Original Article

Checklist For Fern Diversity Of West Karbi Anglong District Of Assam, Northeast India

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DOI: 10.47750/pnr.2022.13.S07.952

Abstract

Pteridophytes are distributed in all the phytogeographical zones of India ranging from aquatic to alpine habitat where they grow as Hydrophyte, Mesophyte, Lithophyte, Epiphyte, Hemi epiphyte, Climbers etc. Present study founds the habitat of pteridophytes in riverine forests, forest floors, on slopes, grasslands, on rocks and crevices, on open walls and stone boulders etc. The study is carried on the area of West Karbi Anglong district of Assam in which major part of the area is hilly and some parts with plains and river valleys. The present study is focused on Fern diversity where 52 species were collected belonging to 31 genera under 20 families.

Keywords: Pteridophytic flora, Habitat, Species, Economic importance, Conservation, West Karbi Anglong.

INTRODUCTION

The first references to Indian Pteridophytes are in the classical Sanskrit linked to Ayurveda. In **Charak** and **Shushrut Samhitas Mayur Sikha** (Actiniopteris), Hansraj and Hanspadi (Adiantum spp.) were mentioned with medicinal properties. In Buddhist literature, it is thought that the species of Moonworts (Botrychium spp.) possess certain magical values and the plants of Botrychium are kept near the statue of Buddha to keep the devil powers away. Pteridophytes, also known as ferns and ferns-allies, flowerless plants without seeds and regarded as the first terrestrial plants to develop a vascular tissue system. Pteridophytes occupy an important position in the vegetation of the land and appeared for the first time around 360 million years ago marking the beginning of the Mesozoic era. They flourished on Earth for 200 million years before flowering plants developed. However, they do not form the dominant vegetation anywhere in the world today, but in few areas of rainforest they exhibit luxurious growth. They constitute an important group of plant diversity and are always present in moist shaded areas, often in abundance, but some species also reach xeric habitats.The main body of the plant is sporophyte, which is the dominant phase of its life cycle. Chapman (2009) estimated that there are about 12,000 species of ferns and fern-allies across the world. According to Moran (2015), "worldwide, there are about 13,600 species of ferns and lycophytes". According to a survey, the pteridophytic flora of India comprises around 1,000 species belonging to 191 genera and 67 families including 47 endemic Indian ferns (Dixit, 1984) and in another report, more than 1,100 species of pteridophytes belonging to 144 genera and 34 families with about 235 endemic species (Chandra, 2000) from India. According to Fraser-Jenkins et. al. (2017), "altogether there are about 1135 species including 42 exotics and 53 further subspecies", from the Indian subcontinent. The north-eastern region of India, including the state Assam, is part of one of the world's biodiversity hot spot regions, with a wide range of physiographic and climatic conditions. This area is being the home of many distinct ecological niches as the area is rich and diversified in flora. From the richness of its plant wealth and great diversity of vegetation, the northeast, formerly Assam in a wide sense, is often called the **"Floristic Gateway of India"**. The area is home to many early taxa and a wide range of endemic and threatened species. (Anonymous, 2006).

REVIEW OF LITERATURE

Previously, several workers had documented pteridophytes in north-eastern India. Among them, the oldest records are those of Kachroo (1953, 1975) who recorded ferns from various parts of the Assam. Panigrahi (1960),

Panigrahi & Chowdhury (1961, 1962), Panigrahi & Patnaik (1961, 1968), etc. had listed the eastern India ferns from time to time. Over the past few years, many workers have conducted research into the species diversity of Pteridophytes in present time. Some of the important works are Dutta et. al. (1980) on the pteridophyte diversity of N. C. Hills district, Baruaet.al. (1989) of Kamrup district, Bhattacharya (1994) of Karimganj district, Bhattacharya et. al. (1995) of Cachar district, Das et. al. (2012) in Nazira Subdivision of Sivasagar district etc. Bir et. al. (1992) published the North-Eastern Indian Pteridophyte species catalogue and Borthakur et. al. (2000) published a work on ferns and allied ferns in Assam. Chandra et. al. (2008) evaluated rare and threatened pteridophytes in India and found 414 species, 219 of which are at risk, 160 are critically endangered, 82 are near threatened and 113 are rare. However, this group of plants has not yet received enough attention due to the difficulty in identification and exploration in remote areas.

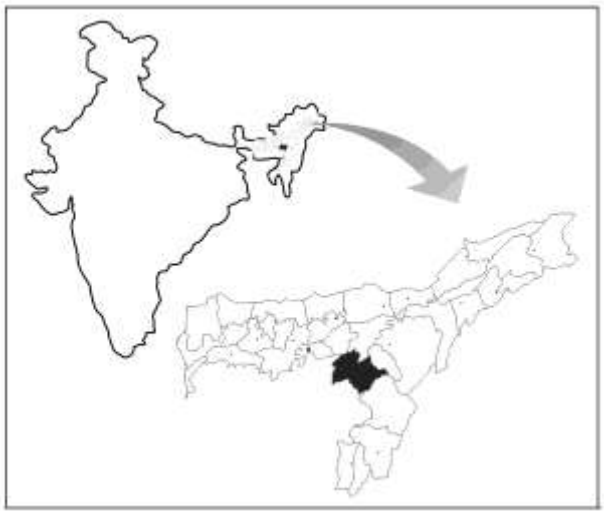

Figure : 1, Map showing the study area (West Karbi Anglong District of Assam, India. Map not in scale)

STUDY AREA

The Karbi Anglong district, the largest district of Assam, houses five wildlife sanctuaries viz., Nambor, East Karbi Anglong, North Karbi Anglong, Garampani, and Marat Longri Wildlife Sanctuary. East Karbi Anglong Wildlife Sanctuary (EKAWLS) is located in the eastern part of the Karbi Anglong district and is an integral part of the Karbi Anglong-Kaziranga landscape. The present study area is selected in the area of newly upgraded to district as West Karbi Anglong in 2016. Headquarter is Hamren. 70% of the area is hilly and covered by moist and mixed semi evergreen forest. Other part is composed of plain river valleys with human habitat and cultivated lands. The hilly terrain is continuous to the plateau of Meghalaya on west. The district is situated in the latitude of 25°33´N to 26º09´N and longitude of 92º08´E to 93º04´E. The climate is hot and humid, annual temperature ranges from 6 ºC to 12ºC and 23°C to 32°C in summer. The average rainfall is about 2416 mm. Annual precipitation of 1800 mm.

It is considered to be one of the rich floral and wildlife diversity regions of the Indo-Burmese biodiversity hotspot (WWF, 2002). The topography is varied with undulating hills, large valleys, rugged gorges, rivers and streams, annual and perennial streams and few waterfalls. The area is home to different types of forests ranging from semi-evergreen moist, moist mixed deciduous to various types with strewn patches of pure or mixed bamboo. The ground is well drained, sandy loam to clayey loam.

METHODS

A number of field visits were undertaken to the study areain different seasons to make a complete record of different habitats of the species and their occurrence during 2020-2021. Specimens were collected with their fertile and vegetative parts. Herbarium specimens were prepared by following standard herbarium technique (Jain & Rao 1977). Digital photographs of the concerned species were taken. Field notes viz. ecological data, habit, habitat and some diagnostic characters of each species were recorded. The specimens were kept in herbarium of department of Botany, RTU, further studied with standard literature like Baishya & Rao (1982), Jamir & Rao

(1988), and Borthakur et. al. (2001, 2018). Botanical names were verified by consulting with the herbaria of Gauhati University and the Botanical Survey of India, Shillong (ASSAM). The nomenclature of the species has been given according to the International Plant Names Index (IPNI), available at www.ipni.org.

RESULTS& DISCUSSION

A total of 52 species of pteridophytes belonging to 31 genera and 20 families are recorded (Table 1). The Pteridaceae family had the highest number of species among the fern allies with 7 species (14.5%) belonging to 2 genera, which is followed by Thelypteridaceae family with 5 species (10.41%) from 1 genus. The third most dominant families are Lycopodiaceae, Polypodiaceae and Salviniaceae with 4 species each (8.3%). Besides these, the families Dryopteridaceae and Selaginellaceae has 3 species each (6.25%); Aspleniaceae, Athyriaceae, Blechnaceae, Davalliaceae, Dennstaedtiaceae, Lygodiaceae, Oleandraceae with 2 species (4.16%) each and Cyatheaceae, Equisetaceae, Gleicheniaceae and Marsileaceae with 1 species each (2.08%) each. This is the characteristic features of the vegetation of the region.

Table:1

Sl. No.	Family	Genus	Species	Habitat	Place of collection	Distribution
1.	Adiantaceae	Adiantum	Adiantum incisum Forssk.	1	Sekso Hill	Abundant
		Adiantum	Adiantum philippense L.	1	Umpanai	Frequent
		Cheilanthes	Cheilanthes_argentea (Gmel.) Kunze.	1	Sekso Hill	Frequent
2.	Aspleniaceae	Asplenium	A. nidus L.	4	Dongka Sib Mandir	Abundant
		Asplenium	A. phyllitidis D. Don	4	Boithalangso, Zirikending	Abundant
3.	Athyriaceae	Diplazium	D. dilatatum Bl.	1	Sekso Hill, Zirikending	Abundant
		Diplazium	D. esculentum (Retz.) Sw.	1	Sekso Hill, Zirikending	Abundant
4.	Blechnaceae	Blechnum	B. orientaleL.	1	Sekso Hill, RonghangRongbong	Abundant
		Stenochlaena	S. palustris (Burm.f.) Bedd.	5	Khanduli roadside	Abundant
5.	Cyatheaceae	Cyathea	C. gigantean (Wall. ex Hook.) Holttum	1	Near khanduliwater falls	Rare
6.	Davalliaceae	Araiostegia	A. divaricata (Bl.) M.Kato.	4	Khanduli	Abundant
		Davallia	D. griffithiana Hook. f.	4	Khanduli	Abundant
7.	Dennstaedtiaceae	Microlepia	M. speluncae (L.) T.Moore	1	Donka, Khanduli	Abundant
		Odontosoria	O. chinensis (L.) J. Sm	1	Amtring	Abundant
8.	Dryopteridaceae	Bolbitis	B. heteroclita (Presl.) Ching	1	Umpanai	Abundant
		Tectaria	T. coadunate (Wall. ex Hook. &Grev.) C. Chr	1	Umpanai	Abundant
		Pleocnemia	P. submembranacea (Hayata) Tagawa & K. Iwats.	1	Sekso Hill	Frequent
9.	Equisetaceae	Equisetum	E. debile D. Don	1	Donka Sib Mandir	Frequent
10.	Gleicheniaceae	Dicranopteris	D.linearis (Burm.f.) Underw.	1	On the way to Khanduli	Abundant

11.	Lycopodiaceae	Huperzia	H. phlegmaria (L.) Rothm.	4	Koka	Rare
		Huperzia	H. squarrosa (G.Forst.) Trevis	4	Umpanai	Rare
		Lycopodiella	L. cernua (L.) Pic. Serm	1	Koka	Frequent
		Lycopodium	L. cernuum L.	1	Sekso Hill	Frequent
12.	Lygodiaceae	Lygodium	L. japonicum (Thunb.)	5	Sekso Hill	Frequent
		Lygodium	L. microphyllum (Cav.) R. Br	5	Sekso Hill	Frequent
13.	Marattiaceae	Angiopteris	Angiopterisevecta(G. Frost.) Hoffm	1	Way to Kanduli from Hamren near waterfalls	Rare
14.	Marsileaceae	Marsilea	M. quadrifoliaL.	2	Donka	Abundant
15.	Oleandraceae	Nephrolepis	N. bisserata(Sw.) Schott	4	Sekso Hill	Frequent
		Nephrolepis	N. cordifolia C. Presl.	1	Amtring	Frequent
16.	Pteridaceae	Adiantum	A. capillus-veneris L.	1	TikaPahar	Frequent
		Adiantum	A. philippense L.	1	Umpanai	Abundant
		Pteris	P. ensiformis Burm. f.	1	Khanduli water falls	Abundant
		Pteris	P. longipinnula Wall. ex J. Agardh.	1	Khanduli water falls	Abundant
		Pteris	P. multifida Roxb.	1	Amtring	Abundant
		Pteris	P. semipinnataL.	1	Amtring	Abundant
		Pteris	P. biauritasub sp. walkeriana Fraser-Jenk. &Rajkumar	1	Umpanai	Abundant
17.	Polypodiaceae	Microsorum	M. punctatum (L) Copel.	4	Ulukunchi	Abundant
		Pyrrosia	P. lanceolata (L.) Farewell.	4	Tumpren, Donka	Abundant
		Pyrrosia	P. nuda (Giesenh.) Ching	4	Koka	Abundant
		Pyrrosia	P. piloselloides (L.) M.G.Price	4	Koka, Zirikending, Hamren	Abundant
18.	Salviniaceae	Azolla	A. pinnata R. Br. subsp. asiatica R.M.K. Saunders & K. Fowler	3	Tumpreng	Abundant
		Salvinia	S. cucullata Roxb.	3	Tumpreng	Abundant
		Salvinia	S. molestaD. S. Mitch.	3	Tumpreng	Abundant
		Salvinia	S. natans(L.) All.	3	Tumpreng	Abundant
19.	Selaginellaceae	Selaginella	S. helferi Warb.	1	Donka Sib Mandir	Frequent
		Selaginella	S. monospora Spring	1	Amtring	Frequent
		Selaginella	S. semicordata (Wall. ex Hook. Grev.) Spring	1	Boithalangso	Abundant
20.	Thelypteridaceae	Thelypteris	T. dentata (Forssk.) E.P.St.John	1	Sekso Hill	Abundant
		Thelypteris	T. interrupta (Willd.) K.Iwats.	1	Umpanai	Abundant
		Thelypteris	T. ornata (Wall ex Bedd.)	1	Sekso Hill	Abundant
		Thelypteris	T. prolifera (Retz.) C.F.Reed	1	Hamren	Abundant

		Thelypteris	T. triphylla (Sw.) K. Iwats.	1	Sekso Hill	Abundant

1 – Terrestrial, 2 – Marshy Species, 3 – Free Floating, 4 – Epiphytic and 5 – Climbers

According to habitat-types the species were further classified under 5 broad groups viz., Terrestrial (33 species, 63.43%), Epiphytic (11 species, 21.15%) Free floating (4 species, 7.69%) Climbers (3 species, 5.76%) and Marshy places (1 species, 1.92%).Based on distribution, 35 species among total were Abundant (67.30%), 13 species were Frequent (25%) and 4 were rare (7.69%).

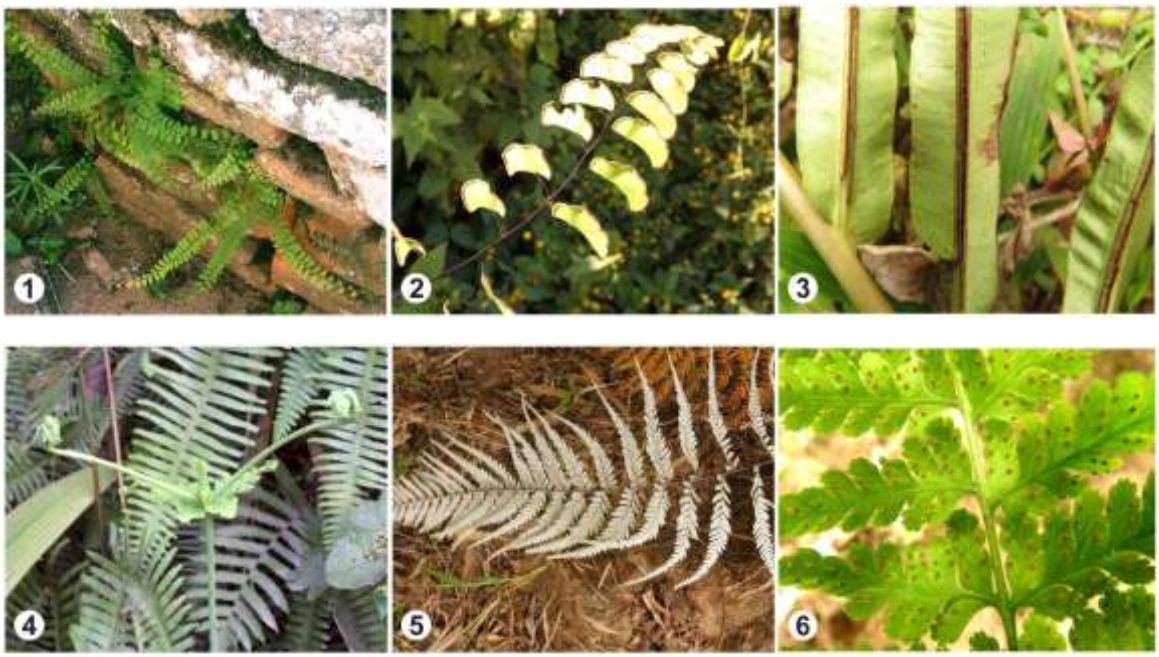

Plate: 1- Some photographs of collected specimens

1. Adiantum incisum Forssk. 2. Adiantum philippense L. 3. Blechnum oriental L.(Sporangium) 4. Dicranopterislinearis (Burm.f.) Underw. 5. Cheilanthes_argentea (Gmel.) Kunze. 6. Microlepia speluncae (L) T. Moore

ECONOMIC IMPORTANCE

Humans have been depending on plants as an important source of medicine since ancient times**.** Vegetable curry is made with the tender leaves of Dryopteris cochleata, D. sparsa and Leucostegia immersa. Diplazium esculentum (Retz.) Sw.is used extensively as vegetables in the neighbouring region.The fresh leaves of Diplazium esculentum (Retz.) Sw., Helminthostachy szeylanica (L.) Hook., Ophioglossum reticulatum L. and Marsilea minuta L. are mixed with legumes and consumed with selection in north east India. Due to ornamental nature of fronds of Dryopteris, Adiantum, Nephrolepis etc., the potted plants of such species find place in terrace of houses, hotels and gardens etc. Dried stems are also used for ornamental purposes. The pith of Angiopteris evecta, Cibotium assamicum and tree ferns are being eaten by some tribals in the period of shortage of food, as such or sometimes after colling also in the Eastern India and Arunachal Pradesh. Adiantum philippense L. and Marsilea minuta L. are referred to as important medications in **'Charak Samhita'**. Selaginell abryopteris popularly referred to as **Sanjiwani** is widely used as a tonic in India. Lycopodium spores serve as a powder to the skin. The Lycopod spores known as vegetable brimstone are used for fireworks. The decoction of Actiniopteris radiata frond is used to control excessive bleeding in womens during mensuration or abortion. The decoction of Adiantum lunulatum used as diuretic, and useful in dysentery. The fronds of Asplenum adiantum, A. nigrum leaves are used in spleen disorder and also used among ladies for family planning in Unani system of Medicine. Rhizome of Helminthostachys zeylanica (L.) Hook. is used against dysentery, and leaves are used to cure sores on tongue. The stems of Lygodium flexuosum boiled with mustard oil and used against rheumatism. The rhizome of Polystichum squamosum known as 'Nirviri' in India, used against scorpion and insect bites. A juice is extracted from the rhizomes of Tectaria macrodonta in Darjeeling district and used against diarrhea among children. The

leaf and root decoction of Frequently occurring Adiantum phillipensis has been found to be very effective in the treatment of chest complaints.Adiantum philippense L. and Lygodium microphyllum (Cav.) R.Br., are used as a medicine in fever, dysentery, jaundice, etc. (Patiri & Borah, 2007; Sen & Ghosh, 2011).The fronds of Pteris Spp. are used to cure cuts and wounds. Orchids are grown in the main stems of Osmunda, Alsophila, Angiosphila, Angiopteris. There are many species of Pteridophytes which can be useful in the preparation of medicines. The medicinal qualities of ferns, real or imagined, are mentioned as far back as 300 B.C. by the Greek philosopher Theophrastus and by his Indian contemporaries **Sushrut** and **Charak**. Thus, Pteridophytes are vastly useful to humanity.

Ferns also have fertility properties. One of the famous Fern known as biofertilizeris Azolla pinnata R.Br. subsp. asiatica R.M.K. Saunders & Fowler, which shows symbiotic association with nitrogen-fixing Anabaena azollae Strasburger (bluegreen algae)is used extensively in the rice fields. Through this property, Azolla's agronomic potential as a biofertilizer for rice has been recognized in many countries, including India. Other ferns like Adiantum sp.,Asplenium sp., Selaginella sp., Lygodium sp., Pteris sp., etc. are also cultivated in gardens and pots.Ferns also play a significant role in the bio-remediation of wastewater.

CONSERVATION

At present, many different ecological niches are threatened to a large extent due to a variety of anthropogenic activities, creating a serious problem for fern survival in the region. The increasing human population, expansion of agricultural land to meet the demand of food, harvesting of fuel-wood and timber, misuse of non-timber forest products (NTFPs), selective removal of species and other developmental activities are continuing at the cost of the natural flora. In addition to these, urbanization, construction of buildings, roads, housing etc. in areas, are all examples of direct attacks against nature that have resulted in the loss of pteridophytic diversity in the area. All these activities pose a threat to many epiphytic ferns, filmed ferns, climbing ferns and many other shade-loving ferns, which can result in co-extinction. The rules of the Biodiversity Convention, are powerless to address real conservation issues like this and are largely an impediment to botanical research. The conservation of Pteridophytes has received very little attention in comparison to Angiosperms despite being medicinal, food, rituals and ornamental and ecological values. In this context, it is important to formulate and implement in situ conservation of Pteridophytes in order to maintain the richness of the biodiversity of the district and the state as a whole.

ACKNOWLEDGEMENT

We are grateful to the Joint-Director, Botanical Survey of India, Shillong and HOD, dept of Botany, Gauhati University for allowing us to access their Herbarium and Library. We are very grateful to the Karbi Anglong District Forest Officer for providing the necessary permission and facilities to explore the reserve's forest throughout the study period.

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