Journal of Bioresources 13 (1): 67 - 75, January – March 2025

JOURNAL OF BIORESOURCES

journal webpage: https://jbr.rgu.ac.in

ISSN: 2394-4315 (Print)
ISSN: 2582-2276 (Online)

RESEARCH ARTICLE

Depleting pteridophyte diversity in Kaliabor Subdivision of Assam, India

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Article No.: BKJBR122; Received: 09.12.2024; Peer-reviewed: 20.01.2025; Accepted: 11.02.2025; Published: 31.03.2025
Doi: https://doi.org/10.5281/zenodo.16443428

Abstract

The Pteridophytes include a group of primitive land plants with well-developed vascular system but without flower. Since ancient time, pteridophytes have been utilizing by different ethnic group of the world as source of food, medicine and decoration. There are about 12000 species of pteridophytes under 300 genera all over the world. A survey of pteridophytes in Kaliabor Subdivision of Assam was carried out during 2010-2011 which revealed the presence of 41 species in the Subdivision. At an interval of approximately 10 years the survey was repeated during 2022-2023. The recent survey reveals the presence of 39 species and shows a total declination in the number of species and distribution of the pteridophytes in Kaliabor Subdivision. *Angiopteris evecta* (G. Frost) Hoffm and *Lycopodium clavatum* L. lose their existence from the area. Considering as a probable cause for the declination of species distribution and lose of some species, the pattern of yearly average rainfall in peak rainy season and average temperature of the area for last 10 years were studied. After study the pattern of rain fall, temperature and rate of urbanization; the declining trend and lose of some species diversity may be attributed to changing climate and the process of rapid urbanization.

Key Word: Pteridophytic species; diversity; declination; rainfall; urbanization

1. Introduction

The pteridophytes include a group of primitive land plants with well-developed vascular system but without flower. This group of plants also referred as "Vascular Cryptogams", which has dominated the vegetation of earth during Devonian and Carboniferous periods of paleozoic era. Though these are now replaced by well-developed seed-bearing vascular plants, yet they contribute and constitute a large part of the world vegetation. Pteridophytes has some other importance along with the contribution and constitution to the world flora. Some of the pteridophytic species are edible and found to be a good source of starch, greens and additives. Some ferns are consumed as a vegetable and leaves; young fronds, stems and rhizomes of some species are also consumed to treat many diseases (Keller and Prance, 2015). Some species of pteridophytes are used to get relive from stomach pains, fever, colds and headaches, treatments of boil, ulcers and wounds. Some pteridophytes are also used in the time of menstruation, childbirth and as contraceptives. 21 species of pteridophytes were reported to use to treat much disease by local communities of India. A large number of the ferns are also used as ornamental plants for interior as well as outdoor decoration. Pteridophytic species like *Azolla*, *Salvinia* are also used as bio-fertilizer in rice fields.

There are about 12000 species of pteridophytes under 300 genera all over the world. In India more approximately 1000 species of pteridophytes under 191 genera are found (Dixit, 1984), of them 47 species are endemic to India (Fraser-Jenkins, 2008). Being one of the hot-spots of biodiversity, Assam is also rich in pteridophytic diversity. But there was a few systematic studies about the ferns and fern allies and the only account of the flora of the state did not deal with this group of plants. Of late some workers have listed the pteridophytes of some particular area of the state. Total 60 species under 36 genera were observed in Nazira subdivision of Sibsagar District of Assam (Das and Nath, 2012). Total 68 species were reported from Sibsagar district of Assam (Baruwati and Gogoi, 2013). From the Bongaigaon district of Assam 61 species of pteridophytes were reported (Das and Sarkar, 2018). In Bherjan-Borajan-Padumoni Wild life Sanctuary of Assam 33 pteridophytic species belonging to 23 genera were listed (Borah and Barukial, 2021). It is found that the pteridophytic vegetation in Assam is predominantly evergreen and shows a wide range of habitat variation. Terrestrial, epiphytic, climbers, lithophytes, aquatic-all types of pteridophytes occur in this region.

Kaliabor is a subdivision of Nagaon district situated in the middle part of the state of Assam. The area of the subdivision is 947.40 sq. km. The Subdivision includes some reserve forests and some dense private forests. Laokhowa Wild life Sanctuary, Diju Valley Reserve Forest, Bagsar Reserve Forest, Deosurchang Reserve Forest, a part of Kaziranga National Park (Burapahar), Hatimura hill, Trishuldhary hill, Chikoni hill are the main forests situated in Kaliabor Subdivision. These forests were very rich in biodiversity including Pteridophytes. But due to rapid urbanization, antisocial human interference and may be due to changing environment gradually the heritage of rich biodiversity of the areas start to decrease. During the period of 2010-2011 a survey of pteridophytes in the forests of the subdivision were made. The survey revealed the presence of 41 species in the forests of the subdivision.

Considering the trend of rapid urbanization and changing environment (rainfall pattern) the objective of the present work was set to make a comparative study of the pteridophytic diversity of the subdivision during a period of approximately 10 years i.e. between 2010-11 and 2022-23.

2. Material and method

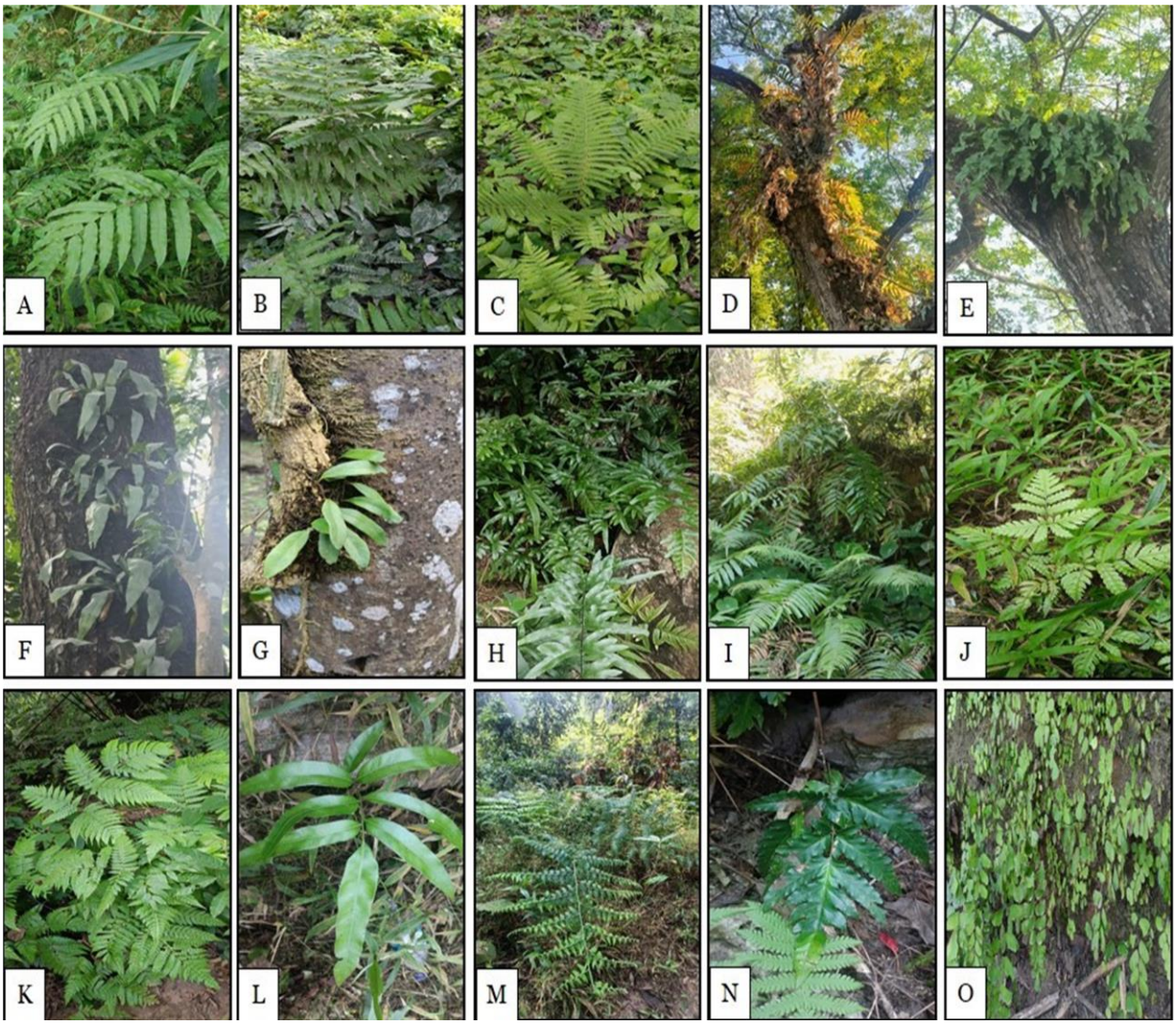

Figure 1. Some pteridophytes of Kaliabor Subdivision. (A)*Angiopteris evecta,* (B) *Diplazium esculantum,* (C) *Christella dantata,* (D) *Christella dantata* (E) *Asplenium nidus,* (F) *Pyrossia sp.,* (G)*Pyrossia sp.,* (H)*Lygodium japonicum,* (I)*Blechnum sp.,* (J)*Dryopteris sp.,* (K)*Dryopteris sp.,* (L) *Pteris ensiformis,* (M)*Pteridium aquilinum,* (N) *Tecteria sp., (O)Adiantum assamicum.*

The present study on the ferns or pteridophytes of Kaliabor Subdivision is based on extensive survey and collection from the forests of Kaliabor Subdivision. The forests included in the survey are-

1. Laokhowa Wild Life Sanctuary
2. Diju Valley Reserve Forest
3. Bagsar Reserve Forest
4. Deosurchang Reserve Forest
5. Burapahar
6. Chikoni Hill
7. Hatimura hill
8. Trishuldhary Hill

The first survey was done during the year 2010-2011 and again during the year 2022-2023 using random sampling method. Number of individuals in a collected spot were not counted.

During collection in the field all the essential data were collected. The collection, pressing and preparation of herbarium specimens were done according to the recommended procedure (Jain and Rao, 1976) and are preserved at the herbarium of Kaliabor College, Nagaon, Assam.

Provisional Identification of the specimens was made with the help of available literature.Rainfall data were collected from the report of Assam State Disaster Management Cell (Flood Memorandum to the Ministry of Home Affairs Government of India on Assam Flood).

3. Result

The survey made during 2010 -2011 revealed the presence of 41 species under 31 genera in the forests of Kaliabor Subdivision (Table 1)

Definition of terminology used for frequency in the Tables
Very Common: Occurring in large number or more than adequate
Common: Occurring in adequate number
Frequent: Number is not much but frequently noticed
Sparsely distributed: Occurring only a few species here and there
Rare: Very rare occurrence.

Table 3 reveals that the pteridophytic diversity of Kaliabor shows a total declination in their distribution. But the tendency of loss is very clear in certain species. Two species lose their existence from the area and many species are following similar path.

The pteridophytic flora though neglected has significant importance due to their ornamental value and medicinal values. During the survey in 2010-2011, about 41 species were found in the forests. The important of them are species like, *Adiantum* (ornamental), *Blechnum* (ornamental), *Lycopodium* (ornamental), *Selaginella* (ornamental), *Gleichenia* (ornamental). Of these species in the survey of 2022-2023 *Angiopteris evecta* (collected sites marked white coloured spots in map) and *Lycopodium clavatum* (marked yellow-coloured spots in map) have been fairly lost and the number of species like *Lygodium, Sellaginella, Pteris, Angiopteris, Adiantum, Pyrrosia* have been reduced significantly. The rest like *Asplenium, Amphineuron, Drymoglossum, Dryopteris, Microsporium, Sphenomeris, Lepisorous, Marsilea, Salvinia,* etc are ecologically important but their numbers are also drastically reduced (Table 4).

The pattern of rainfall in peak rainy season (i.e. from June to September) of Nagaon district from 2010 was also studied (Table 5). This may be attributed to shrinkage of habitat due to rapid urbanization and the changing pattern of rainfall.

4. Discussion

Table 5 shows that there is a vast deviation of the rainfall from the expected actual rainfall during the period. It is clearly observed that out of 14 years (from 2010 to 2023) only 5 year (2010, 2012, 2013,2014 and 2015) have some amount of surplus amount of rainfall but in all other years there is deficit of rainfall and the deficit is being increased from 2016 to 2023. In 2016 the deficit of rainfall was 32% and in 2023 it becomes 58%.

The increasing population leads to the rapid urbanization which in turn reduces forest cover of the district. The total area of humid forest in Nagaon district decreased by 3. 9% during 2002-2023 (https://www.globalforestwatch.org).

From 2002 to 2023, Nagaon district lost 896 ha of humid primary forest, making up 14% of its total tree cover loss. Total area of humid primary forest in Nagaon decreased by 3.9% in this time period (https://www.globalforestwatch.org). The loss of primary forests is mainly due to the process of urbanization. Apart from the construction of residential buildings different industries are also being constructed at the cost of natural forests. It is also noticed that the amount of rainfall in the area gradually decreased. The decreased amount of rainfall touched as many as 58%. Process of urbanization and decreasing trend of rainfall may lead to the loss of different plant diversity of the area. In the present study it is noticed that over a period of 10 years two species of pteridophytes - *Angiopteris evecta* and *Lycopodium clavatum* have been lost from the area. Mean time the number of species like *Lycopodium, Sellaginella, Pteris, Angiopteris, Adiantum, Pyrrosia, Asplenium, Amphineuron, Drymoglossum, Dryopteris, Microsporium, Sphenomeris, Lepisorous, Marsilea, Salvinia*, etc are drastically reduced. These losses and decrease in number of pteridophytic species in Kaliabor Subdivision may be due to habitat loss, a result of urbanization and decreasing trend of rainfall pattern.

5. Conclusion

If the sustainability of Kaliabor as a biodiversity hot spot is to be considered, the importance of these plants cannot be ignored. As there is very sparse work on loss of biodiversity, loss of pteridophytes may ring alarm bell for conservation of biodiversity in this fringe area of Kaziranga. This work can serve as a basis to raise awareness among the people so that whenever any construction is planned or any use of large land area for development, the importance of the plant species not only the pteridophytes but also the others should be considered as a top-level priority in any fringe area of rich biodiversity.

Authors' contributions

Both the authors have equal contribution in this research paper

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Table 1. Distribution of pteridophytic Flora in Kaliabor Sub division during the year 2010-2011. Very Common-Occurring in large number or more than adequate, Common-Occurring in adequate number, Frequent- Number is not much but frequently noticed, sparsely distributed -Occurring only a few species here and there, Rare-Very rare occurrence.

Sl. No	Name of the Taxa (Species/ Variety)	Vernacular/ Common Name (Ass=Assamese, Eng=English)	Laokhowa	Diju Valley	Baghchar	Deochur	Burapahar	Chikanihill	Hatimura	Trishuldhay hill	Frequency	Occurrence
1	*Adiantum assamicum*. Nyar	Khoj Kada Dhekia (Ass)	+	+	+	+	+	+	+	+	Common	Along Roadside and Foot Hill
2	*Adiantum phillipense* L.	Khoj Kada Dhekia (Ass)	+	+	+	+	+	+	+	+	Very Common	Moist Shady Place
3	*Angiopteris evecta* (Forst)Hoffm		+	+	+	+	+	+	+	+	Common	Dense natural forest
4	*Asplenium nidus* L.	Bird's Nest Fern (Eng)	+			+	+		+		Rare	Tree trunk
5	*Ampelopteris prolifera* Retz.		+	+	+	+	+	+	+	+	Very Common	Wet low lands
6	*Amphineuron esculantum* Retz.	Bihlongoni (Ass)	+	+	+	+	+	+	+	+	Very Common	Along forest edges
7	*Azolla pinata* R.Br,		+	+	+	+	+	+	+	+	Common	Paddy Field and stagnent water
8	*Blechnum orientale* L.		+	+	+	+	+	+	+	+	Very Common	Moist and shady forest edge
9	*Christella sp*.		+	+	+						Frequent	Open dry places
10	*Ctenitopsis fuscipes* Wall. Ex Bedd.		+	+	+						Common	Moist shady places
11	*Dicranopteris linearis* var. Altisima Holttum.	Kap Dhekia (Ass)		+			+				Sparsely distributed	Hill slopes
12	*Diplazium esculantum* Retz.	Dhekia Sak (Ass)	+	+	+	+	+	+	+	+	Very common	Moist area
13	*Diplazium muricatum* Mett.		+	+	+	+	+	+	+	+	Common	Moist area as well as sunny places
14	*Drynaria quercifolia* L.		+	+	+	+	+	+	+	+	Very common	Shady as well as exposed tree trunks
15	*Drymoglossum heterophullum* L		+	+	+	+	+	+	+	+	Frequent	Tree trunks
16	*Drymoglossum piloselloids* L.		+	+	+	+	+	+	+	+	Common	Tree trunks
17	*Dryopteris sparsa* Bush-Hm ex D' Don		+	+	+	+	+	+	+	+	Frequent	Moist shady places along the slope of roads
18	*Equisetum diffusum* Don		+				+				Sparsey distributed	Sandy riverside
19	*Gleichania volubilis* Jungh			+	+		+				Common in some areas	Along the side of forest roads
20	*Lycopodium clavatum* L.						+				Rare	Along the hillside
21	*Lygodium japonicum* (Thunb) Sw.	Kapou lota (Ass)	+	+	+	+	+	+	+	+	Common	Moist places twining on bushes.
22	*Lepisorous thunbergianus* (Kulf) Ching.		+	+	+	+	+	+	+	+	Common	Moist shady tree trunks
23	*Lindsaea odorata* Rxb.		+	+	+						Common	Bank of partially shaded stream and roadside
24	*Marsilea minuta* L.		+	+	+	+	+	+	+	+	Common	Swamp areas and along the side of water bodies
25	*Macrothalipteris ornate* (Wall.ex Bedd) Ching			+	+	+	+			+	Common	Along the side of forest roads

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Sl. No	Name of the Taxa (Species/ Variety)	Vernacular/ Common Name (Ass=Assamese, Eng=English)	Laokhowa	Diju Valley	Baghchar	Deochur	Bura pahar	Chikani hill	Hatimura	Trishuldhay hill	Frequency	Occurrence
26	*Microsporium punctatum* L.	Mirioni mura (Ass.)	+	+	+	+	+	+	+	+	Very common	Shady tree trunks, moist rock surface.
27	*Microsporium membranaceum* D.Don			+	+					+	Common	Moist humas covered rocks along riverside
28	*Microlepia speluncae* (L.) Moore			+	+						Frequent	Tree trunks
29	*Ophioglossum reticulatum* L.	Libha (Ass.)	+	+	+	+	+	+	+	+	Frequent	Sandy soil among grasses
30	*Pteris ensiformis* L.		+	+	+	+	+	+	+	+	Frequent.	Humas rich forest floor
31	*Pteris vittata* L.		+	+	+	+	+	+	+	+	Common	
32	*Pteris cretica* L.		+	+	+	+	+	+	+	+	Common	Dry floor of forest an along roadside
33	*Pteris quadriaurita* Retz.		+	+	+	+	+	+	+	+	Common	Shady places
34	*Pyrresia adnascens* Sw.	Son-chokolia (Ass.)	+	+	+	+	+	+	+	+	Very common	Tree trunk as epiphyte.
35	*Pyrrosia varia* Kaulf.		+	+	+	+	+	+	+	+	Common	Tree trunk as epiphyte.
36	*Pyrrosia nummulariifolia* (Sw.)Ching		+	+	+	+	+	+	+	+	Common	Tree trunk as epiphyte.
37	*Salvinia cucullata* Roxb.		+	+	+	+	+	+	+	+	Very Common	Pond and paddy fields
38	*Selaginella reticulata* (Hook. & Grev) Spring		+	+	+	+	+	+	+	+	Very common	Open sunny area or as lithophytes
39	*Sphenomeris chinensis* L.		+	+	+	+	+	+	+	+	Common	Forest edge and radside
40	*Tecteria devexa* Kuntze.		+	+	+		+			+	Common	Moist shady places
41	*Tecteria variolosa* (Wall. ex Hook.) C.Chr.		+	+	+		+			+	Common	Moist Shady Places

Table 2. Genus wise species diversity in Kaliabor.

Sl. No.	Genus	Species	Number of species
1	Adiantum	*Adiantum assamicum* Nyar	2
		Adiantum phillipense L.	
2	Angiopteris	*Angiopteris evecta* (Forst)Hoffm	1
3	Aspelnium	*Aspelnium nidus* L.	1
4	Ampelopteris	*Ampelopteris prolifera* Retz.	1
5	Amphineuron	*Amphineuron esculantum* Retz.	1
6	Azolla	*Azolla Pinata* R.Br	1
7	Blechnum	*Blechnum orientale* L.	1
8	Christella	*Christella Sp.*	1
9	Ctenitopsis	*Ctenitopsis fuscipes* Wall. Ex Bedd.	1
10	Dicranopteris	*Dicranopteris linearis* var. Altisima Holttum.	1
11	Diplazium	*Diplazium esculantum* Retz.	2
		Diplazium muricatum Mett.	
12	Drynaria	*Drynaria quercifolia* L.	1
13	Drymoglossum	*Drymoglossum heterophullum* L	2
		Drymoglossum piloselloids L.	
14	Dryopteris	*Dryopteris sparsa* Bush-Hm ex D' Don	1
15	Equisetum	*Equisetum diffusum* Don	1
16	Gleichania	*Gleichania volubilis* Jungh	1
17	Lycopodium	*Lycopodium sp.*	1
18	Lygodium	*Lygodium japonicum* (Thunb) Sw.	1
19	Lepisorous	*Lepisorous thunbergianus* (Kulf)	1
20	Lindsaea	*Lindsaea odorata* Rxb.	1
21	Marsile	*Marsilea minuta* L.	1
22	Macrothalipteris	*Macrothalipteris ornate* (Wall.ex Bedd) Ching	1
23	Microsporium	*Microsporium punctatum* L.	2
		Microsporium membranaceum D.Don	
24	Microlepia	*Microlepia speluncae (*L.) Moore	1
25	Ophioglossum	*Ophioglossum reticulatum* L.	1
26	Pteris	*Pteris ensiformis* L.	4
		Pteris vittata L.	
		Pteris cretica L.	
		Pteris quadriaurita Retz.	
27	Pyrresia	*Pyrresia adnascens* Sw.	3
		Pyrrosia varia Kaulf.	
		Pyrrosia nummulariifolia (Sw.) Ching	
28	Salvinia	*Salvinia cucullata* Roxb.	1
29	Selaginella	*Selaginella reticulata* (Hook. & Grev) Spring	1
30	Sphenomeris	*Sphenomeris chinensis* L.	1
31	Tecteria	*Tecteria devexa* Kuntze.	2
		Tecteria variolosa (Wall. Ex Hook.) C.Chr.	

Table 3. Distribution of pteridophytic Flora in Kaliabor Subdivision During 2022-2023. Very Common-Occurring in large number or more than adequate, Common-Occurring in adequate number, Frequent- Number is not much but frequently noticed, Sparsely Distributed-Occurring only a few species here and there, Rare-Very rare occurrence.

Sl. No.	Species	Laokhowa	Diju Valley	Bagsar	Deosurchang	Bura pahar	Chikoni Hill	Hatimura	Trishuldhay Hill	Frequency	Occurrence
1	*Adiantum assamicum* Nyar	+	+	+	+	+	+	+	+	Common	Along Roadside and Foot Hill
2	*Adiantum phillipense* L.	+	+	+	+	+	+	+	+	Very Common	Moist Shady Place
3	*Asplenium nidus* L.	+			+	+		+		Rare	Tree trunk
4	*Ampelopteris prolifera* Retz.	+	+	+	+	+	+	+	+	Very Common	Wet low lands
5	*Amphineuron esculantum* Retz.	+	+	+	+	+	+	+	+	Very Common	Along forest edges
6	*Azolla Pinata* R.Br,	+	+	+	+	+	+	+	+	Common	Paddy Field and stagnent water
7	*Blechnum orientale* L.	+	+	+	+	+	+	+	+	Very Common	Moist and shady forest edge
8	*Christella sp*.	+	+	+						Frequent	Open dry places
9	*Ctenitopsis fuscipes* Wall. ex Bedd.	+	+	+						Common	Moist shady places
10	*Dicranopteris linearis* var. Altisima Holttum		+			+				Sparsely distributed	Hill slopes
11	*Diplazium esculantum* Retz.	+	+	+	+	+	+	+	+	Very common	Moist area
12	*Diplazium muricatum* Mett.	+	+	+	+	+	+	+	+	Common	Moist area as well as sunny places
13	*Drynaria quercifolia* L.	+	+	+	+	+	+	+	+	Very common	Shady as well as exposed tree trunks
14	*Drymoglossum heterophullum* L	+	+	+	+	+	+	+	+	Declining	Tree trunks
15	*Drymoglossum piloselloids* L.	+	+	+	+	+	+	+	+	Common	Tree trunks
16	*Dryopteris sparsa* Bush-Hm ex D' Don	+	+	+	+	+	+	+	+	Frequent	Moist shady places along the slope of roads
17	*Equisetum diffusum* D.don					+				Rare	Sandy riverside
18	*Gleichania volubilis* Jungh		+							Lost in two areas	
19	*Lygodium japonicum* (Thunb) Sw.	+	+	+				+	+	Rare	Moist places twining on bushes.
20	*Lepisorous thunbergianus* (Kulf) Ching	+	+	+	+	+	+	+	+	Common	Moist shady tree trunks

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Sl. No.	Species	Laokhowa	Diju Valley	Bagsar	Deosurchang	Bura pahar	Chikoni Hill	Hatimura	Trishuldhay Hill	Frequency	Occurrence
21	*Lindsaea odorata* Roxb.	+	+	+						Common	Bank of partially shaded stream and roadside
22	*Marsilea minuta* L.	+	+	+	+	+	+	+	+	Common	Swamp areas and along the side of water bodies
23	*Macrothalipteris ornate* (Wall.ex Bedd) Ching		+	+	+	+			+	Common	Along the side of forest roads
24	*Microsporium punctatum* L.	+	+	+	+	+	+	+	+	Very common	Shady tree trunks, moist rock surface.
25	*Microsporium membranaceum* D.Don		+	+					+	Common	Moist humas covered rocks along riverside
26	*Microlepia speluncae* (L.) Moore		+	+						Frequent	Tree trunks
27	*Ophioglossum reticulatum* L.	+	+	+	+				+	Rare	Sandy soil among grasses
28	*Pteris ensiformis* L.	+	+	+	+	+	+	+	+	Frequent.	Humas rich forest floor
29	*Pteris vittata* L.	+	+	+	+	+	+	+	+	Common	
30	*Pteris cretica* L.	+	+	+	+	+	+	+	+	Common	Dry floor of forest an along roadside
31	*Pteris quadriaurita* Retz.	+	+	+	+	+	+	+	+	Common	Shady places
32	*Pyrresia adnascens* Sw.	+	+	+	+	+	+	+	+	Very common	Tree trunk as epiphyte.
33	*Pyrrosia varia* Kaulf.	+	+	+	+	+	+	+	+	Common	Tree trunk as epiphyte.
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35	*Salvinia cucullata* Roxb.	+	+	+	+	+	+	+	+	Very Common	Pond and paddy fields
36	*Selaginella reticulata* (Hook. & Grev) Spring	+	+	+	+	+	+	+	+	Frequent	Open sunny area or as lithophytes
37	*Sphenomeris chinensis* L.	+	+	+	+	+	+	+	+	Common	Forest edge and radside
38	*Tecteria devexa* Kuntze.	+	+	+		+			+	Common	Moist shady places
39	*Tecteria variolosa* (Wall. Ex Hook.) C.Chr.	+	+	+		+			+	Common	Moist Shady Places

Table 4. Comparison of Presence of depleting Species.

Sl. No.	Species	Status of Distribution	Present in Study area (2010-2011)	Status of Distribution	Present in Study area (2022-2023)
1	*Adiantum philippense* L	Very common	Laokhowa, Diju Valley, Bagsar,Deosurchang,Bura pahar, Chikoni Hill, Hatimura Hill, Trishuldhary Hill.	Common	Laokhowa, Diju Valley, Bagsar,Deosurchang,Bura pahar, Chikoni Hill, Hatimura Hill, Trishuldhary Hill.
2	*Angiopteris evecta* (Hrost)Hoffm	Common	Laokhowa, Diju Valley, Bagsar,Deosurchang,Bura pahar, Chikoni Hill, Hatimura Hill, Trishuldhary Hill.	Lost	Lost from all areas
3	*Drymoglossum heterophyllum* L.	Frequent		Declining	Declining in all areas
4	*Equisetum diffusum* Don	Sparsely distribute	Laokhowa, Bura pahar	Rare occurrence	Lost in Laokhowa
5	*Gleichenia vulubis* Jungh.	Not common	Diju Valley, Bagsar, Bura pahar.	Rare	Lost in two areas Bagsar Bura pahar
6	*Lycopodium clavatum* L.	Rare observed only in one area	Bura pahar	Lost	Lost
7	*Lygodium japonicum* (Thunb) Sw.	Common	Laokhowa, Diju Valley, Bagsar,Deosurchang,Hatimura ,Hill, Chikoni Hill, Trishuldhary Hill.	Rare	Lost in two area Chikoni Hill, Hatimura Hill
8	*Ophioglossum reticulutum* L.	Frequent	Laokhowa, Diju Valley, Bagsar,Deosurchang,Bura pahar, Chikoni Hill, Hatimura ,Hill, Trishuldhary Hill	Rare	Lost in Chikoni Hill, Hatimura Hill, Trishuldhary Hill
9	*Pteris ensiformis* L.	Frequent	Laokhowa, Diju Valley, Bagsar,Deosurchang,Bura pahar, Chikoni Hill, Hatimura ,Hill, Trishuldhary Hill	Declining	Although found in all areas population declines.

Table 5. Rainfall data of last 14 years in Nagaon District (June to September) in mm. (Source: Flood Memorandum to the Ministry of Home Affairs Government of India on Assam Flood).

Year	Duration of Rainfall	Actual Rainfall (A)	Normal Rain Fall (N)	Deviation (D) % D = (A - N) / N x 100
2010	1st June to 30th September	1422.6	1031.3	+38
2011	1st June to 30th September	1023.2	1031.3	-.78
2012	1st June to 30th September	1260.2	1031.3	+22
2013	1st June to 30th September	1241	1031.3	+20
2014	1st June to 30th September	1142	1031.3	+10
2015	1st June to 30th September	1063	1031.3	+3
2016	1st June to 30th September	750	1109.7	-32
2017	1st June to 30th September	874.2	1124.9	-22
2018	1st June to 30th September	734.5	1031.3	-29
2019	1st June to 30th September	649.7	1031.3	-37
2020	1st June to 30th September	523.5	1031.3	-49
2021	1st June to 30th September	538.6	1031.3	-48
2022	1st June to 30th October	470	956.1	-54
2023		431	1031.3	-58