

Diversity of Fern Flora for Ecological Perspective – A Review

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ABSTRACT

One of the important cut foliage and indoor potted plant grown for its attractive foliage is fern. The foliage of fern is highly valued in the international florist greenery market because of its long post-harvest life, low cost, year round availability and versatile design qualities in form, texture and colour. Ferns (Pteridophytes) are the seedless vascular plants, dominated the vegetation on earth about 280-230 million years ago. Although they are now largely replaced by the seed bearing vascular plants in the existing 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. There are about 12,000 species of pteridophytes occur in the world flora, of which 1,000 species belonging to 70 families and 192 genera occur in the different parts of the present Indian political boundary. Western Himalaya and Western Ghats supported 399 and 349 pteridophytes species of fern and fern allies in India, respectively. Hence, it is need of the hour for documenting the available fern diversity and selection of superior genotypes.

Key words: Ferns, Pteridophytes, Diversity, Pollution.

INTRODUCTION

Ferns are one of the important cut foliage and indoor potted plant grown for its attractive foliage. The foliage of fern is highly valued in the international florist greenery market because of its long post-harvest life, low cost, year round availability and versatile design qualities in form, texture and colour²⁵. The ornamental use of ferns has been practiced

since long time. Due to ornamental nature of the fronds of *Drypteris*, *Adiantum*, *Nephrolepis*, the potted plants of these species find place in the terrace of houses, hotels, gardens, etc.¹⁰. Ferns are the most diverse group and the oldest lineage of vascular plants and the second-most speciose after angiosperms with approximately 12,000 species.

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But, currently many pteridophytes extinction are fragmentation, degradation and habitat destruction, commercial collection, pathogens, predators and invasive species, climate change and pollution. These ferns are not only taxonomic oddities but those are plants with dynamic relationship to their environment. The Western Ghats of peninsular India is of great phyto-geographical importance which constitutes one of the 34 global biodiversity hotspot centers, on account of exceptional levels of plant endemism because of its diversified topography and varied climatic conditions. Recently Fraser Jenkins¹³ reviewed pteridophytic numbers to be 1000 species in India. Western Himalaya and Western Ghats supported 399 and 349 pteridophytes species of fern and fern allies in India, respectively. In Central Western Ghats, Karnataka region houses richest pteridophytic diversity. About 26 species of Pteridophytes are listed in the forests around Mudigere taluk, in Chikkamagaluru district of Central Western Ghats²⁰. Ecological study of ferns is important as it forms baseline data for the distribution of plant species or communities and their relationship with the physical environment of the particular area.

Diversity of fern flora

Baishya and Rao⁴ studied the terrestrial, lithophilic, and epiphytic ferns. The pteridophytes comprised of 256 species in 91 genera, a rich and diverse flora.

Muktesh Kumar¹⁹ documented 159 species from Munnar forest division. Among them 109 species were terrestrial and 50 epiphytic. A checklist of rare and endangered species found in different forests of Munnar were also provided.

Aldasoro *et al.*¹ concluded that the distribution of ferns in Africa has been influenced by refuges, which allowed many species to recolonize the neighbouring areas after the extinctions of the Pleistocene. Three major components were detected in the African flora: Guinea-Congolian *thermophilous*, cold-tolerant Afro-montane, and Southern drought-tolerant elements. These are related to the three main refuge areas, *i.e.*, the Gulf of Guinea area, the eastern tropical

region, and the Cape region. Endemicity in ferns was found to be lower than that of seed plants due to the higher dispersability of fern spores. The distance between operational geographical units seemed to be the main predictor of the number of endemic fern species these areas contained.

Dudani *et al.*¹² stated that the major families of pteridophytes found in the Western Ghats are Aspleniaceae, Polypodiaceae, Thelypteridaceae, Selaginellaceae, Pteridaceae, *etc.* Whereas, on the generic level, maximum diversity was observed in the genus *Asplenium*, *Selaginella*, *Pteris*, *Athyrium*, *Diplazium*, *etc.* The Western Ghats also harbors endemic species like *Polystichum manickamii*, *Cyathea nilgiriensis*, *Bolbitis semicordata*, *Selaginella radicata*, *etc.* Many endangered pteridophytes like *Psilotum nudum*, *Tectaria zeylanica*, *Lindsaea malabarica*, *Cheilanthes rufa*, *etc.* may soon face the brunt of extinction.

Singh *et al.*³⁰ studied the pteridophytic flora of Nokrek Biosphere Reserve, Meghalaya. Sixty nine species under 38 genera and 24 families has been provided. Among these 14 species were new records for the Meghalaya State, while 41 species extend their distribution from Khasi and Jaintia hills to Garo hills district. Ecologically 36 species recorded growing in terrestrial condition while 26 were epiphytic and seven species were lithophytes.

Itaf *et al.*¹⁴ described a total of 36 fern species belonging to 18 genera and 13 families ethno botanically and taxonomically which were collected from Punjab. Dryopteridaceae was found to be the largest family with 7 species and 3 genera, whereas Adiantaceae was the second largest family with 4 species. A dichotomous key was prepared for characterization and identification of the families, genera and species on the basis of morphological characteristics of the plant body with special reference of sporangium and spores.

Shukla and Chakravart²⁸ documented the status of fern diversity, biomass and carbon accumulation at Chilapatta Reserve Forest in Cooch Behar Wildlife Division,

West Bengal. Nineteen fern species were recorded. Identified species were of eight families and nine genera. Highest and lowest frequency recorded were 25.44 and 0.19 while relative frequency varied from 3.16 to 12.25. Fern density ranged from 93 to 13,403 individuals $\cdot\text{ha}^{-1}$. Most of the species were widely distributed. IVI values ranged from 7.54 to 37.45. The above ground portion of ferns accumulated the major portion of biomass and carbon.

Singh *et al.*²⁹ documented the checklist consists of 113 taxa (98 ferns, 15 fern allies), of which 25 species were newly reported for the Meghalaya State (*Selaginella involvens*, *Selaginella semicordata*, *Selaginella subdiaphana*, *Selaginella tenuifolia*, *Asplenium gueinzianum*, *Asplenium perakense*, *Microlepia hancei*, *Microlepia rhomboidea*, *Dicranopteris linearis*, *Coniogramme procera*, *Bolbitis sinensis*, *Loxogramme chinensis*, *Lygodium microphyllum*, *Lemmaphyllum microphyllum*, *Lemmaphyllum rostratum*, *Pleopeltis macrosphaera*, *Pyrrosia lanceolata*, *Pyrrosia longifolia*, *Pteris biaurita* ssp. *walkeriana*, *Pteris grevilleana*, *Tectaria fuscipes*, *Cyclosorus crinipes*, *Pseudocyclosorus falcilobus*, *Diplazium apicisorum* and *Diplazium pseudosetigerum*) and 43 species were new for all the three Garo Hill districts of the Garo Hills in the Meghalaya State.

Baruwati and Gogoi⁵ recorded the pteridophytes in the reserve forest of Sivasagar district, Assam. A total of 68 specimens of pteridophytes were collected and classified into 68 species from 27 families, According to habitat types, the specimens can be classified into four groups: terrestrials 38 species, epiphytes 14 species, lithophytes five species, aquatic plant eight species and climbers three species, although five species were found in more than one habitat.

Deepa *et al.*⁷ indicated that the checklist consists of 38 taxa, of which 29 species of terrestrial, five epiphytic, one climber and six lithophytes belonging to eighteen families. Pteridaceae stands the dominant family of the study area with eight species followed by Polypodiaceae (5),

Adiantaceae and Aspleniaceae each with three species. Pteris is reported as a largest genus including eight species in study area. *Arachniodes sledge* Fraser-Jenk. Is followed by *Pteris biaurita* L., *Tectaria couduinata* (Wall. Ex Hook. & ex Grev.) C. Chr., *Odontosoria tenuifolia* (Lam.) J. Sm. and *Thelypteris caudipinna* Ching the most densely populated with highest Importance value index in the study area. The Shannon's diversity index value (H^1) 2.97 and Simpson's diversity (D) =0.269 values for Pteridophytic species in Kemmangundi forest evidencing the pteridophytes richness of the area.

Deepa *et al.*⁸ documented thirty one species of Pteridophytes belonging to twenty two families with their Diversity index in Kigga forest of Chikmagalur district located in central Western Ghats. *Aleuritopteris anceps* (Blanf.) Panigrahi. was the most abundant species and has highest IVI and density. The Shannon's diversity index value (H^1) 2.81 and Simpson's diversity (D) =0.084 values for pteridophytic species in Kigga forest showed high diversity and species richness.

Ashwini and Parashurama³ documented 19 species of pteridophytes belonging to 16 genera of 11 families with their diversity index in Banajalaya forest region of Shimoga district. *Athyrium hohenackeranum* (Kunze) T. Moore is the most abundant species with highest important value index (77.9) and density (79.57). The Shannon's diversity value (H^1) 1.79 and Simpson's diversity (D) 0.247 value for pteridophytic species in Banajalaya forest showed high species richness.

Nineteen species of Pteridophytes belongs to 11 families were authentically documented in Banajalaya region in Sagar taluk of Shimoga district. Pteridaceae was occurred as the dominant family in study area. The majority of the ferns are terrestrial, two of them are epiphytic, and one is hydrophytic species. Study helped for conservation programmes of these ferns, which were important for their academic, medicinal and ornamental values⁶.

Mallayya *et al.*¹⁷ collected twenty-seven species Pteridophytes belongs to 22

genera and 16 families. Taxonomically Pteridaceae was the dominant family with four genera and six species followed by Lomariopsidaceae was the codominant family represented by two species.

Diversity of ferns and lycophytes in Brazil was studied²³. The results showed 1,253 species: 1,111 of ferns and 142 of lycophytes. Thirty six families and 133 genera were recognised. The ten most diverse families were Pteridaceae (196 spp.), Dryopteridaceae (179), Polypodiaceae (164), Hymenophyllaceae (90), Thelypteridaceae (86), Aspleniaceae (78), Lycopodiaceae (64), Selaginellaceae (55), Anemiaceae (51), and Cyatheaceae (45). The three most diverse genera were *Elaphoglossum* (87 spp.), *Thelypteris* (85), and *Asplenium* (74). The richest phytogeographic domain was seen in Atlantic Rainforest with 883 species which also had the largest number of endemic and threatened species, followed by the Amazon Rainforest (503), Cerrado (269), Pantanal (30), Caatinga (26), and Pampa (eight). Minas Gerais remained as the richest state (657 spp.).

Vanlalpeka and Laha³² assessed 32 species of ferns belong to 17 families from eight different sites of the Champhai district, Mizoram. Amongst them 27 species are terrestrial, 5 species are epiphytic (*Pseudodrynaria coronans* (Wall. Ex Mett.) Ching, *Drynaria quercifolia* (Bory) J. Sm., *Platynerium wallichii* Hook., *Drynaria propinqua* J) and 6 species are of ethnobotanical use (*Platynerium wallichii* Hook., *Adiantum lunulatum* Burm. f., *Lygodium flexuosum* (Linn.) Sw., *Diplazium esculentum* (Retz.) Sw. *Dicranopteris linearis* Burm. F and *Lycopodiella cernua* (L.) Pic.).

Anthony *et al.*² identified 26 species of ferns belonging to 11 families among 10 species were terrestrials and 16 were epiphytes and one species *Leptochilus cf. decurrens* is new to Danum Valley. Shannon-Wiener Index showed that secondary forest of high biomass ($H^1=2.49$) have high species richness than primary forest ($H^1=2.03$) and secondary forest of low biomass ($H^1= 2.07$).

Kishore *et al.*¹⁶ collected about 23 species from Gujarat state, from which eight

species viz., *Actiniopteris radiata* (Sw.) Link, *Adiantum caudatum* L., *A. incisum* Forssk., *Lygodium flexuosum* (L.) Sw., *Pteris vittata* L., *Selaginella ciliaris* (Retz.) Spring, *S. Delicatula* (Desv. ex Poir.) Alston, and *S. Repanda* (Desv. ex Poir.) Spring. were added as new distributional record for the Gujarat state. This survey concluded that *E. debile* is regionally extinct in the wild while *Isoetes coromandeliana*, will be lost from its natural habitat in short time if not conserved properly.

Parashurama *et al.*²⁰ documented twenty six species of Pteridophytes belonging to seventeen families with distribution study was carried out in the forest of Mudigere taluk located in Chikmagalur district of Central Western Ghats. *Adiantum philippense* was observed as higher importance value index followed by L., *Pteris biaurita* L., *Adiantum concinnum* Humbl. & Bonpl. Ex Wild and *Tectaria paradoxa* (Fee) Sledge. The Shannon's diversity index value (H^1) of 5.54 and Simpson's diversity (D) values of 2.66 for pteridophytic species in study area showed the high diversity and species richness.

Patil *et al.*²¹ studied the diversity and distribution along different ecological gradients of eighty six species of Pteridophytes from the Satara district. The maximum Pteridophytes were observed above 1000 m (high altitude, 77 species) whereas only 34 species were observed at low altitude (600 m). Amongst the species most common species were viz., *Adiantum philippense*, *Aleuritopteris bicolor*, *Azolla pinnata* sub sp. *asiatica*, *Marsilea minuta*, *Pityrogramma calomelanos*, *Pteridium revolutum*, *Pteris vittata*, *Selaginella ciliris* and *Tectaria coadunata*.

Thapa and Lama³¹ gave detail information on the diversity and distribution of Gleicheniaceae Presl in Darjiling Hills. Study revealed the occurrence of two genera with four species and represent 57 % of Gleicheniaceae present in the Indian sub-continent and these four species represent the diversity of this family for the state of West Bengal.

Deepa *et al.*⁹ authentically documented the pteridophyte diversity of Madhuguni state forest. This preliminary enumeration listed 23

pteridophyte species. The majority of the ferns here were terrestrial except two epiphytes, one aquatic fern and one climbing fern there was *Lygodium flexosum* (L.).

Dudani *et al.*¹¹ indicated that in central Western Ghats if humid microhabitats such as Myristica swamps, dipterocarp dominated relic primary forests, perennial waterfalls, sholas etc., most sought after for hydro-electric projects, expansion of coffee and tea plantations, betelnut gardens etc. were prioritized for conservation, the continuance of even relatively rarer pteridophytes like *Cyathea nilgiriensis*, *Psilotum nudum*, *Lycopodium squarrosum*, *Stenochlaena palustris*, *Lindsea odorata*, *Hymenophyllum polyanthosum* and *Asplenium crinicole* etc. will be reassured.

Kavitha *et al.*¹⁵ reported that 42 species of Pteridophytes which includes terrestrials, aquatic and epiphytic forms, from Sitheri hill station in Dharmapuri District located in Tamil Nadu, India. *Psilotum nudum*, *Huperzia* sps, *Actiniopteris radiata*, etc were important specie. Most of the surveyed species determined to rare limited in distribution. Therefore more habitat protection is suggested for conservation of fern flora in Sitheri hills.

Mir *et al.*¹⁸ documented vascular cryptograms growing Hirpora Wildlife Sanctuary, Shopian, Jammu and Kashmir. A total 46 species of ferns and fern-allies belonging 20 genera and nine families were recorded. Among them *Dryopteridaceae* (14 species and two genera) was the dominant family followed by *Woodsiaceae* (12 species and six genera), *Aspleniaceae* (8 species and one genera) and *Pteridaceae* (6 species and five genera). The dominant genera collected from the sanctuary were *Dryopteris* and *Asplenium* (8 species each) followed by *Polystichum* (6 species) and *Athyrium* (4 species).

Patil *et al.*²² documented 41 species belonging to 17 families and 29 genera were of which 31 species were terrestrial, 7 epiphytic, and 3 aquatic species. Maximum diversity of fern species was observed in the hills of Mahabaleshwar (40 species) whereas, the least

diversity was recorded at Mann hills (6 species). Out of the 41 species, 9 occurred occasionally and were common species, 3 were rare species and 5 were threatened species. Maximum number of ferns belongs to the family Pteridaceae.

Rekha and Krishnan²⁴ focussed on the diversity of pteridophytes in the Attoor beat of Akamala forest station, Thrissur district. A total of 24 species of pteridophytes were collected from the study area. The collected species belonged to 17 genera, 14 families and 2 classes. Except different species of Selaginella ((Lycopsidea) all other members belonged to the class Filicopsida (Fern group). The most frequently represented species were Selaginella, Adiantum, Hemonitis and Pteris. Most of the collected species were terrestrial. Epiphytes, lithophytes and aquatic species. The result of the study indicates the richness of pteridophyte diversity in the study area.

Saharia and Saikia²⁶ conducted an intensive field study of ferns of Amsoi, Nagaon. The fern species found during the field study were collected, studied and identified. A total of 16 species under 14 genera of 12 families have been enumerated.

Sharma *et al.*²⁷ gave a taxonomic inventorization of pteridophytes occurring in a human inhabited buffer zone of Murlen National Park. Survey revealed 35 species belonging to 27 genera and 15 families. Polypodiaceae was recorded as dominant family, represented by six genera and eight species, followed by Pteridaceae (three genera and six species) and Lycopodiaceae (three genera and four species). Of the recorded species, 23 species were terrestrial, 11 (epiphytic) and two (lithophytic) in their habit forms. The species richness was highest in Tualpui village, with 11 species, followed by Rabung and Ngur (7 and 6, respectively).

Vijayakant *et al.*³³ studied the fern flora of Tamil Nadu, India and documented two ferns *Athyrium parasnathense* (Athyriaceae) and *Leptochilus metallicus* (Polypodiaceae) as new addition to Tamil Nadu, India. Lectotype is selected for *Athyrium parasnathense*.

CONCLUSION

India with a highly variable climate has a rich Pteridophyte diversity. There are about thousand species occur in the different parts of India. Western Himalaya and Western Ghats supported pteridophytes species of fern and fern allies in India. Biodiversity conservation is the need of time and hence it has become imperative to develop *in-situ* and *ex-situ* conservation methods for the conservation of existing pteridophyte diversity in the area. *In-situ* conservation methods should be given prominence as it allows the evolution of the species within the natural habitat thus increasing its further diversity.

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