



Pteridophytes of India; Diversity, Distribution and Conservation

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Introduction

Pteridophytes, the seedless vascular plants, had a very flourishing past in dominating the vegetation on the earth about 280-230 million years ago. Although they are now largely replaced by the seed bearing vacular plants in the extant flora today, yet they constitute a fairly prominent part of the present day vegetation of the world. India with a highly variable climate has a rich diversity of its flora and Pteridophytic flora greatly contributes to its diversity. Pteridophytes also form an interesting and conscious part of our national flora with their distinctive ecological distributional pattern. On a very conservative estimate 500 species of ferns and 100 species of fern-allies are on record from India. According to a census, *the Pteridophytic flora of India comprises of 67 families, 191 genera and more than 1,000 species* (Dixit 1984) including 47 endemic Indian ferns, less than 10% of those reported previously and 414 species of Pteridophytes (219 At risk, of which 160 critically endangered, 82 Near-threatened and 113 Rare), constituting 41-43 % of the total number of 950-1000 Pteridophytes of India. Chandra Shubhash (2000) recorded *34 families, 144 genera and more than 1100 species of ferns* with about 235 endemic species from Indian region. The vascular flora of our country in general has about 15,000 species and as a constituent of Indian flora of vascular plants, the ferns and fern-allies form only five percent part as far as the number of species is concerned. But, due to their abundance in individuals as well as their conspicuousness in epiphytic vegetation and in the terrestrial vegetation along forest margins, roadsides and forest floors, the contribution of ferns and fern-allies to the vegetational pattern in India rank only next to the flowering plants.

Pteridological Studies

In the nineteenth century R. H. Beddome, C.B. Clarke and C.W. Hope produced commendable works on the taxonomy of ferns of Indian subcontinent. A major boost to fern studies in India came with the establishment of the Indian Fern Society in 1983. This organization has helped to bring together the pteridologists of the country, and is promoting interest in the study of ferns through meetings and through its publications. With the start of Indian Fern Journal in 1984, a channel has been created for communication with international groups of pteridologists. Bir wrote an account of "Pteridology in India" giving details of work done in various fields. Foreign scientists did lot of work on Indian Pteridophytes. Of which R.H. Beddome, C.B. Clarke and C.W. Hope are the pioneers, worked upto the end of 19th century. Beddome's Handbook of the ferns of British India", Ceylon and Malay Peninsula" is the only authentic useful work even to-day. Regional flora on Nagaland (Jamir & Rao 1988) Meghalaya, (Baishya & Rao 1981), Tirap (Singh, S. and G. Panigrahi (2005). (Arunachal Pradesh) and North-West Himalayas have already been published. Checklist on pteridophytes of North-East India; Darjeeling and Sikkim Himalayas, Western Himalayas, Mount Abu in Rajasthan and other places viz., Pachmarhi, Tamiya and Patakot in Madhya Pradesh, Kambab; Shevroy and Pachaku-Tattachi hills and Bombay, Mahabaleshwar, Mather and Kanara etc. in western Ghats have been published. Dixit (1984) published "A census of Indian pteridophytes" and "Dictionary of Pteridophytes of India" respectively. There are various places in India where thorough collections



of pteridophytes have not yet been made till to date, i.e. North-East India, Andaman and Nicobar Island, South Indian Hills and several species will be added if extensive collections are made from these areas in near future.

Ecology

Habit and Habitat: The Pteridophytes grow in different habitats like moist or dry rocks and boulders, on tree trunks, as hydrophytes in lakes, ponds, etc., on forest floors and edges, along perennial streams and deep ravines, grasslands, tea and coffee estates, inside dark Georges, etc. Pteridophytes habitats are presented below:

(A) Hydrophytes (Aquatic),

(B) Terrestrial: I Sun loving– (a) Exposed sites away from the water course, (b) In exposed sites but nearer to water course (II) Shade Loving (III) Ravine plants–(a) inhabiting deep gorges, (b)Thicket forming (IV) Climbing ferns– (a) Low climbing, (ii) High climbing, (iii) Twiners, (v) Xeric Plants, **(C) Lithophytes:** (I) on exposed Rocks, (II) On Moist Rocks,

(D) Epiphytes: (I) Low epiphytes–(a) shade loving, b) Epiphytes of wet conditions), (II) Epiphytes of Medium height, (III) Epiphytes on high exposed branch –(a) nest forming ferns, (b) Bracket forming ferns

Majority of ferns and fern allies are terrestrial growing and differing in growth and habitat they occupy. Some major terrestrial growing pteridophyte genera are *Pteris*, *Dryopteris*, *Athyrium*, *Diplazium*, *Thelypteris*, *Cyclosorus*, *Alsophila*, etc. Some of the epiphytic pteridophyte species are *Pyrrosia* spp., *Drynaria quercifolia*, *Lepisorus nudus*, *Microsorium punctatum*, *Asplenium nidus*, *Huperzia squarrosus*, etc. Most of these epiphytic species prefer trees like *Ficus* sp. and *Mangifera* sp. At high altitudes, the stems and branches of trees are usually covered with moist mossy surface and leafy liverworts which provide an ideal condition for the growth of pteridophytes. The fern genera *Lygodium*, *Stenochlaena* and *Microsorium* are climbing ferns with underground serpentine

rhizomes. For securing favourable light, the plants grow up the adjacent shrubs and branches of nearby trees with the help of rachis.

Some ferns are lithophytes and are found in rock crevices and among rock boulders along water channels. Species such as *Adiantum venustum*, *A. capillus veneris* and *Asplenium rutamaria* grow in wall crevices under shade or around falls among rock boulders.

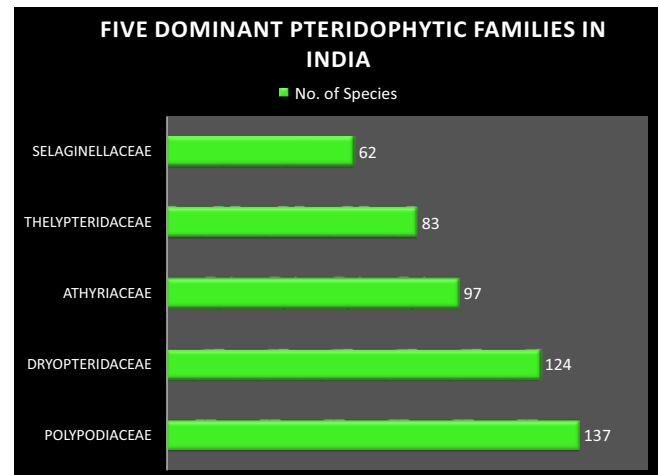
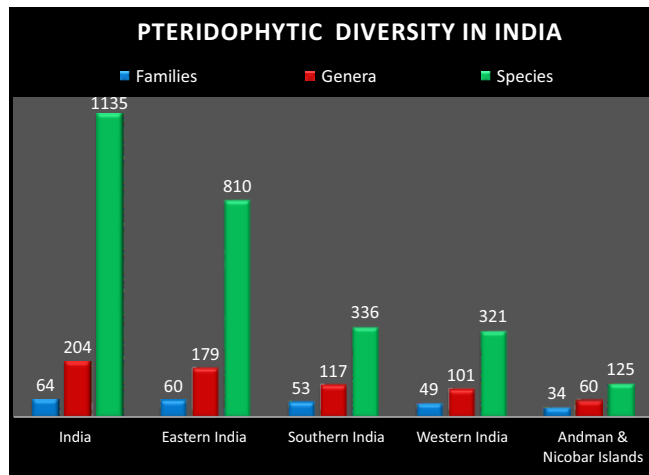
Diversity

In view of variable climatic and altitudinal variations the Indian sub-continent represents Himalayas, Gangetic plains and Thar Desert as biodiversity centres. Maximum number of diversity of Pteridophytes observed in Himalayas, Eastern and Western Ghats. Except Pachmarhi and Parasnath hills; gangetic plains and Aravalli hills or towards North-west Hindu-Kudh much pteridophytes do not occur. The lesser rainfall from Eastern Himalayas to Western hills is responsible for a decrease in Pteridophytic vegetation.

There are about 12,000 species of pteridophytes occur in the world flora, of which 1,000 species into 70 families and 192 genera occur in the different parts of the present Indian political boundary. Keeping in view of large area of the country the present number of diversity is quite less. Region-wise studies reveals, that maximum number of 700 species (i.e. 58% of Pteridophytes) occur in Eastern Himalayas and adjoining states. Thus, Eastern Himalayas may be termed as one of the Hot Spots diversity centre for pteridophytes. In other regions viz., 400 species in Southern India, 300 species in North-West India and 100 species in Central India and 125 species in Andaman and Nicobar Islands.

The maximum diversity has been observed between 1,200-2,800m. alt. in Temperate Himalayas and adjoining forest areas. The scrutiny of diversity of pteridophytes on all India basis, revealed the maximum number of 150 species and 28 genera in the family Polypodiaceae. Afterwards Dryopteridaceae (109 species, 4





genera), Athyriaceae (101 species, 13 genera), Thelypteridaceae (88 species, 21 genera), Aspleniaceae (70 species, 4 genera), Aspediaceae (50 species, 11 genera), Hymenophyllaceae (35 species, 10 genera), Cheilantheae (30 species, genus *Cheilanthes*), Adiantaceae (30 species, genus *Adiantum*), Lindsiaceae (26 species, 3 genera), Bolbitidaceae (22 species), Vittariaceae (20 species, genus *Vittaria*). On the basis of genus, the maximum number of diversity of 70 species occur in genus *Asplenium*; afterwards similarly, genera *Selaginella* (62 species), *Pteris* (60 spp.), *Dryopteris* (57 spp.), *Polystichium* (41 spp.), *Athyrium* (35 spp.), *Cheilanthes*, *Adiantum*, *Lepisorus*, *Pyrrosia*, each with 30 species, *Christella* (25 species), *Lindsaea* (23 spp.), *Plagiogyria* (19 spp.) etc.

Diversity in Different Phytogeographical Regions of India

Central India: Central India includes 10 species of Fern allies and 68 species of Ferns. Tamia, Pachmarhi, Patalkot and Achanakmar-Amar-kantak Biosphere reserve are the hot spot for Pteridophytic diversity.

Eastern Himalayan Region: Sikkim, Darjeeling district of West Bengal and 7 states of North-East (Arunachal Pradesh, Assam, Nagaland, Manipur, Meghalaya, Mizoram and Tripura) are included as diversity centers in this region. Maximum bio-

diversity has been observed in Polypodiaceae, out of 150 species in India, 107 species occur in this region. Data on the diversity of species in 10 families in India and Eastern Himalayas is provided in Table 1.

Thus, generic diversity is different. Maximum number of diversity observed in *Asplenium*, out of 70 species in India, 23 species occur in the Eastern Himalayas. Similarly, out of 62 species of *Selaginella* occurring in India, about 30 species occur in Himalayas is given in Table 2.

Pteridophytes of Eastern Himalayas have been published specially from Tirap district (305 spp.) of Arunachal Pradesh; Nagaland (280 species, 98 families) and Meghalaya (244 spp., 82 genera).

Endemic Pteridophytes

Of 530 Pteridophytes reported as endemic to the India in recent decades (about half the total number of 950-1000 known Indian species), only 47 endemic Indian ferns, less than 10% of those reported previously, are accepted by Fraser. The great majority of endemic Indian Pteridophytes are peninsular-Indian to south-Indian ferns (27) with far fewer being N.E. Indian (7) and W. Himalayan (2); the floristically Malesian Nicobar Islands have (3). These numbers are only to be expected as N.E. India is an intimate part of the Sino-Himalayan and S.E. Asian flora, connected without barriers to Tibet and China or to Myanmar by two mountain



Table 1: Comparative number of members of ten well representative families in Eastern Himalaya

Sl. No.	Name of the Family No. of species in India	Approximate no. of species in India	Approximate no. of species in	Percentage in Eastern Himalayas
1.	Polypodiaceae	150	107	71.3
2.	Dryopteridaceae	109	92	82.56
3.	Athyriaceae	101	92	75.24
4.	Thelypteridaceae	88	64	72.72
5.	Aspleniaceae	70	33	47.1
6.	Selaginellaceae	62	27	43.55
7.	Pteridaceae	60	43	71.66
8.	Aspidiaceae	50	23	46.0
9.	Sinopteridaceae	38	23	60.2
10.	Hymenophyllaceae	28	22	78.57

Table 2: Distribution of ten fern genera in Eastern Himalaya

Sl. No.	Name of the Family No. of species in India	Approximate no. of species in India	Approximate no. of species in	Percentage in Eastern Himalayas
1.	Asplenium	70	23	32.82
2.	Selaginella	62	30	48.40
3.	Pteris	60	43	71.66
4.	Dryopteris	57	52	91.23
5.	Polystichum	45	56	80.00
6.	Athyrium	35	26	74.28
7.	Allantoidea	25	07	28.00
8.	Amphineuron	23	19	82.60
9.	Lindsaea	23	09	39.13
10.	Elaphoglossum	20	13	65.00

chains, while S. India is more isolated geographically since more ancient times and has a partly Malesian fern-flora. (Source: C. R. Fraser - Jenkins, 2008)

The importance of Botany of particular country or region is much increased due to presence of endemics. Keeping in view of diversity and presence of endemic in pteridophytes, the

Himalayan region may be considered one of the important areas.

Threatened Pteridophytes

An assessment of rare and threatened Pteridophytes of political India, classifying species into different categories, has been made based on our own field-observations, data from herbarium-





collections, and published literature. According to Chandra S. (2008), 414 species of Pteridophytes (219 at risk, of which 160 critically endangered, 82 Near-threatened and 113 Rare), constituting 41-43 % of the total number of 950-1000 Pterido-phytes of political India, are threatened or rare there. 84 species included in earlier works are excluded as they are not considered to be of threatened status.

Economic Importance

Man has been dependent upon the plants as an important source of medicine since ancient times. The red dye obtained from young stems of *Sphenomeris chinensis* widely used by villagers and tribals. Vegetable curry is prepared from the tender fronds of *Dryopteris cochleata*, *D. sparsa* and *Leucostegia immersa*. The fresh fronds of *Ampelopteris prolifera*, *Ceratopteris thalictroides*, *Marsilea minuta*, *Tectaria caudunata* are mixed with pulses and eaten with choice in India. Due to ornamental nature of fronds of *Dryopteris*, *Adiantum*, *Nephrolepis*, the potted plants of such species find place in terrace of houses, hotels and gardens etc. The dried stipeses are also used as ornamentals. The pith of *Angiopteris evecta*, *Cibotium assamicum* and tree ferns are being eaten by trials in the period of shortage of food, as such or sometimes after colling also in the Eastern India and Arunachal Pradesh. *Adiantum capillsveneris* and *Marsilea minuta* are mentioned as of medicinal importance in 'Charak Samhita'. *Selaginella bryopteris* popularly known as Sanjiwani is widely used as tonic in India. The spores of *Lycopodium* are used as powder on skin. The spores of Lycopods known as vegetable brimstone are used in fire work. The decoction of fronds of *Actiniopteris radiata* is used against excessive bleeding in ladies during mensuration or abortion. The decoction of *Adiantum lunulatum* used as diuretic, and useful in dysentery. The fronds of *Asplenium adiantum-nigrum* are used among ladies for family planning in Unani system of Medicine and leaves are used in spleen disorder. The rhizome of *Helminthostachys zeylanica* is used against dysentery, and leaves are used to cure sores on tongue. The stems of

Lygodium flexuosum boiled with mustard oil used against rheumatism. The rhizome of *Polystichum squamosum* known as 'Nirviri' in India, used against scorpion bite and insect bites. The juice extracted from rhizomes of *Tectaria macrodonta* used against diarrhea among children in Darjeeling with confidence. The fronds of *Pteris* Spp. are used to cure cuts and wounds. Main stems of *Osmunda*, *Alsophila*, *Angiosphila*, *Angiopteris* are used as ideal base for growing orchids. Thus Pteridophytes are widely useful to mankind.

There are many species which can be useful and several medicines may be prepared. The medicinal qualities of ferns, real or imaginary, are mentioned as early as 300 B.C. by the Greek philosopher Theophrastus and by his Indian contemporaries Sushrut and Charak. The medicinal uses of some ferns and pteridophytes of India have also been described. One important characteristics of *Azolla* is its 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 *Adiantum capillsveneris* and *Marsi. lea minuta* have been mentioned as of medicinal importance in 'Charak Samhita' and the rhizome of *Polystichum squamosum*, which is known as 'Nirviri' in India is effectively used against scorpion bite and insect bites. The leaf and root decoction of commonly occurring *Adiantum phillipensis* has been found to be very effective in the treatment of chest complaints. The leaf extract of *Angiopteris evecta* is used in treatment of dysentery whereas the spores are effective in the treatment of leprosy and other skin diseases. *Actiniopteris radiata* possesses the properties like anthelmintic, astringent, sweet, cooling, acrid, febrifuge and is used for treating severe conditions of diarrhea, dysentery, helminthiasis, haemopstysis and fever *Nephrolepis cordifolia* also commonly known as 'Sword fern' is one of the most commonly used ornamental fern species. Other ferns like *Adiantum capillsveneris*, *Asplenium* sp., *Selaginella* sp., *Lygodium*



sp., *Pteris* sp., etc. are also grown in the gardens or in the pots. The ferns have also shown to be having an important role in bioremediation of wastewater.

Conservation

The collection of rare species of pteridophytes from the forest is to be stopped and as such species are to be grown in the gardens under proper habitat to save and increase their numbers. Generally, it is observed that the college students collect rare plants from the forests areas viz., *Lycopodium*, *Selaginella*, *Psilotum* species. The major biotic causes are the habitat destruction through wanton clearance of forests, urbanization, pollution, and also the disturbance in their natural habitat due to tourism and pilgrimage. The habitat requirement of Ferns and allies, in general, is highly limited because of their great dependence on external supply of water for fertilization. Even different ferns communities have their own specific preferences. For example, different microclimates to epiphytic in relation to the direction of light

source, the same in relation to prevailing wind and their inclination provide different microclimates to epiphytic or epiphyllous communities. It is mentioned, a species if it is cleared from locality could never be located again despite repeated attempts. Apart from that, pollution (land, water and atmospheric) also renders certain habitats inhospitable for a number of species. The natural factors affecting the Pteridophytes could be the earthquake, flood or the biological image the species, including segregation of male and female plants. Tree ferns need special attention for conservation, since all 14 species are becoming rare in nature. The conservation of pteridophytes may be taken up by declaring pteridophytes sanctuaries or biosphere reserves in the Himalayas.

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