

Biodiversity and Prospective of Pteridophyte in North India

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Abstract

Biodiversity is fundamental to the fulfillment of human needs; a biodiversity rich region offers wide options and opportunities for sustaining human welfare including adoption to changes. The climatic condition and wide variety in physical features witnessed in India have resulted in a diversity of ecological habitats such as forests, grasslands, wetlands, which harbor and sustain wide ranging floral and faunal species placing. In order to prevent diversity loss of such pteridophytes during construction of hill road, their current diversity and ecology have been studied here. The aquatic plants species belongs to diverse habits and have distinctive characteristics. More than 9 aquatic species have been identified and they can be described. In ancient period these plants were prescribed as herbal extract for the cure of several diseases. The bio-resource based industrial setup has been proving itself as an emerging field of economy development. The pteridophytes (*Nephrolepis cordifolia*, *Nephrolepis exaltata*, *Nephrolepis tuberosa*, *Adiantum incisum*, *Cyrtomium falcatum*) with their attractive foliar are enormously used during the ceremonial events as beautifying and decorative assets for their aesthetic appeal.

Key words : Biodiversity, Indicator, Nutrition, Pteridophyte.

Introduction

In plant kingdom pteridophytes i.e. feather plants are most primitive vascular plants and are known as vascular cryptogams. They were the first vascular plants to grown on the surface of earth and began their life period from leafless, rootless individuals in the Silurian and Devonian periods. The pteridophytes are consisting of four groups: Licopods, Equisetum, Psilotaceas and Ferns¹.

Biodiversity refers to the variety of life forms at all levels of organization, from gene through species to higher taxonomic forms and also includes the variety of ecosystems and habitats as well the processes occurring therein. Biodiversity is fundamental to the fulfillment of human needs; a biodiversity rich region offers wide options and opportunities for sustaining human welfare including adoption to changes. India is one of the 17 Mega bio-diverse countries in the world and accounts for 7-8% of the recorded species². The climatic condition and wide variety in physical features witnessed in India have resulted in a diversity of ecological habitats such as forests, grasslands, wetlands, which harbor and sustain wide ranging floral and faunal species placing. The climatic conditions cause prevalence of not and highly humid weather in this part of country and coupled with heterogenic physiography make possible luxuriant growth of a number of plant communities phyto-geographically, many a species are endemic to this region and it is also the center of origin for commercially important plants. The species diversity is so spectacular that it becomes often difficult to clearly identify separate riche to existing plant formations³.

There are nearly more than two hundred numerous marshy land exist here which should be used for development of the area. The soil is mainly clayey loam mixed with silt.

The soil is acidic and pH varies from 4.36-6.86. The average annual rainfall remains around 2000 mm and about 70% occurs during June-September. The relative humidity varies between 65-95% and is lowest during the month of March. The present paper deals with the floristic diversity of the study site and their prospective⁴.

Ferns and their allies also known as the vascular cryptogamic plants have enormous aesthetic value and multifarious scope for exploring the bioactive molecules against various pathogenic causal organisms of bacterial, fungal and microbial origins. In view of the evolutionary trends of plants the Pteridophytes have valuable importance to unearth the number of uncertain hypothesis of evolution. In addition, more species of the Pteridophytes have been known and validated as potential genetic resource against many diseases and source of miscellaneous articles. However, the Pteridophytes have long history of their evolution and were known as dominant group of the plants during the carboniferous periods. Since, their dominating era few of the species have survived long and known as relic species (*Psilotum nudum*) playing major role to resolve the phylogenetic relationships and evolutionary trends.

Biodiversity in pteridophytes

The pteridophytes which dominated the earth during carboniferous are survived today by about 12,000 species comprising 305 genera. Amongst of which most numerous are the homosporous ferns comprised of approximately 11,500 species, where as rest 500 as fern-allies known globally⁶. In India the Pteridophytes have been found to grow in almost all climatic zones under different habitats and represented by approximately 1200 species falling under 191 genera. In addition to species composition the Pteridophytes are very diverse in their habitat as well as occupancy. Accordingly, they have been categorized aquatic (*Azolla* sp., *Marsilea* sp., and *Salvinia* sp.), terrestrial (*Cyathea* sp., *Angiopteris* sp., *Pteris* sp., *Polystichum* sp., *Athyrium* sp., *Lycopodium* sp., *Diplazium* sp.), epiphytic (*Oleandra* sp., *Vittaria* sp., *Drynaria* sp., *Microsorium* sp.). However, most of the species of *Adiantum*, *Psilotum*, *Cheilanthes* preferentially grow on rocks, where as few others like *Actiniopteris*, *Woodsia* and *Onychium* survive under extreme dry conditions. Very few are also known to grow in mangrove forests viz. *Acrostichum speciosum*. Amongst these Pteridophytes, the species of *Cyathea* commonly known as “tree fern” standing at a status of threatened category grow in tropical humid forests of the country. Being one of the twelve mega biodiversity countries of the world, India portrays three hotspots across its territory. The north east regions of the country comprised of seven provinces are a major component of the Eastern Himalayas which is richest in the Pteridophytic wealth. About 845 taxa belonging to 179 genera are known from these regions followed by the species composition of south India (Eastern and Western Ghats) from where approximately 345 taxa under 110 genera are known so far. In addition to above phytogeographical regions, the Western Himalayas of the North India stand at the third position exhibiting 340 taxa belonging to 100 genera. This trend of diversity and species composition has enforced the Indian subcontinent to be very distinct in respect of

Pteridophytes⁷. Therefore, about 17% of the total species known from the country are at endemic status which needs urgent attention for their conservation.

Further construction and widening of the road is in offing as the area is in path of rapid modernization. This will impact diversity of these plants. In order to prevent diversity loss of such pteridophytes during construction of hill road, their current diversity and ecology have been studied here. Status of enlisted pteridophytes growing along hill roads is also ascertained from IUCN red list and list of catalogue of life (COL). The study is likely to help in further capacity augmentation/widening of these roads without harming the current diversity of the pteridophytes growing there. The study also provides a protocol to be followed for monitoring and management of biodiversity along other roads of this hotspot. Pteridophytes growing along hill roads of north India have not yet reported⁸.

MATERIALS AND METHODS

All the selected area were surveyed with team of experts for two consecutive years during the months of October to January (2019). Data were collected within 200m (considering corridor of impact) of the roads by traversing on foot along all the pteridophytic habitats on both side of the roads (valley side and hill side). Vegetation, water channels, ridges and various habitats within the corridor of impact (200m of the road) were also considered for the listing of the pteridophytes.

The taxonomy of recorded species was done as per Fraser-Jenkins (2009). However, the genera and species within the families are listed alphabetically. The authorities of names follow Brummitt and Powell (1992) while the taxonomic citation is based on published literature and IPNI, Tropicos and The Plant List.

COLLECTION OF SPECIMEN

All the specimens were collected in fertile stage and were processed through conventional herbarium. They were identified by matching them with herbarium specimens of local universities and research institutions and also by using different floras of nearby areas⁹. Identifications of specimens were based on field characters with the aid of existing literature¹⁰.

RESULTS AND DISCUSSION

The results here are the first report of Pteridophytes growing North India, so far their diversity, ecology and status in IUCN Red List and List of Catalogue of Life is concerned.

There are about 12,000 species of pteridophytes occurring 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 Pterido-phytes) occur in Eastern Himalayas and adjoining states. Thus, Eastern Himalayas may be termed as one of the Hot Spots diversity centre for pteridophytes¹¹. North 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 diversity¹².

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

Table-1: Comparative number of members of ten well representative families in North India

S.No	Name of the Family No. of species in India	Approximate no. of species in India	Approximate no. of species in North India
1	Polypodiaceae	150	89
2	Dryopteridaceae	109	81
3	Atryiaceae	101	90
4	Thelypteridaceae	88	39
5	Aspleniaceae	70	30
6	Selaginellaceae	62	23
7	Pteridaceae	60	39
8	Aspidiaceae	50	23
9	Sinopteridaceae	38	19
10	Hymenophyllaceae	28	11

Table-2: Distribution of ten genera in North India

S.No	Name of the Family No. of species in North India	Approximate no. of species in India	Percentage in North India
1	Asplenium	14	20.00
2	Selaginella	18	29.03
3	Pteris	27	45.00
4	Dryopteris	39	68.42
5	Polystrichum	32	71.11
6	Athyrium	21	60.00
7	Allantoidea	05	20.00
8	Lindsaea	04	17.39

Of 530 Pteridophytes reported as endemic to the India in recent decades (about half the total number of 950-1000 known Indian species). 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 North India may be considered one of the important areas mentioned in table 1 and 2.

Medicine and Pteridophytes

The Pteridophytes are long known for their medicinal and therapeutical utility. In ancient period these plants were prescribed as herbal extract for the cure of several diseases. Theophrastus (327-287 BC) and Dioscorides (50 AD) listed many Pteridophytes as a potential herbal formulation to cure more deadly disorders. However, Shushruta and Charak in their monumental contribution on the medicinal attributes of ferns have enormously mentioned the utility of *Marsilea minuta*, *Adiantum capillus-veneris* etc. First historical effort was made by Caius in 1935 to describe the medicinal uses of ferns in India, therefore get recognized as the first man to take this very initiative kind of investigations. Recently, enormous efforts have been made to determine the potentiality of Pterido-phytes in relation to their chemical

composition and other aspects¹⁴. These plants are distinct in having glycosides, flavonoids, terpenoids, alkaloids and many primary as well as secondary metabolites which are used for preparation of expectorant. Formulations of these plants are also advised as supplement of aphrodisiac, appetizer, stimulants; however, certain species are used for the ailment of diuretic, ulcer as well as stomachic. Few of the Pteridophytic species are historically in practice in the homeopathy as well as ayurvedic system of medicines. The *Selaginella bryopteris*, *Lycopodium clavatum* are well known Pteridophytes for the homeopathic system of medicine, wherein the *Selaginella* is prescribed for the cure of neurological disorder and heat stroke effects. Similarly, the *Lycopodium clavatum* is also recommended to the patients of splinted bones. The *Helminthostachys zeylinica* commonly known as ‘Kamraj’ is well known herbal ayurvedic formulation to enhance the sexual efficiency and as a source of stimulant and aphrodisiac. Few of the Pteridophyte species have been screened out chemically and numbers of active novel chemical compounds are validated. The marsiline isolated from *Marsilea minuta* has immense utility and is used in psychopathy, diarrhea, cough, skin diseases, dyspepsia fever and insomnia. Many other fern species have been extensively explored and determined to exhibit great economic value. The *Pteris vittata* commonly called “Braken fern” has also shown antimicrobial activities against number of gastro-intestinal bacterial strains. Thus, pteridophytes having tremendous importance and vast medicinal scope would prove itself as the biological resource for the upliftment of human society¹³.

Pteridophytes in industrial implications

The poverty alleviation in the developing countries like India is coherent to the multifarious industrial setup. The bio-resource based industrial setup has been proving itself as an emerging field of economy development. The pteridophytes (*Nephrolepis cordifolia*, *Nephrolepis exaltata*, *Nephrolepis tuberosa*, *Adiantum incisum*, *Cyrtomium falcatum*) with their attractive foliar are enormously used during the ceremonial events as beautifying and decorative assets for their aesthetic appeal¹⁵. Few of these species are used in the bouquet to extend the love in broad sense. The pteridophytes comprised of many relic species of the carboniferous periods are of immense importance in tracing the evolutionary trends in plants. However, many relic and recently evolved species are becoming rare and confined to fernery and nurseries with their high importance and increasing costs. In this way the industrial approaches of developing the fernery and nurseries can be an asset to meet out the requirement of fern lovers and enriching the economic inequities.

Environmental Management and Pteridophytes

The alarming rate of industrialization and urbanization has led the over emission of suspended particulate matter, metals and metalloids in the ecosystem of air, water and soil. These pollutants have toxic effect in living organisms at different biomagnifications level in water, soil and air. The bioaccumulation is a wonderful and cost effective technique to mitigate the impact of these toxicants. The plants particularly Pteridophytes are best known bio-accumulator of many metals and metalloids. *Pteris vittata*, *Marsilea minuta*, *Equisetum debile*, *Salvinia molesta*, *Azolla pinnata* has been experimentally determined as a hyper-accumulator of carcinogenic heavy metals viz. arsenic, cadmium, mercury, copper and

chromium respectively¹⁶. The arsenic has been major problem in the area of high water fed and paddy field practices mainly in West Bengal in India. Thus, these peculiar physiological properties of *Pteris vittata* can be utilized for the management of environmental related problems.

Genetic Resources and Pteridophytes

Adaptation to diverse habitats has indulged the pteridophytes to exhibit wonderful genetic traits. Many of the taxa adapted to cold, desiccation and rains have been very peculiar to synthesize the proteins of specific composition. These specific protein have enabled many pteridophytes viz. *Selaginella bryopteris*, *Cheilanthes farinosa* to tolerate the extreme desiccation, whereas, *Azolla* sp., *Salvinia* sp., are known to tolerate rain fed. These plants having such potentiality can be utilized as the genetic resource for executing various research related activities and development of transgenic plants of high economic value.

References:

1. B.S. Kholia 2010 A note on mistaken identity of 'sanjeevanibooti'. Indian Fern J. 26 : 199-200.
2. Ghosh C., Biswas R. and Das A.P. (2008). Ethnic uses of some pteridophytic weeds of tea gardens in Darjeeling and Duars. NBU J. Pl. Sci., 2, 86–93.
3. India State of Forest report (2015). Forest Survey of India, (Ministry of Environment Forest), Dehradun , 201 -205.
4. IUCN (2001). IUCN Red List Categories and Criteria: Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.
5. IUCN (2003). Guidelines for Application of IUCN Red List Criteria at Regional Levels: Version 3.0. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.
6. IUCN (2010). Guidelines for Using the IUCN Red List Categories and Criteria, version 8.1 (August 2010), prepared by the Standards and Petitions Subcommittee of the IUCN Species Survival Commission: on www. <http://intranet.iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines.pdf>
7. Kholia, B. S. and Bhakuni, K. (2009). Western Himalaya a new range of distribution for a critically endangered fern, *Dryopsis manipurensis* (Bedd.) Holttum et P. J. Edwards. Nelumbo, Bulletin of the Botanical Survey of India 51:245–248.
8. Kumar Ashok (2013). Butterfly (Lepidoptera: Insecta) Diversity from Different Sites of Jhagadia, Ankleshwar, District-Bharuch, Gujarat, Oct. Jour. Env. Res.1(1):09-18.
9. Kumar Ashok (2014). Environmental Management Plan for Chemical Industries Especially Resin Manufacturing Unit, Oct. Jour. Env. Res.. 2(3): 262-273.
10. Kumar Ashok and Aggarwal Savita Goyal (2013a). Ecology and Biodiversity status of Sachin gidc and its surroundings with Special reference to Conservation measures for Indian Peafowl (*Pavo cristatus*) schedule –I Bird species, Oct. Jour. Env. Res.2(1): 82-100.
11. Kumar Ashok and Srivastava Meena (2012). Diversity of medicinal Plants in Uttarakhand and their conservation Strategy with special reference to Orchids, In: Proceeding of National Conference on Environmentla Health: Challaneges and Management, Jan.20-21, 2012, organized by Pt. Deendayal Upadhyay Govt. PG College Rajajipuram, Lucknow. pp 139-142.
12. Kumar Ashok, Srivastava Meena and Goyal Savita (2013). The Biodiversity At Sandi Bird Sanctuary, Hardoi With Special Reference to Migratory Birds. Oct. Jour. Env. Res. 1(3):173-181.

13. Rawat V.K. and Satyanarayana P. (2015). Pteridophytes of India; Diversity, Distribution and Conservation –Biodiversity for Sustainable Development – Uttar Pradesh State Biodiversity Board.
14. Sachin Sharma, Bhupendra S. Kholia, Ramesh Kumar & Amit Kumar, (2017). Pteridophytic diversity in human-inhabited buffer zone of Murlen National Park, Mizoram, India, and Check List 13(2): article 2081.
15. Singh S. and Panigrahi G. (2005). Ferns and Fern-Allies of Arunachal Pradesh. Vol. I. and II. Dehra Dun.
16. Vijaya Sankar, R., Ravikumar, R. and N.M. Ganesh Babu (2005). On the collection of a Peninsular Endemic, *Barleria stocksii* (Acanthaceae), after a century. Zoo's Print 20:1820.

