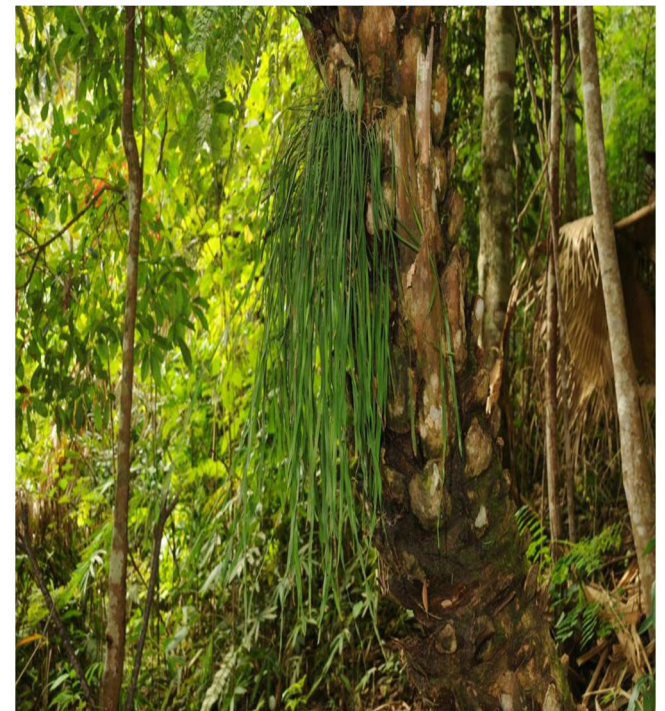
**Botanical name:** *Vittaria elongata* Sw.

**Family:** Vittariaceae

**Botanical description:** Rhizome short, creeping, branched, densely clothed by scales all over. Fronds about 2 mm apart, linear-oblong lanceolate, progressively narrowing towards the base and apex; fronds dark green, texture chartaceous, flexuous. Sori marginal, erect when mature, spores monolet, ellipsoid, pale yellowish-green.

**Distribution and ecology:** Growing as low altitude epiphytes in forests.

Photo source: <http://rbg-web2.rbge.org.uk>



**Botanical name:** *Microlepia speluncae* (L.) Moore

**Family:** Dennstaedtiaceae

**Botanical description:** Rhizome long, creeping, branched upto 2 cm thick, densely clothed by pale brown, multicellular, uniseriate, tubular hairs all over. Lamina broadly deltoid, ovate, tripinnatifid, primary pinnae about 8 pairs, Secondary pinnae about 20 pairs, slightly ascending; Lamina usually pubescent above and below, dark green, texture soft, herbaceous. Sori submarginal, usually on the basal acroscopic vein end of each lobe; spores trilete, pale green, triangular with rounded corners.

**Distribution and ecology:** Grow as terrestrials on forest floor or along shaded stream banks, rarely found along shaded road sides.



**Botanical name:** *Pteridium revolutum* (Blume) Nakai Syn. *P. aquilinum* (L.) Kuhn.

**Family:** Dennstaedtiaceae

**Botanical description:** Rhizome long creeping, subterranean, upto 2 cm thick, densely covered by pale brown, multicellular, uniseriate, deciduous hairs all over. Lamina deltoid-ovate, acute, broadly cuneate, tripinnatifid at base, becoming bipinnatifid at apex; primary pinnae about 8 pairs, opposite or subopposite; lamina dark green, texture coriaceous. Sori linear, submarginal, about 1 mm wide.

**Distribution and ecology:** Gregariously growing on fully exposed grassy slopes on the forest edge, roadsides and clearings.

**Uses:** Rhizome is astringent, anthelmintic and is useful in diarrhea and inflammation of gastric and intestinal mucous membranes. Rhizome is boiled in oil and is made into ointment for wounds. The dried fronds are employed as packaging materials. Also used in floral decorations.



**Botanical name:** *Lindsaea ensifolia* Sw.

**Family:** Lindsaeaceae

**Botanical description:** Rhizome up to 3 mm thick branched, densely covered by scales all over. Stipes scattered, glossy and glabrous all over. Lamina obovate, simply pinnate with terminal pinna similar to lateral ones; pinnae one to six pairs, shortly stalked, margin entire in fertile pinnae, finely serrate or wavy or entire in sterile ones; texture herbaceous. Sori linear continuous or interrupted, all along the margin except at the very base, indusiate; spores dark brown.

**Distribution and ecology:** Terrestrial, commonly seen on fully exposed dry places, seen rarely on fully shaded places.

Photo source: <http://rbg-web2.rbge.org.uk>



**Botanical name:** *Lindsaea heterophylla* Beddome

**Family:** Lindsaeaceae

**Botanical description:** Rhizome up to 3 mm thick often branched, densely covered by scales all over. Stipes scattered, tetragonal, glabrous and glossy. Lamina deltoid or ovate, bipinnate, pinnules up to 10 pairs, alternate, shortly stalked, margin usually entire, no distinct midrib; pinnules dark green, glabrous above and below; texture herbaceous. Sori sub-marginal, continuous all along the margin except at the cuneate base, discontinuous in lobed ones; indusial pale green, margin crenate; spores pale brown, exine granulose.

**Distribution and ecology:** On dry slopes in evergreen forests, not in open areas, at various altitudes.



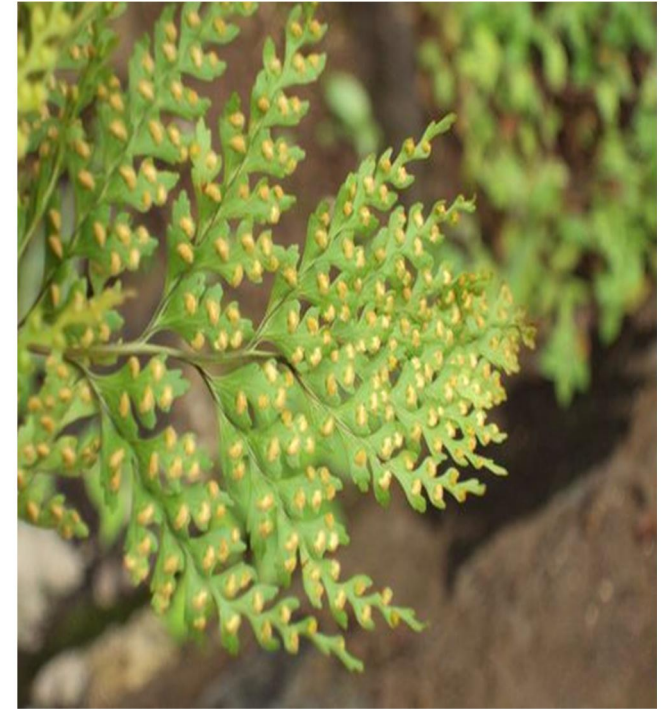
**Botanical name:** *Leucostegia truncata* (D. Don) Fras-Jenk. syn.: *Leucostegia immersa* C. Presl.

**Family:** Davalliaceae

**Botanical description:** Rhizome long creeping, upto 5 mm thick, densely covered by scales and hairs all over. Lamina ovate, bipinnatifid or tripinnate, apex acute, base cuneate; primary pinnae upto eight pairs; lamina yellowish-green, glabrous above and below, texture soft and herbaceous. Sori submarginal on the basal acroscopic lobe of the pinnule at the vein end, more or less orbicular, distinctly raised on upper surface of pinnule.

**Distribution and ecology:** Terrestrial or lithophytes on fully or partially exposed dry places along roadsides, clearings or forest edges between 800 – 1300 m.

**Uses:** Young fronds are cooked with potato and eaten with rice in Darjeeling district of West Bengal (Dixit and Vohra, 1984).



**Botanical name:** *Hymenophyllum polyanthos* Sw.

**Family:** Hymenophyllaceae

**Botanical description:** Rhizome slender, with hairy rootlets. Stipes sparsely hairy especially in the younger parts, rootlets densely hairy. Laminae very variable both in size and form, lanceolate, oblong-lanceolate, usually tripinnatifid, light green, herbaceous. Rachis winged throughout, entire, flat, pinnae less than 10 in pairs. Sori scattered usually in the upper parts of fronds.

**Distribution and ecology:** Epiphytes on tree trunks or mossy rocks in partial or full shade, common at medium or higher altitudes.

Photo source: <http://rbg-web2.rbge.org.uk>



**Botanical name:** *Trichomanes intramarginale* Hook. & Grev.

**Family:** Hymenophyllaceae

**Botanical description:** Rhizome wide creeping, up to 1mm thick, profusely branched. Fronds scattered, , dark hairy stipe, broadly, obliquely obovate in outline, pinnatifid or subpinnatifid, outer margin almost rounded; ultimate segments oblong; lamina dark green, membranaceous. Sori terminal on the segments, immersed, laterally winged; spores spherical, ovoid or elliptic.

**Distribution and ecology:** Epiphytes or lithophytes along shaded stream banks.

**Botanical name:** *Dicranopteris linearis* (Burm. F.) Underwood

**Family:** Gleicheniaceae

**Botanical description:** Rhizome long, creeping, densely covered by ferruginous hairs. Lamina about 30 cm to few meters long, erect or scandant, forked once to several times, bearing accessory branches at or above the forks; ultimate leafy segments oblong, pinnatifid almost to the costa. Sori median or submedian, orbicular, exindusiate; sporangia dehiscing vertically; spores trilete, exine smooth.

**Distribution and ecology:** extensively growing along the road cuttings in shaded or open areas.

**Uses:** The rhizome is used as anthelmintic in Assam while the fronds are used for asthma in Madagascar. The splints are prepared by cracking the outer covering of the long leaf stalks and pulling out the ribbon-like vascular bundles which are woven into mats, chair seats, punches, caps, fishing traps, coiled baskets and belts (Manickam & Irudayaraj, 1992).



**Botanical name:** *Cyathea gigantea* (Wall. ex Hook.) Holttum

**Family:** Cyatheaceae

**Botanical description:** Trunk about 9 cm in diameter, about a meter high with persistent swollen bases of stipes, bearing crown of fronds at the apex; trunk densely covered by scales. Lamina bipinnate, deltoid, primary pinnae about 12 pairs, spreading, alternate, distinctly stalked, oblong-lanceolate, apex acuminate, base truncate or subtruncate. Sori media on the veins, three to five and half pairs, spherical, forming two zigzag rows submarginally, sporangia numerous, compact; paraphyses mingled with sporangia.

**Distribution and ecology:** Found abundantly growing as terrestrial plants along the shaded stream banks.



**Botanical name:** *Cyathea nilgirensis* Holttum

**Family:** Cyatheaceae

**Botanical description:** Trunk about 2 m high, bearing crown of fronds at the apex; scales densely covering the younger fronds, lanceolate, dark brown at centre and orange coloured at periphery, apex hair pointed. Lamina bipinnate, oblong-lanceolate, about 200 x 100 cm, acute; pinnae about 12 pairs, alternate, distinctly petiolate; basal few pairs slightly reduced; pinnules acuminate, base truncate or subtruncate, margin pinnatifid upto the costa. Sori seated at the vein forks of the lower half of the segments, spherical, exindusiate, paraphyses intermingled with sporangia, spores trilete.

**Distribution and ecology:** This is endemic to South India and is found distributed in central and southern Western Ghats.





**Botanical name:** *Thelypteris (Ampelopteris) prolifera* (Retz.) Copel.

**Family:** Thelypteridaceae

**Botanical description:** Large scrambling herb, rhizome short-creeping. Leaves closely spaced, arching; petiole pale brown, glabrous; lamina narrowly lanceolate to narrowly elliptical; pinnae numerous, subsessile, margin crenate. Sori circular to elongate, 4–12 on each side of the pinna lobe, without indusium, at maturity uniting with adjacent sori.

**Distribution and ecology:** Often found scrambling amongst tall grasses, sedges or shrubs in freshwater swamps, or beside rivers, ponds and lakes.

**Botanical name:** *Thelypteris (Amphineuron) terminans* (Hook.) Holttum

**Family:** Thelypteridaceae

**Botanical description:** Rhizome wide creeping, bearing scales densely at the apex; scales linear lanceolate, uniformly thickened. Stipes tetragonal with a shallow groove on either side, dark brown and densely scaly at the base, glabrous above. Lamina simply pinnate, pinnae up to 25 pairs, ascending, shortly stalked or subsessile; texture herbaceous; thin, soft, acicular hairs distributed densely on the lower surface of rachis, costa, veins and intervenal area. Sori up to 10 pairs, strictly confined to the margin of the lobes; spores monolete, dark brown.

**Distribution and ecology:** Usually seen as a colony in the forests along partially exposed roadsides and forest edges.

Photo Source – ASEAN Tropical Plant Database



**Botanical name:** *Thelypteris (Christella) dentata* (Forssk) E.P.St.John

**Family:** Thelypteridaceae

**Botanical description:** Rhizome short to long creeping, upto 1 cm thick, sparsely scaly; scales lanceolate. Lamina oblong-lanceolate; pinnae upto 20 pairs with upto 10 pairs of progressively reduced basal pinnae, reduced basal pinnae opposite or subopposite, unreduced pinnae alternate. Sori median on veins, upto six pairs; spores brown, exine with elongate, thick ridges.

**Distribution and ecology:** This is the most common fern in South India. It is found throughout the Western Ghats, along roadsides, clearings and along stream banks in partially or fully exposed places.



**Botanical name:** *Thelypteris (Christella) hispidula* (Decne) Holttum

**Family:** Thelypteridaceae

**Botanical description:** Rhizome short creeping; stipes 44 cm long and 0.7 cm thick, grey-brown at base, stramineous above, glabrous. Lamina simply pinnate throughout; pinnae about 20 pairs, sessile, subopposite; basal two pairs slightly reduced, pinnae in distal part of the lamina progressively reduced; lower surface of pinnae and rachis with slightly shorter and often capitate hairs. Sori about five pairs, median on veins; indusial reniform, densely covered by acicular hairs.

**Distribution and ecology:** Growing inside the forests.

**Botanical name:** *Thelypteris (Christella) papilio* (Hope) Holttum

**Family:** Thelypteridaceae

**Botanical description:** Rhizome erect, up to 3 cm thick; scales lanceolate, pale brown. Stipes tufted, grey-green, glabrous above, scaly at the base. Lamina lanceolate, pinnae up to 31 pairs, alternate or subopposite, few pairs of basal most pinnae reduced to tubercules; pinnae pale green, glabrous all over, above and below. Sori median, on two to six pairs of basal veins.

**Distribution and ecology:** Not very frequent, occurring along stream banks.

**Botanical name:** *Thelypteris (Christella) parasitica* (L.) Tardieu

**Family:** Thelypteridaceae

**Botanical description:** Rhizome long creeping, rarely erect; rhizome scales linear-lanceolate. Lamina deltoid, broadly ovate or cordate; rachis copiously covered by long and short hairs; pinnae upto 13-20 pairs, opposite at base, subopposite or alternate at distal part; basal pinnae upto 3 cm apart; pinnae pale green. Sori median or submarginal on the veins, upto 5 pairs, often only the lowermost vein bearing the sori, indusial densely hairy.

**Distribution and ecology:** Very common in partially shaded places in the evergreen forests.



**Botanical name:** *Thelypteris (Cyclosorus) interruptus* (Willd.) H. Ito

**Family:** Thelypteridaceae

**Botanical description:** Rhizome wide creeping, profusely branched, scaly at the apex; scales ovate. Lamina elliptic lanceolate, simply pinnate; pinnae upto 27 pairs, subopposite or alternate, basal pinnae not reduced; few pairs of pinnae in the distal part of lamina abruptly reduced; upper surface of pinnae glabrous; texture chartaceous; lamina pale green; sori median on the veins, upto eight pairs in two rows arranged in v-shape; sori indusiate; spores monolete, ellipsoid, pale brown, exine finely spinulose.

**Distribution and ecology:** Usually occurring frequently as large colonies in open marshy places, lakes, walls and borders of paddy fields.



**Botanical name:** *Asplenium inequilaterale* Willd.

**Family:** Aspleniaceae

**Botanical description:** Rhizome erect or suberect, up to 1 cm thick, covered by scales at the apex; scales ovate-lanceolate. Stipes tufted, grey-brown to pale brown, glabrous. Lamina oblong to ovate-lanceolate, simply pinnate; pinnae up to 20 pairs, gradually reduced in the distal part of the frond, basal pinnae not reduced; pinnae alternate or subopposite, shortly stalked; pinnae dark green, glabrous; texture herbaceous. Sori up to 10 pairs; spores planoconvex or reniform with densely, irregularly anastomosed ridges on the surface.

**Distribution and ecology:** Terrestrial on fully shaded or partially exposed streams and stream banks.

**Botanical name:** *Asplenium phyllitidis* subsp. *phyllitidis* D. Don

**Family:** Aspleniaceae

**Botanical description:** Epiphytic or lithophytic. Similar to *Asplenium nidus* L., differing from it in: rhizome scales brown, broader; frond up to 80 by 7 cm (in exceptional cases up to 10 cm broad); midrib raised below; sori usually reaching more than half-way to margin, often occupying 3/4 of the length of veins

**Distribution and ecology:** Epiphytes on mossy trunks or lithophytes on muddy rocks in dense evergreen forests.

**Botanical name:** *Anisocampium cumingianum* Presl.

**Family:** Woodsiaceae

**Botanical description:** Rhizome short creeping, up to 0.8 cm, densely clothed by scales all over. Stipes scattered, pale green when fresh, stramineous when dry, scaly at base, glabrous above. Lamina ovate or ovate-lanceolate, simply pinnate; pinnae up to 10 pairs, slightly ascending, shortly stalked; pinnae dark green, glabrous above and below; texture herbaceous. Sori median on all the veins; indusial very small, pale brown; spores ellipsoid or spherical.

**Distribution and ecology:** Low altitude terrestrial plants, seen along partially exposed road sides or fully shaded forest floor.

**Botanical name:** *Athyrium anisopterum* Christ

**Family:** Woodsiaceae

**Botanical description:** Terrestrial. Rhizome short, ascending, scaly. Stipes up to 12 cm long, stramineous, dark and scaly at base. Lamina narrowly oblong, pinnate-bipinnatifid; pinnae stalked, oblong to oblong-subdeltoid, lobed nearly half way towards costa; lobes rounded, toothed. Sori medial, round, rather large; indusial round to oblong, opening outwards.

**Distribution and ecology:** Growing as terrestrials on humus rich floor of dense evergreen forests.

**Botanical name:** *Athyrium hohenackerianum* (Kuntze) T. Moore

**Family:** Woodsiaceae

**Botanical description:** Rhizome erect, upto 2cm thick, densely scaly at the apex; scales linear lanceolate. Lamina elliptic or lanceolate, simply pinnate, gradually narrowed from the middle portion both towards apex and base; pinnae upto 20 pairs, few basalmost pinnae shortly stalked, opposite. Sori median or submedian on the veins, straight or hooked; indusial pale brown, entire; spores globose, yellowish brown, exine with thin undulate winged perispore.

**Distribution and ecology:** Less frequent species found to be growing as terrestrials or lithophytes on rock crevices along fully or partially shaded roadsides.



**Botanical name:** *Athyrium solenopteris* (Kuntze) T. Moore

**Family:** Woodsiaceae

**Botanical description:** Rhizome erect, upto 6cm thick, densely clothed by scales all over. Lamina ovate or ovate-lanceolate, about 40 x 20 cm, bipinnate or subtripinnate, apex acuminate; pinnae about 12 pairs, patent or ascending subopposite below, alternate above, upto 6 cm apart, shortly stalked. Sori in two rows close to the costules, usually hooked, rarely straight; upto 2 x 1mm, indusiate.

**Distribution and ecology:** This is the most common species of *Athyrium* and is commonly found along fully shaded stream banks. They also grow on forest floor and in fully exposed marshy places between 1300-2200 m.



**Botanical name:** *Diplazium esculentum* (Retz.) Sw.

**Family:** Woodsiaceae

**Botanical description:** Rhizome erect, up to 4 cm thick, densely scaly at the apex; scales linear-lanceolate. Stipes tufted, sparsely scaly at the base, glabrous above; purplish bands scattered throughout the stipe and rachis. Lamina deltoid, bipinnate with simply pinnate apex; pinnae up to seven pairs, basal one or two pairs opposite or sub-opposite, rest of the pairs alternate; pinnae dark green, glabrous above and below; texture herbaceous. Sori all along the veins except the base and apex; indusial pale brown with wavy margin.

**Distribution and ecology:** Terrestrial ferns growing in large colonies in open marshy places along streams and canals.

**Uses:** Young leaves are cooked as vegetables by the tribals of Uttar Pradesh (Singh *et al*, 1989). Decoction prepared from rhizome and young leaves is used for haemoptysis and cough in Philippines (Manickam and Irudayaraj, 1992).



**Botanical name:** *Dryopteris cochleata* (Buch. Ham. ex D. Don) C. Chr.

**Family:** Dryopteridaceae

**Botanical description:** Rhizome short creeping, upto 3 cm thick, densely clothed by scales all over. lamina lanceolate, bipinnate; pinnae upto 10 pairs, ascending, shortly stalked, subopposite, upto 5 cm apart; pinnae pale green; texture subcoriaceous, long, soft. Fertile pinnule oblong, acute, margin lobed more than half way to the costule; lobes upto eight pairs, oblique, apex acute, toothed; sori one per lobe, indusial reniform; spores dark brown.

**Distribution and ecology:** Terrestrial plants frequently growing along fully exposed roadsides, dry places or clearings.

**Uses:** The extract of whole plant is given twice daily orally in case of snake bites while the plant paste is applied on the bite wound to prevent infection. A small portion of powdered rhizome is taken with water daily twice for treating rheumatism, epilepsy and leprosy (Singh, 1999; Verma and Singh, 1995).



**Botanical name:** *Tectaria coadunata* (J. Sm.) C. Chr.

**Family:** Dryopteridaceae

**Botanical description:** Rhizome short creeping, upto 3 cm thick, densely scaly at the apex; scales ovate-lanceolate. Lamina ovate or broadly ovate, apex acute, base cordate, bipinnate or bipinnatifid, distinct primary pinnae three to five pairs; secondary pinnae about 5 pairs, alternate. Lamina pale green, texture thin, soft herbaceous. Sori on the end of veinlets in two rows along the costules of secondary pinnae; spores pale brown.

**Distribution and ecology:** Frequent along fully or partially shaded roadsides, along waysides inside the forest or on forest floor.

**Uses:** Young fronds are used as vegetable curry or as salad; extract from fresh rhizomes is used for preventing diarrhea in children in Darjeeling district (Dixit and Vohra, 1984).





**Botanical name:** *Tectaria polymorpha* (Wallich. Ex Hook.)

**Family:** Dryopteridaceae

**Botanical description:** Rhizome short, ascending to sub-erect, scales linear-subtriangular. Stipes stramineous to brown, glabrescent beneath. Lamina imparipinnate, ovate-oblong; rachis densely pubescent on upper surface, glabrescent beneath; lateral pinnae oblong-lanceolate; shortly stalked or sessile. Sori on cross veins or sometimes on included free veins, irregularly scattered on the lower surface of pinnae; indusia small, pubescent.

**Distribution and ecology:** On mountain slopes usually in dry places in dense forests at low to medium altitudes.



**Botanical name:** *Bolbitis appendiculata* (Willd.) K. Iwatz

**Family:** Lomariopsidaceae

**Botanical description:** Rhizome short creeping, 0.5-1 cm thick, covered by scales at the apex. Sterile lamina lanceolate, simply pinnate, apex acuminate, base truncate; pinnae upto 25 pairs, dark green when fresh, dark olivaceous when dry, glabrous above and below; texture firm, herbaceous. Fertile pinnae upto 20 pairs, oblong, margin crenate; Sori acrostichoid, covering lower surface, covering the costa when mature, spores monolete, spherical, pale brown.

**Distribution and ecology:** Usually growing as lithophytes in large colonies along fully or partially shaded streams or stream banks.

Photo source: <http://rbg-web2.rbge.org.uk>



**Botanical name:** *Bolbitis lancea* (Copel.) Ching

**Family:** Lomariopsidaceae

A type specimen of this has been found to be a genuine hybrid with abortive spores, from Rumpa hills, Tamil Nadu (Fraser-Jenkins, 2008b). Hennipman (1977) has identified this hybrid as being *B. augustipinna* x *B. semicordata*, pending further experimental study.

**Botanical name:** *Bolbitis presliana* (Fee) Ching

**Family:** Lomariopsidaceae

**Botanical description:** Rhizome creeping, scaly. Stipe 15-25 cm long, scaly. Fronds 15-30 cms long, of two kinds, pinnate. Pinnae of the sterile fronds 5-10 cms long, 1.25 cm wide, stalked, narrow, lanceolate, gradually tapering at both ends, entire. Fertile fronds much contracted, surface naked, rachis scaly, more or less winged.

**Distribution and ecology:** Growing as terrestrials near water bodies and other moist places.

**Botanical name:** *Bolbitis prolifera* (Bory) C. Chr.

**Family:** Lomariopsidaceae

**Botanical description:** Rhizome short creeping, densely scaly all over; scales appressed, ovate-lanceolate. Stipes grey-brown, densely scaly at the base, sparsely scaly above; rachis narrowly winged and scaly throughout; sterile lamina ovate, simply pinnate; pinnae about 10 pairs, subsessile or shortly stalked; pinnae pale green to dark green, glabrous above and below, texture herbaceous to chartaceous. Fertile fronds with slightly longer stipe, fertile pinnae with about eight pairs; sori acrostichoid, spores abortive.

**Distribution and ecology:** Lithophytes on shaded rocks on the forest floor usually along stream banks.

**Botanical name:** *Bolbitis semicordata* (Bak.) Ching

**Family:** Lomariopsidaceae

**Botanical description:** Rhizome short, creeping, upto 0.4 cm thick, densely scaly at the apex; scales lanceolate, uniformly dark brown. Lamina simply pinnate, narrowly deltoid, progressively narrowed from base to apex, bearing terminal pinna slightly different from others; pinnae glabrous above and below, dark green; texture herbaceous. Fertile pinnules much contracted ones, upto eight pairs, alternate, upto 2 cm apart, sori acrostichoid.

**Distribution and ecology:** Usually found as lithophytes growing along shaded stream banks. Endemic to south India.



**Botanical name:** *Bolbitis subcrenatoides* Fras.-Jenk. new name for *Bolbitis subcrenata* (Benth & Hook.) var. *prolifera* (Rev.)

**Family:** Lomariopsidaceae

**Botanical description:** Endemic to South India. Much elongated and narrow fertile pinnae; frond apex in mature plants is much elongated and flagellated.

**Distribution and ecology:** Occurs in partially shaded or open road side cuttings in semi-evergreen and evergreen forests.



**Botanical name:** *Blechnum orientale* L.

**Family:** Blechnaceae

**Botanical description:** Rhizome erect, upto 12cm thick, densely clothed by scales all over; scales linear-lanceolate, uniformly dark brown. Lamina ovate to linear-lanceolate, apex acute, base subtruncate or broadly cuneate; pinnae 10-56 pairs, spreading or slightly ascending, alternate. Sori linear along either side of the costa, parallel, dark brown, continuous, very rarely interrupted, indusiate; indusial dark brown, firm with entire margin.

**Distribution and ecology:** Terrestrial plants, growing on fully exposed dry places and clearing along roadsides and road cuttings.

**Uses:** Fresh fronds are used as a poultice for boils in Malaya; the rhizome is used as an anthelmintic in China, eaten during scarcity of food in Malaya, as cure for intestinal worms, bladder complaints in India, Polynesia and as diaphoretic, aromatic, aperative in Philippines (Dixit and Vohra, 1984).



**Botanical name:** *Stenochlaena palustris* (Burm.) Beddome

**Family:** Blechnaceae

**Botanical description:** Rhizome long creeping, scandant, stramineous with few scattered scales, often reaching the top of trees. Fronds scattered, dimorphic; lamina ovate or oblong-lanceolate; pinnae up to 20 pairs, spreading, shortly stalked. Fertile fronds borne at the distal part of the plant or at the interval, more or less of the same size and shape of the steriles one; sori borned all over the lower surface of fertile segments, protected by pale brown, firm, entire, reflexed margin; spores monolete.

**Distribution and ecology:** Low altitude climber, found along partially shaded roadsides or inside the forest in fully shaded places.

**Uses:** The young shoots are eaten either raw, as salad or cooked. Owing to their durability when submerged in salt water, the rhizomes are utilized as cordage in binding fish traps and as anchor ropes. They are also used for making baskets (Manickam and Irudayaraj, 1992).



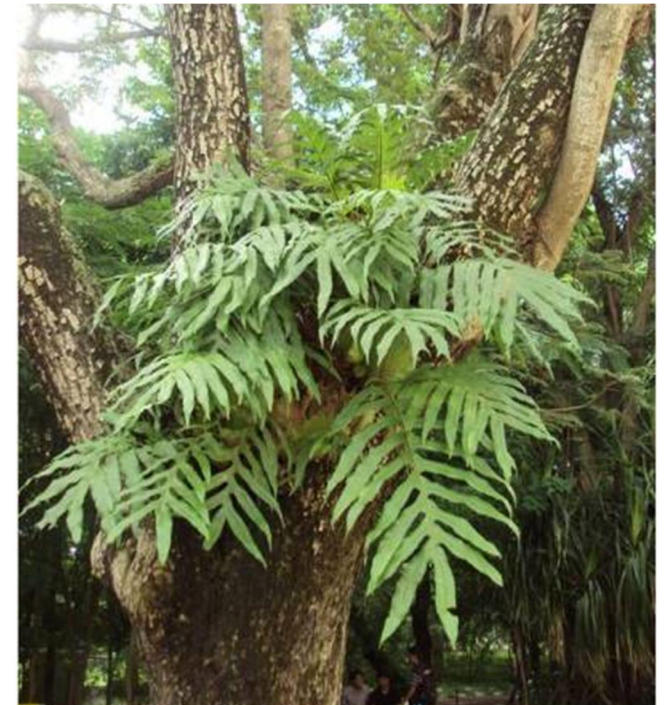
**Botanical name:** *Drynaria quercifolia* (L.) J. Sm.

**Family:** Polypodiaceae

**Botanical description:** Rhizome short creeping, upto 4.5 cm thick, densely clothed by scales. Lamina oblong, pinnately lobed, base decurrent; lobes upto 15 pairs, basal pairs much reduced; costa and veins raised above and below, interconnected by veinlets; pinnae pale green, glabrous, texture coriaceous. Sori seated at the juncture of veins, more or less in two rows along each primary vein, exindusiate.

**Distribution and ecology:** They occur as epiphytes on the bark of trees in partly or fully shaded places.

**Uses:** Rhizome is bitter and is used as antibacterial, anti-inflammatory, for treating constipation, diarrhea, ulcers and other inflammations. The decoction of plant is used in typhoid fever and fronds are useful in treating swellings (Dixit & Vohra, 1984; Warriar *et al*, 1996).



**Botanical name:** *Lepisorus nudus* (Hook.) Ching

**Family:** Polypodiaceae

**Botanical description:** Rhizome long creeping, upto 3 mm thick, branched, densely covered by scales. Laminae simple, linear-elliptic to linear-lanceolate, apex acuminate, base decurrent, narrowly cuneate, margin entire; midrib slightly raised above and below; lamina dark green above, pale green below. Sori superficial; arranged in the distal half of the frond in two rows between margin and midrib; conspicuous, hemispherical, upto 5 mm in diameter.

**Distribution and ecology:** Commonly seen as epiphytes on shola trees and sometimes also grow as lithophytes along stream banks or on forest floor.



**Botanical name:** *Leptochilus decurrens* Blume

**Family:** Polypodiaceae

**Botanical description:** Rhizome about 0.4 cm thick, densely scaly all over; scales ovate-lanceolate, uniformly pale brown. Stipes up to 5 cm apart, pale brown or stramineous when dry, glabrous; lamina ovate-lanceolate, apex acute or acuminate, base abruptly decurrent. Fertile frond with up to 37 cm long stipe, spores reniform or planoconvex, exine granulose.

**Distribution and ecology:** Terrestrial or lithophytes along full shaded streams or stream banks.

Photo source: <http://rbg-web2.rbge.org.uk>



**Botanical name:** *Loxogramme involuta* (D. Don) Presl

**Family:** Polypodiaceae

**Botanical description:** Rhizome long creeping, up to 0.5 cm thick, densely scaly; scales lanceolate, yellowish brown at very base, pale brown in the rest, margin entire. Fronds scattered, elliptic or linear-lanceolate, flattened, margin entire; lamina succulent, pale green or yellowish-green, brittle, glabrous above and below. Sori linear, up to 3 cm long, oblique, parallel up to 17 pairs, mostly in the distal part of the frond; spores monoete, reniform, planoconvex or ellipsoid, yellowish-green with finely granulose exine.

**Distribution and ecology:** High altitude epiphytes or lithophytes growing inside the forests.

Photo source: <http://rbg-web2.rbge.org.uk>



**Botanical name:** *Microsorium membranaceum* (D. Don) Ching

**Family:** Polypodiaceae

**Botanical description:** Rhizome long creeping, up to 0.4 cm thick, sparsely covered by scales. Fronds elliptic or lanceolate, arranged in a single row on the adaxial side of rhizome, up to 1 cm apart, pale brown, distinct stipe, margin entire; pinnae pale green, glabrous all over; texture membranaceous or thin herbaceous. Sori numerous, distributed all over the lower surface of the frond at random; spores yellowish-green; exine finely granulose.

**Distribution and ecology:** Epiphytes on fully shaded shola trees inside the forest or at the forest edge.

Photo source: <http://rbg-web2.rbge.org.uk>



**Botanical name:** *Microsorium punctatum* (L.) Copel.

**Family:** Polypodiaceae

**Botanical description:** Rhizome short creeping, up to 1 cm thick, densely scaly at the apex, sparsely in the rest. Fronds closely arranged in two rows, lanceolate or elliptic, margin entire, stramineous above, rounded below; pinnae dark green when fresh, blackish when dry, glabrous above and below, texture coriaceous. Sori numerous, distributed all over the lower surface of the pinna leaving the basal part; spores yellowish-green, exine finely granulose.

**Distribution and ecology:** Epiphytes along partially or fully shaded stream banks.

**Uses:** Leaves and juice are used as purgative, diuretic and wound healer in Ivory Coast (Boquet, 1974).



**Botanical name:** *Marsilea minuta* L.

**Family:** Marsileaceae

**Botanical description:** Rhizome long, creeping, branched, subterranean, up to 2mm thick, green in aquatic plants, pale or dark brown in terrestrials, covered by soft, slender hairs sparsely or densely; roots borne usually on nodes. Stipes scattered, usually green, terete. Leaves four, sessile, arranged at the tip of the stipe in clover leaf model, obovate or wedge-shaped; leaves pale or dark green, glabrous with few hairs, texture thin, soft herbaceous. Sporocarps borne at the nodes in clusters alternately, five per cluster, more or less bean-shaped, black or dark brown, very hard; microsporangia and megasporangia enclosed in same sporocarp.

**Distribution and ecology:** Aquatics or semi-aquatics in marshy places.

**Uses:** The leaves and sprouts are cooked as vegetable and sold in market (Dixit and Vohra, 1984). Plants are used in cough, spastic condition of leg, muscles and insomnia (Manickam and Irudayaraj, 1992).





**Botanical name:** *Azolla pinnata* R. Br.

**Family:** Azollaceae

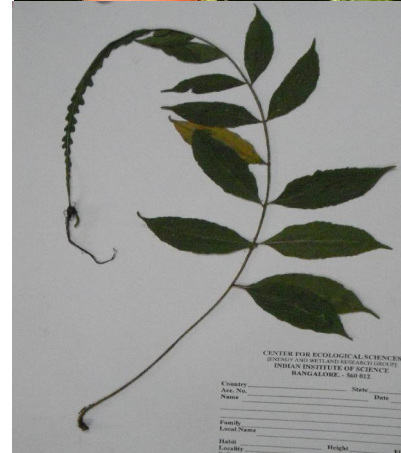
**Botanical description:** Stem horizontal, profusely branched, zig-zag, bearing roots which are densely covered by hairs. Leaves alternate, arise from dorsal lobe, aerial, more or less rectangular, sessile, grey-green, thick, enclosing large mucilage filled cavities that harbour blue-green algae; ventral lobes submerged, margin entire, lobes thin, membranaceous, transparent, brownish, glabrous. Microsporocarps globose, brown with two layered wall, containing numerous microsporangia; megasporocarp smaller than microsporocarp, ovate, enclosing single megasporangium.

**Distribution and ecology:** Free floating, aquatic plants in the plains.

**Uses:** Used as an important biofertilizer in paddy fields because of presence of blue-green algae. Also known for heavy metal absorptions and employed as cattle feed too at some places.



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