

Checklist of pteridophytes from the district Jalpaiguri, West Bengal, India

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ABSTRACT

Pteridophyte is a major plant group that has great ecological significance. They can be found in various environments, including aquatic, epiphytic, lithophytic, and terrestrial. They can be found in their native state in open areas, alone, or in groups with other plants. District Jalpaiguri, which is situated in the northern part of West Bengal, is a well-appreciated biodiversity region of the Indian subcontinent. The rich and diverse vegetation in the area is a testament to the many unique ecological niches it has. However, the plant explorers in the region have not given enough attention to this particular group of plants due to the challenges associated with identifying the species. To fill the gap, we have conducted the present investigation to prepare a checklist of the area. This study aims to connect and showcase the wide range of intriguing species in this enigmatic group, catering to the interests of pteridologists. Among the studied species, 40 species were terrestrial, 18 species were lithophytic, 19 species were epiphytic, and 9 species were aquatic.

1. INTRODUCTION

Pteridophytes are one of the neglected plant groups that form a prominent part of the earth's vegetation. They create a connecting link between non-vascular lower group plants and the higher group seed-bearing plants. Members of the group have immense economic and ecological significance. Although 250 million years ago pteridophytes constituted the majority of the flora of the planet, thereafter they were mostly left behind by seed-bearing plants [1]. Pteridophytes, comprising Polypodiopsida and Lycopodiopsida (including *Selaginella*), are the second most extensive assemblage of vascular plants, encompassing over 11,916 documented species that belong to 337 genera under 51 families and 14 orders [2]. While their typical distribution is in damp, shady environments like the understory of rainforests, certain species also inhabit rocky terrains and grow as epiphytes in the canopies of forests. As pteridophytes are so sensitive to changes in environmental factors like humidity and sunshine intensity, they may serve as signs of climatic change and

other environmental disturbances [3]. They are important contributors to several biodiversity-rich regions. To gain a deeper comprehension of any ecosystem, it is crucial to examine the phytosociological characteristics and diversity patterns of each community within these ecological settings [4]. The habitat of numerous pteridophytic species in several conserved areas and biodiversity regions was destroyed by anthropogenic activities. Furthermore, infrastructure building, road expansion, and tourism have been observed to negatively impact these populations. In the few decades, many researchers have set their goal in this direction and conducted many phyto-sociological and ecological surveys in forests and biodiversity regions. Regular and systematic documentation of any plant group is required to evaluate its status. The pteridophytes are a paraphyletic group of plants consisting of six extant classes, viz., Lycopodiopsida, Equisetopsida, Psilotopsida, Ophioglossopsida, Marattiopsida, and Filicopsida [5-7] or four extant classes, viz., Psilotatae, Lycopodiatae, Equisetatae, and Filicatae [8]. During the last few decades, the conception of studies on pteridophytes has undergone incredible innovation in comparison to any other group of plants. Many new species and taxa have been reported during the last few decades from several regions [9-14] of the globe. Like most of the biodiversity-rich regions, the Indian subcontinent was also explored by several workers in the context of pteridophytic flora. Some of these are: A Handbook to the Ferns of British India, Ceylon, and the Malay Peninsula [15], The Ferns of Bombay [16], and a Census of the Indian Pteridophytes [17]. Pteridophyte flora of the Western Ghats-South

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India [18], Companion to a Census of Indian Pteridophytes [19]. An illustrated Fern Flora of West Himalaya [20], Taxonomic Revision of Three Hundred Indian Sub-continental Pteridophytes [21], A Summary of the Status of Threatened Pteridophytes of India [22], Fern and Fern-Allies of Nepal, and Satara District. Maharashtra [23-25], Annotated Checklist of Indian Pteridophytes parts I, II, and III [26-28]. Some of the researchers prefer the documentation of a region-based or district-based checklist of respective plant groups for a better understanding of their ecological and taxonomical situation.

District Jalpaiguri is one of the biodiversity-rich regions that is situated in the northern part of the Indian state of West Bengal [29]. The district of Jalpaiguri, depicted in Figure 1, is located between latitudes 26°15'47" and 26°59'34" N, and longitudes 88°23'2" and 89°7'30" E. It encompasses altitudinal ranges ranging from 100 ft to 3000 ft above sea level, with an average rainfall of 3000 mm per year. It shares international borders with Bhutan and Bangladesh in the north and south respectively, and borders with Darjeeling Hills in the west and northwest; Alipurduar district and Cooch Behar district on the east [30-33]. Phytogeographically, it is located at the foothills of Eastern Himalaya and shares a diverse habitat, including forest patches and riverine zones [34]. Although Teesta, Mahananda, and Jaldhaka are the three main rivers of the district Jalpaiguri but several tributaries (Chel, Ghees, Dharala, Karola, Mal, Duduwa, Kartowa, Panga, etc.) of the three rivers thoroughly dissected the district topography. India possesses a diverse and abundant collection of pteridophytic plants, which can be attributed to its origin in Gondwanaland and subsequent movement from the southern hemisphere toward Eurasia [35]. This migration brought with it the ancestors of today's pteridophytes from regions such as Australia, Africa, and Madagascar, as well as potentially unique species that are native to India. That is why several workers have conducted taxonomic enumeration of pteridophytes in several districts of India, especially in the districts that are close to the Himalayan Mountain range [36-42]. As the district Jalpaiguri is in the foothills of range, it has gained much attention from several researchers. Among the 23 districts of West Bengal, the pteridophyte flora of some districts, like Darjeeling [43], Nadia [44], Birbhum [45], Howrah [46], Burdwan [47], Hooghly [48], Sundarban [49], Purulia [50], Coochbehar [51,52] was well documented. Though some workers have surveyed some parts of Jalpaiguri [53-55], there is still lack of comprehensive study on pteridophyte flora in the district. In addition, the nomenclature of the ferns has changed significantly in recent times. Therefore, to provide an updated and more or less complete list of ferns in the district, the present work has been undertaken. Due to the lack of adequate information, there is a need for study and documentation on the distribution, floristics, and diversity of pteridophytes in this district. This is relevant because of the ecological and ethnobotanical value of these plants in the region. Therefore, an initiative was set up to describe and conserve the ferns and fern allies in this area.

2. MATERIALS AND METHODS

Pteridophyte specimens were procured from nine blocks within the districts. The vegetation survey was conducted from January 2019 to January 2024. Some excursions were conducted in the blocks of the district during this period. Fresh specimen collections have been conducted from various locations, encompassing all nine blocks inside the aforementioned district of the state of West Bengal. A wide range of pteridophytes, encompassing those that thrive on terrestrial surfaces, rocky surfaces, plant bodies and aquatic environments, have been recorded. The diagnostic characteristics of all the specimens

were examined, and detailed field notes were recorded on fresh plant materials. Accurate photographs were captured for each of the species. Field notes were taken, including ecological data, habit, habitat, and diagnostic features of each species. Specimens were identified via taxonomic keys as well as descriptions from taxonomic literature and Pteridophyte flora [26-28, 56-74] and compared with digital images of vouchers and type-specimens deposited in various herbaria. Several experts were also consulted. The collected specimens have been deposited in the Botanical Survey of India (BSI) Arunachal Pradesh Regional Centre (ARUN!) and Herbarium (Dept. of Life Science), Govt. Model School, Mal (GMSMH), Jalpaiguri. GeoCAT [75] is also used to help assess the Extent of Occurrence (EOO) and the Area of Occupancy (AOO) of the collected taxa in Jalpaiguri, West Bengal (India).

3. SYSTEMATIC TREATMENT KEY TO FAMILIES

- A. Leaves simple; veins unbranched..... B
- A. Leaves complex; veins branched..... D
- B. Leaves in whorls, forming sheath at nodes; stem hollow and grooved 3. Equisetaceae
- B. Leaves spirally arranged without forming whorls; stem solid and smooth C
- C. Plants heterosporous.....2. Selaginellaceae
- C. Plants homosporous 1. Lycopodiaceae
- D. Fronds usually have indefinite growth due to the presence of dormant vegetative buds on the main rachis 8. Gleicheniaceae
- D. Fronds 100–200 cm long, dichotomously pinnate; pinnae palmately lobed; sori arranged on finger like projections on lamina margin 6. Lygodiaceae
- E. Spikes are simple and solitary4. Ophioglossaceae
- E. Spikes are not simple but branched F
- F. Plant epiphytes; lamina simple 14. Vittariaceae
- F. Plants terrestrial; lamina one or more pinnate G
- G. Indusium bilipped, marginal H
- G. Indusium can be cup-shaped arises around the base of the sorus, leaves large, up to 5 m spores tetrahedral 10. Cyatheaceae
- H. Frond large, thick; sori terminal or submarginal, falsely indusiate or indusiate; indusium not tubular or bilipped I
- H. Fronds pinnate or bipinnate, glabrous; indusia single 13. Pteridaceae
- I. Rhizome non-tuberous J
- I. Rhizome hairy or scaly or fibrillose K
- J. Rhizome scaly or fibrillose; veins free, but vein ends tend to anastomose 21. Lindsaeaceae
- J. Rhizome hairy; veins free or reticulate; sori submarginal at vein ends 11. Dennstaedtiaceae
- K. Lamina pinnately decompound, finely dissected; sori terminal on veins or submarginal 20. Davalliaceae
- K. Lamina simple, lanceolate, margin entire; sori close to midrib to form a row on either side close to costae 19. Oleandraceae

- L. Plants are usually epiphytes or lithophytes; sori exindusiate but are protected by paraphyses M
- L. Plants terrestrial; sori protected by an indusium, rarely exindusiate N
- M. Stipes articulate to a short phyllopodium 9. Polypodiaceae
- M. Stipes generally scaly and fibrillose; lamina glabrous or scaly or fibrillose; rachis prominently grooved 18. Dryopteridaceae
- N. Sori elongated, either discrete or forming continuous coenosori on a secondary vein, close and parallel to the costa or costule, superficial or sunken; indusia flap-like 21. Blechnaceae
- N. Sori not forming coenosori, superficial; indusial shape like the sori P
- P. Stipes, rachis, and lamina are generally hairy; hairs are uniseriate, unicellular, or septate, multiseriate hairs are absent; scales have unicellular hairs on the surface or margin 16. Thelypteridaceae
- P. Stipe, rachis, and hairy but also with multiseriate fibrils or scales glabrous Q
- Q. Rhizome scales clathrate; sori generally on one side of vein 15. Aspleniaceae
- Q. Rhizome scales non-clathrate; sori generally on both sides of vein R
- R. Sori sessile S
- S. Sori round; indusial globose 17. Woodsiaceae
- S. Sori linear along veins and eventually acrostichoid 5. Marattiaceae
- T. Plants are natant or floating U
- T. Plants are rooted within aquatic body 7. Marsileaceae
- U. Three leaves in a whorl on a rootless rhizome 23. Salviniaceae
- U. Two rows of bilobed leaves on a root-bearing rhizome 22. Azollaceae

4. RESULTS AND DISCUSSION

The current effort is the result of a five-year-long, comprehensive field study conducted throughout the area. The current study reported the presence of 86 species of pteridophytes (Plates 1-7) from 23 families [Figure 2]. Among the collected species, 19 belong to Pteridaceae, while 12 belong to Polypodiaceae. Due to the extensive range of soil

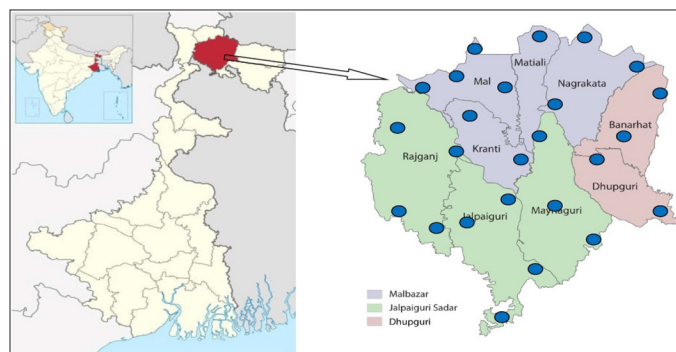


Figure 1: Location of study sites in Jalpaiguri, West Bengal, India.

and climate variations, as well as the diverse range of habitats such as rivers, swamps, forests, cultivated fields, orchards, meadows, etc., a wide variety of land plants. Among the studied species, 40 were terrestrial, 18 species were lithophytic, 19 species were epiphytic, and 9 species were aquatic [Figure 3]. Epiphytic ferns, or fern-allies grow on the base platforms of several trees. Some common tree species that serve as hosts for pteridophytes include *Alstonia scholaris* R. Br., *Shorea robusta* Gaertn., *Lagerstromia speciosa* Pers., *Samanea saman* (Jacq.) Merr., *Butea monosperma* (Lam.) Taub., *Mangifera india* L., *Syzygium cumini* (Linn.) Skeels, *Terminalia belerica* Roxb., *Amoora rohituka* W. & A, *Sterculia villosa* Roxb etc. The ecological distributional survey of the ferns and fern allies in the Jalpaiguri district is of great significance due to its richness and conservation value. This has attracted numerous researchers in the past and present. Pteridophytes make up a significant portion of plant diversity and are renowned for having exquisite leaf fronds. The following are comprehensive descriptions of the pteridophytes discovered in the study area, arranged according to C. R. Fraser-Jenkins [76].

5. CHECKLIST OF PTERIDOPHYTE (FERNS AND FERN-ALLIES) OF JALPAIGURI DISTRICT

FERN-ALLIES

1. LYCOPODIACEAE

- Huperzia squarrosa* (Froster) Trevisan: Epiphytic. Khumai, Chalsa (Matiali). Elevation: ca. 150-250 m.
Material: *M Dey* MD025/21, 28/07/2021 (ARUN!), *M Dey* H1104 (GMSMH).
- Huperzia phlegmaria* (L.) Rothm.: Epiphytic. Chalsa view point, Matiali bazar. Elevation: ca. 300-350 m.
Material: *M Dey & A K Soni* MD015/21, 28/07/2021 (ARUN!), *M Dey* H1101 (GMSMH).
- Lycopodium japonicum* Thunberg.: Terrestrial. Bagrakote Goodricke Tea garden (Mal), Jiti Tea Garden. Elevation: ca. 280-370 m.
Material: *M Dey & A K Soni* MD008/20, 23/01/2020 (ARUN!), *M Dey* E0144 (GMSMH).
- Lycopodiella cernua* (L.) Pich. Sermolli: Terrestrial, Epiphytic. Odlabari, Chamurchi, Belakoba, Jalpaiguri town. Elevation: ca. 100-200 m.
Material: *M Dey* MD144/20, 23/10/2020 (ARUN!), *M Dey* E2041 (GMSMH).

2. SELAGINELLACEAE

- Selaginella monospora* Spring.: Lithophytic, marshy habitat-alongside the tea garden canal. Raipur tea garden; Panikauri (Fatapukur), Nathua (Dhupguri). Elevation: ca. 50-100 m.
Material: *M Dey & A K Soni* MD057/20, 24/05/2020 (ARUN!), *M Dey* C4209 (GMSMH).
- Selaginella repanda* (Desv. ex Poir.) Spring.: Lithophytic, Terrestrial. Denguajhar tea garden, Raipur-Joypur tea garden; Borodighi tea garden, Bagrakote, Nagrakata. Elevation: ca. 50-100 m.
Material: *M Dey & A K Soni* MD019/19, 01/05/2019 (ARUN!), *M Dey* A0068 (GMSMH).

2.3 *Selaginella bisulcata* Spring.: Lithophytic. Matiali Tea garden, Matiali bazar. Elevation: ca. 350 m.
Material: *M Dey* MD031/20, 03/05/2020 (ARUN!), *M Dey* C2211 (GMSMH).

2.4 *Selaginella chrysocaulos* (Hooker & Greville) Spring.: Lithophytic. Dumdim (Mal), Samsing. Elevation: ca. 300 - 450 m.
Material: *M Dey & A K Soni* MD014/20, 23/01/2020 (ARUN!), *M Dey* B1210 (GMSMH).

2.5 *Selaginella ciliaris* (Retz.) Spring.: Lithophytic, marshy habitat-alongside the tea garden canal. Odlabari tea garden, Apalchad forest. Elevation: ca. 250 m.
Material: *M Dey* MD089/23, 20/02/2023 (ARUN!), *M Dey* C2320 (GMSMH).

2.6 *Selaginella subdiaphana* (Wallich ex Hooker & Greville) Spring.: Lithophytic. Khumai, Sevoke. Elevation: ca. 200-250 m.
Material: *M Dey & A K Soni* MD041/21, 15/08/2021 (ARUN!), *M Dey* H1714 (GMSMH).

3. EQUISETACEAE

3.1 *Equisetum ramosissimum* Desf.: Semi aquatic, Marshy habitat. Model school campus (Kranti), Sevoke. Elevation: ca. 150 m.
Material: *M Dey & A K Soni* MD015/20, 26/01/2020 (ARUN!), *M Dey* G2320 (GMSMH).

3.2 *Equisetum arvense* Linn. subsp. *Diffusum* (D. Don) Fraser-Jenkins: Semi aquatic. Sevoke. Elevation: ca. 250 m.
Material: *M Dey* MD042/22, 15/08/2022 (ARUN!), *M Dey* W1110 (GMSMH).

FERNS

4. OPHIOGLOSSACEAE

4.1 *Helminthostachys zeylanica* (L.) Hook.: Terrestrial, marshy habitat. Moraghat, Ramsai. Elevation: ca. 90 m.
Material: *M Dey* MD668/22, 10/07/2022 (ARUN!), *M Dey* V0615 (GMSMH).

4.2 *Ophioglossum reticulatum* Linn.: Terrestrial. Jalpaiguri Sonali Girls school campus; A.C. College playground. Elevation: ca. 80 m.
Material: *M Dey & A K Soni* MD010/19, 19/04/2019 (ARUN!), *M Dey* A0847 (GMSMH).

5. MARATTIACEAE

5.1 *Angiopteris crassipes* Wall. Ex C. Presl.: Terrestrial, shade loving habitat. Targhera forest, Apalchad forest. Elevation: ca. 140 m.
Material: *M Dey & A K Sarkar* MD049/24, 24/03/2024 (GMSMH).

6. LYGODIACEAE

6.1 *Lygodium flexuosum* (L.) Sw.: Terrestrial. Lataguri forest, Murti beat, throughout the district. Elevation: ca. 80- 300 m.
Material: *M Dey & A K Soni* MD025/19, 29/05/2019 (ARUN!), *M Dey* A2568 (GMSMH).

6.2 *Lygodium japonicum* (Thunb. in Murray) Sw.: Terrestrial. Samsing. Elevation: ca. 350 m.
Material: *M Dey* MD109/19, 18/09/2019 (ARUN!), *M Dey* A3004 (GMSMH).

6.3 *Lygodium microphyllum* (Cav.) R. Br.: Terrestrial. Khumai. Elevation: ca. 300 m.
Material: *M Dey & A K Soni* MD095/19, 08/09/2019 (ARUN!), *M Dey* A2898 (GMSMH).

7. MARSILEACEAE

7.1 *Marsilea minuta* L.: Aquatic. Boulbari, Singimari, Paharpur more. Elevation: ca. 80 m.
Material: *M Dey* MD027/19, 29/05/2019 (ARUN!), *M Dey* A1844 (GMSMH & NBUH).

8. GLEICHENIACEAE

8.1 *Dicranopteris linearis* (Burm. f.) Underw.: Terrestrial. Denguajhar tea garden. Elevation: ca. 100 – 300 m.
Material: *M Dey & A K Soni* MD009/19, 30/03/2019 (ARUN!), *M Dey* A0241 (GMSMH).

9. POLYPODIACEAE

9.1 *Microsorium cuspidatum* (D. Don) Tagawa: Epiphytic. Meteli, Khumai, Samsing. Elevation: ca. 300-400 m.
Material: *M Dey & A K Soni* MD079/21, 26/09/2021 (ARUN!), *M Dey* R3305 (GMSMH).

9.2 *Microsorium punctatum* (L.) Copeland: Epiphytic, lithophytic. Lataguri forest road side area. Elevation: ca. 140 m.
Material: *M Dey & A K Soni* MD112/19, 08/09/2019 (ARUN!), *M Dey* D3118 (GMSMH).

9.3 *Drynaria quercifolia* (L.) J. Sm.: Epiphytic, lithophytic. Park more - Pandapara road (Jalpaiguri). Elevation: ca. 80 m.
Material: *M Dey & A K Soni* MD015/19, 26/04/2019 (ARUN!), *M Dey* A0072 (GMSMH & NBUH).

9.4 *Drynaria propinqua* (Wall. ex Mett.) J. Sm. ex Bedd.: Epiphytic. Chapramari reserve forest. Elevation: ca. 250 m.
Material: *M Dey* MD558/23, 14/02/2023 (ARUN!), *M Dey* Z6233 (GMSMH).

9.5 *Pyrrosia costata* (C. Presl ex Bedd.) Tagawa & K. Iwats: Epiphytic. Salbari more (Matiali), khunia more. Elevation: ca. 150-180 m.
Material: *M Dey & A K Soni* MD039/20, 03/05/2020 (ARUN!), *M Dey* B1093 (GMSMH & NBUH).

9.6 *Pyrrosia mannii* (Giesenh) Ching.: Epiphytic, lithophytic. BSNL office quarters boundary wall (Jalpaiguri). Elevation: ca. 80 m.
Material: *M Dey & A K Soni* MD044/19, 16/07/2019 (ARUN!), *M Dey* B1192 (GMSMH).

9.7 *Pyrrosia lanceolata* (L.) Farwell: Epiphytic - lithophytic. Gairkata Bus-stand (Dhupguri). Elevation: ca. 100 m.
Material: *M Dey & A K Soni* MD022/19, 07/05/2019 (ARUN!), *M Dey* A2898 (GMSMH & NBUH).

9.8 *Pyrrosia stenophylla* (Bedd.) Ching.: Epiphytic. Khumai, Sipchu SSB camp. Elevation: ca. 300 m.
Material: *M Dey & A K Soni* MD984/22, 03/12/2019 (ARUN!), *M Dey* Z8894 (GMSMH).

9.9 *Lepisorus contortus* (Christ.) Ching.: Epiphytic, lithophytic. Khunia more (Nagrakata). Elevation: ca. 200 m.
Material: *M Dey & A K Soni* MD116/21, 24/10/2021 (ARUN!), *M Dey* S5689 (GMSMH).

- 9.10 *Leptochilus decurrens* Blume ssp. *hemionitideus* Fraser-Jenk.: Lithophytic, terrestrial. Bagrakote (Mal). Elevation: ca. 300 m.
Material: *M Dey & A K Soni* MD085/21, 03/10/2021 (ARUN!), *M Dey* R4207 (GMSMH).
- 9.11 *Loxogramme involuta* (D.Don) C.Presl.: Epiphytic. Matiali, Sumsing. Elevation: ca. 300-350 m.
Material: *M Dey & A K Soni* MD081/21, 26/09/2021 (ARUN!), *M Dey* P8455 (GMSMH).
- 9.12 *Loxogramme porcata* Prince: Epiphytic. Chapramari reserve forest. Elevation: 400 m.
Material: *M Dey & A K Soni* MD202/22, 18/07/2022 (ARUN!), *M Dey* T7684 (GMSMH).
- 10. CYATHEACEAE**
- 10.1 *Cyathea gigantea* (Wall. ex. Hook.) Holttum.: Lataguri forest, Jurabandha road side. Elevation: ca. 80-150 m.
Material: *M Dey & A K Soni* MD020/20, 26/01/2020 (ARUN!), *M Dey* D1453 (GMSMH).
- 11. DENNSTAEDTIACEAE**
- 11.1 *Hypolepis polypodioides* (Blume) Hooker: Terrestrial. Panapara kalibari road side. Elevation: ca. 50 m.
Material: *M Dey & A K Soni* MD061/19, 11/08/2019 (ARUN!), *M Dey* A2100 (GMSMH).
- 11.2 *Microlepia speluncae* (Linn.) Moore: Terrestrial. Lataguri forest, Jalpaiguri town. Elevation: ca. 50-100 m.
Material: *M Dey & A K Soni* MD107/19, 08/09/2019 (ARUN!), *M Dey* A2135 (GMSMH & NBUH).
- 11.3 *Microlepia rhomboidea* (Wall. ex Kunz.) Prantl: Terrestrial. Khunia more, Samsing, Sipchu forest, khumai. Elevation: ca. 130-250 m.
Material: *M Dey & A K Soni* MD055/21, 15/08/2021 (ARUN!), *M Dey* K6245 (GMSMH).
- 12. LINDSAEACEAE**
- 12.1 *Lindsaea ensifolia* Sw.: Terrestrial. Sipchu SSB camp, Khumai. Elevation: ca. 200-300 m.
Material: *M Dey & A K Soni* MD003/19, 28/03/2019 (ARUN!), *M Dey* D0062, 09/08/2021 (GMSMH).
- 12.2 *Odontosoria chinensis* subsp. *chinensis* (L.) Smith: Terrestrial. Denguajhar tea garden. Elevation: ca. 80 m.
Material: *M Dey & A K Soni* MD057/19, 04/08/2019 (ARUN!), *M Dey* A2898 (GMSMH & NBUH).
- 13. PTERIDACEAE**
- 13.1 *Adiantum philippense* L.: Lithophytic. On the wall of Ashram para more (Jalpaiguri). Elevation: ca. 80 m.
Material: *M Dey & A K Soni* MD077/20, 02/08/2020 (ARUN!), *M Dey* E6911 (GMSMH & NBUH).
- 13.2 *Adiantum capillus-veneris* L.: Lithophytic. On the wall of Ashram para more (Jalpaiguri). Elevation: ca. 80 m.
Material: *M Dey & A K Soni* MD058/19, 11/08/2019 (ARUN!), *M Dey* C0909 (GMSMH).
- 13.3 *Adiantum caudatum* Klotz.: Lithophytic. Municipality Health centre, Congress para (Jalpaiguri). Elevation: ca. 80 m.
Material: *M Dey & A K Soni* MD046/19, 16/07/2019 (ARUN!), *M Dey* C3364 (GMSMH).
- 13.4 *Adiantum incisum* Forssk. subsp. *incisum* Fraser-Jenk.: Lithophytic, epiphytic. Wall of BSNL housing (Jalpaiguri), Chalsa. Elevation: ca. 80-300 m.
Material: *M Dey & A K Soni* MD104/21, 17/10/2021 (ARUN!), *M Dey* T2450 (GMSMH).
- 13.5 *Aleuritopteris bicolor* (Roxb.) Fraser-Jenk.: Lithophytic, Terrestrial. Diana forest, Sevoke. Elevation: ca. 150-250 m.
Material: *M Dey & A K Soni* MD127/20, 27/09/2020 (ARUN!), *M Dey* E1235 (GMSMH).
- 13.6 *Ceratopteris thalictroides* (L.) Brongn.: Aquatic. Rajbari pond, road side ditch at Paharpur, Jalpaiguri. Elevation: ca. 70-100 m.
Material: *M Dey & A K Soni* MD069/20, 02/08/2020 (ARUN!), *M Dey* E1130 (GMSMH & NBUH).
- 13.7 *Coniogramme serrulata* (Blume) Fee.: Lithophytic, Terrestrial. Aibheel tea garden. Elevation: ca. 300 m.
Material: *M Dey & A K Soni* MD177/22, 13/11/2022 (ARUN!), *M Dey* X3411 (GMSMH).
- 13.8 *Onychium siliculosum* (Desv.) Christ.: Terrestrial. Chapadanga (near 70 more). Elevation: ca. 100 m.
Material: *M Dey & A K Soni* MD059/21, 15/08/2021 (ARUN!), *M Dey* M5541 (GMSMH).
- 13.9 *Pityrogramma calomelanos* (L.) Link.: Terrestrial, Lithophytic. Koranipara (Jalpaiguri). Elevation: ca. 80 m.
Material: *M Dey & A K Soni* MD079/20, 02/08/2020 (ARUN!), *M Dey* F3524 (GMSMH & NBUH).
- 13.10 *Pteris vittata* L. subsp. *vittata*: Lithophytic. Gairkata Bus stand, Salbari (Dhupguri). Elevation: ca. 50-200 m.
Material: *M Dey & A K Soni* MD023/19, 07/05/2019 (ARUN!), *M Dey* B0902 (GMSMH & NBUH).
- 13.11 *Pteris alata* L.: Terrestrial. Gairkata, Banarhat (Dhupguri). Elevation: ca. 80-300 m.
Material: *M Dey & A K Soni* MD091/19, 01/09/2019 (ARUN!), *M Dey* B1365 (GMSMH).
- 13.12 *Pteris biaurita* L. subsp. *fornicata* Fraser-Jenk.: Terrestrial. Sipchu SSB camp. Elevation: ca. 200-300 m.
Material: *M Dey & A K Soni* MD115/19, 08/09/2019 (ARUN!), *M Dey* B1426 (GMSMH).
- 13.13 *Pteris biaurita* L. subsp. *Walkeriana* Fraser-Jenk. & Dom. Rajkumar: Terrestrial. Lataguri forest, Diana forest. Elevation: ca. 100-300 m.
Material: *M Dey & A K Soni* MD117/19, 08/09/2019 (ARUN!), *M Dey* B1459 (GMSMH).
- 13.14 *Pteris cretica* L. ssp. *Cretica*: Terrestrial, Lithophytic. Dumdim Tea garden, Sevoke. Elevation: ca. 350 m.
Material: *M Dey & A K Soni* MD071/21, 12/09/2021 (ARUN!), *M Dey* J6044 (GMSMH).
- 13.15 *Pteris aspericaulis* Wall. ex J. Agardh.: Terrestrial. RPF training centre (Domohoni). Elevation: ca. 100 m.
Material: *M Dey* MD233/22, 20/10/2022 (ARUN!), *M Dey* P0161 (GMSMH).
- 13.16 *Pteris ensiformis* Burm. f.: Terrestrial. Teesta udyan park, Jalpaiguri Holy Child school campus. Elevation: ca. 80-100 m.

Material: *M Dey & A K Soni* MD198/22, 16/09/2022 (ARUN!), *M Dey* P0085 (GMSMH).

- 13.17 *Pteris kathmanduensis* Fraser-Jenk. & T.G.Walker: Lithophytic. Domohoni-Basusuba road side. Elevation: ca. 90 m.

Material: *M Dey & A K Soni* MD335/22, 02/11/2022 (ARUN!), *M Dey* V5514 (GMSMH).

- 13.18 *Pteris multifida* Poir.: Lithophytic. DWO office wall (near PWD more), Jalpaiguri. Elevation: ca. 90 m.

Material: *M Dey & A K Soni* MD239/22, 11/07/2022 (ARUN!), *M Dey* T4612 (GMSMH).

- 13.19 *Pteris scaberrigens* Fraser-Jenk. & S.C. Verma: Terrestrial. Sipchu – Khumai road side. Elevation: ca. 250 m.

Material: *M Dey & A K Soni* MD377/22, 02/12/2022 (ARUN!), *M Dey* Z0873 (GMSMH).

14. VITTARIACEAE

- 14.1 *Antrophyum reticulatum* (G. Forst.) Kaulf.: Epiphytic. Lataguri road side, Khumai. Elevation: ca. 150-350 m.

Material: *M Dey & A K Soni* MD082/21, 26/09/2021 (ARUN!), *M Dey* J2291 (GMSMH).

- 14.2 *Vittaria elongata* Swartz: Epiphytic. Road side area of Pandapara (Jalpaiguri), Ramsai forest. Elevation: ca. 80-300 m.

Material: *M Dey & A K Soni* MD083/20, 02/08/2020 (ARUN!), *M Dey* E7014 (GMSMH).

15. ASPLENIACEAE

- 15.1 *Asplenium crinicaule* Hance: Epiphytic. Matiali High school more. Elevation: ca. 250 m.

Material: *M Dey & A K Soni* MD034/20, 03/05/2020 (ARUN!), *M Dey* D4406 (GMSMH).

- 15.2 *Asplenium nidus* L.: Epiphytic. Salbari more (near Chalsa). Elevation: ca. 200 m.

Material: *M Dey & A K Soni* MD075/19, 15/08/2019 (ARUN!), *M Dey* B4004 (GMSMH).

- 15.3 *Asplenium finlaysonianum* Wall. ex Hook et Grev.: Epiphytic. Near Bagrakote Army camp, Sevoke. Elevation: ca. 300 m.

Material: *M Dey & A K Soni* MD039/19, 14/07/2019 (ARUN!), *M Dey* A6231 (GMSMH).

16. THELYPTERIDACEAE

- 16.1 *Thelypteris nudata* (Roxb.) Morton: Terrestrial. Road side area of Lataguri forest, Adabari (Moulani). Elevation: ca. 130 m.

Material: *M Dey & A K Soni* MD029/20, 03/05/2020 (ARUN!), *M Dey* C2454 (GMSMH & NBUH).

- 16.2 *Thelypteris triphylla* (Sw.) Iwatsuki: Terrestrial. Sipchu SSB camp, Khumai, Nagrakata. Elevation: ca. 200-300 m.

Material: *M Dey & A K Soni* MD040/19, 14/07/2019 (ARUN!), *M Dey* B3332 (GMSMH & NBUH).

- 16.3 *Thelypteris dentata* (Forssk.) Brown. & Jermy: Terrestrial. Duck bungalow para, Dhupguri. Elevation: ca. 100 m.

Material: *M Dey & A K Soni* MD092/19, 01/09/2019 (ARUN!), *M Dey* A2990 (GMSMH).

- 16.4 *Thelypteris arida* (Don) Morton: Terrestrial. Belakoba, Sulkapara. Elevation: ca. 80-150 m.

Material: *M Dey & A K Soni* MD066/21, 30/08/2021 (ARUN!), *M Dey* E4457 (GMSMH).

- 16.5 *Thelypteris torresiana* (Gaudich) Alston: Terrestrial. Pandapara Park more. Elevation: ca. 80 m.

Material: *M Dey & A K Soni* MD073/21, 15/09/2021 (ARUN!), *M Dey* E5628 (GMSMH).

- 16.6 *Thelypteris procera* (D. Don) Fraser-Jenk.: Terrestrial. Lataguri forest near Mahakal mandir. Elevation: ca. 120 m.

Material: *M Dey & A K Soni* MD123/21, 24/10/2021 (ARUN!), *M Dey* S1728 (GMSMH).

- 16.7 *Thelypteris interrupta* (Wild.) K. Iwats.: Terrestrial. Nathua forest. Elevation: ca. 100 m.

Material: *M Dey* MD989/22, 24/09/2022 (ARUN!), *M Dey* V70284 (GMSMH).

17. WOODSIACEAE

- 17.1 *Diplazium esculentum* (Retz.) Sw.: Terrestrial. Pandapara roadside (Jalpaiguri). Elevation: ca. 80 m.

Material: *M Dey & A K Soni* MD007/19, 28/03/2019 (ARUN!), *M Dey* A0012 (GMSMH & NBUH).

18. DRYOPTERIDACEAE

- 18.1 *Dryopteris cochleata* (D. Don) C. Chr.: Marshy habitat. Sipchu forest beat. Elevation: ca. 310 m.

Material: *M Dey & A K Soni* MD109/21, 24/10/2021 (ARUN!), *M Dey* K3245 (GMSMH).

- 18.2 *Polystichum lentum* (D. Don) T. Moore: Terrestrial. Khumai, Khunia more. Elevation: ca. 200-3000 m.

Material: *M Dey & A K Soni* MD121/20, 27/09/2020 (ARUN!), *M Dey* H6312 (GMSMH).

- 18.3 *Polystichum pseudotsus-simense* Ching: Terrestrial, marshy habitat. Khumai more. Elevation: ca. 340 m.

Material: *M Dey & A K Soni* MD123/20, 27/09/2020 (ARUN!), *M Dey* H6320 (GMSMH).

- 18.4 *Polystichum manmeiense* (Christ) Nakaike: Terrestrial. Jhalong road side, Khunia more. Elevation: ca. 400 m.

Material: *M Dey & A K Soni* MD195/22, 18/07/2022 (ARUN!), *M Dey* W3210 (GMSMH).

- 18.5 *Polystichum nepalense* (Spreng.): Lithophytic. Meenglas tea garden (Matiali). Elevation: ca. 280 m.

Material: *M Dey & A K Soni* MD200/22, 18/07/2022 (ARUN!), *M Dey* W3222 (GMSMH).

- 18.6 *Tectaria codnuta* (J. Smith) C. Christensen: Terrestrial. Meenglas tea garden, Khumai more. Elevation: ca. 250-340 m.

Material: *M Dey & A K Soni* MD133/20, 27/09/2020 (ARUN!), *M Dey* H6374 (GMSMH & NBUH).

- 18.7 *Tectaria polymorpha* (Wall. ex Hook.) Copeland: Terrestrial. Khunia more (Nagrakata). Elevation: ca. 180 m.

Material: *M Dey & A K Soni* MD125/21, 24/10/2021 (ARUN!), *M Dey* Q1516 (GMSMH).

19. OLEANDRACEAE

- 19.1 *Nephrolepis cordifolia* (L.) C. Presl.: Terrestrial. Khunia more. Elevation: ca. 180 m.

Material: *M Dey & A K Soni* MD051/21, 15/08/2021 (ARUN!), *M Dey* P4285 (GMSMH & NBUH).

19.2 *Nephrolepis radicans* (Burm. f.) Kuhn.: Epiphytic. Khumai, Khunia more. Elevation: ca. 180-300 m.

Material: *M Dey & A K Soni* MD049/21, 15/08/2021 (ARUN!), *M Dey* P4210 (GMSMH).

20. DAVALLIACEAE

20.1 *Davallia trichomanoides* Blume: Epiphytic, climber. Khumai more. Elevation: ca. 280 m.

Material: *M Dey & A K Soni* MD145/20, 24/10/2020 (ARUN!), *M Dey* F2231 (GMSMH).

21. BLECHNACEAE

21.1 *Blechnum orientale* L.: Terrestrial. Koranipara canal (Jalpaiguri). Elevation: ca. 80 m.

Material: *M Dey & A K Soni* MD087/20, 02/08/2020 (ARUN!), *M Dey* G2231 (GMSMH & NBUH).

21.2 *Stenochlaena palustris* (Burm.) Bedd.: Climbing / creeping, Terrestrial. Meenglas tea garden (Matiali). Elevation: ca. 280 m.

Material: *M Dey* MD660/22, 28/06/2022 (ARUN!), *M Dey* P4740 (GMSMH).

22. AZOLLACEAE

22.1 *Azolla pinnata* R.Br.: Aquatic. Road side ditch at Maynaguri Road, Paharpur more. Elevation: 80-150 m.

Material: *M Dey & A K Soni* MD019/20, 26/01/2020 (ARUN!), *M Dey* C3256 (GMSMH).

23. SALVINIACEAE

23.1 *Salvinia cucullata* Bory: Aquatic. Chapadanga - 70 more (Kranti), Paharpur more. Elevation: 80-120 m.

Material: *M Dey & A K Soni* MD076/21, 18/09/2021 (ARUN!), *M Dey* T8694 (GMSMH).

23.2 *Salvinia natans* (L.) All.: Aquatic. Chapadanga - 70 more (Kranti), Barnish, Domohoni (Maynaguri). Elevation: 80-150 m.

Material: *M Dey & A K Soni* MD074/21, 18/09/2021 (ARUN!), *M Dey* T8617 (GMSMH).

23.3 *Salvinia molesta* D.Mitch.: Aquatic. Gajoldoba (Rajganj). Elevation: 140 m.

Material: *M Dey* MD799/22, 06/10/2022 (ARUN!), *M Dey* Z7822 (GMSMH).

Among the listed plants some are very common, where as some are less frequent. Unlike the rare species, certain ferns exhibit a high degree of local abundance, making them a distinctive attribute of their specific geographic locations. The presence of a wide range of species in the district, combined with the delicate ecological balance caused by human-induced stress, requires the implementation of suitable conservation strategies to safeguard pteridophyte community. Preparation of Checklist of pteridophytes after a time interval is very important task for researchers as this plant group can be influenced by environmental phenomena such as earthquakes, floods, and the biological characteristics of the species, including the separation of male and female plants. The combination of human disturbance and global climate change poses a significant threat to plant diversity on a global scale, leading to habitat loss and fragmentation. Certain species of ferns require specific conservation efforts due to their increasing scarcity in the natural environment. One potential approach to preserving pteridophytes in the study area is the establishment of

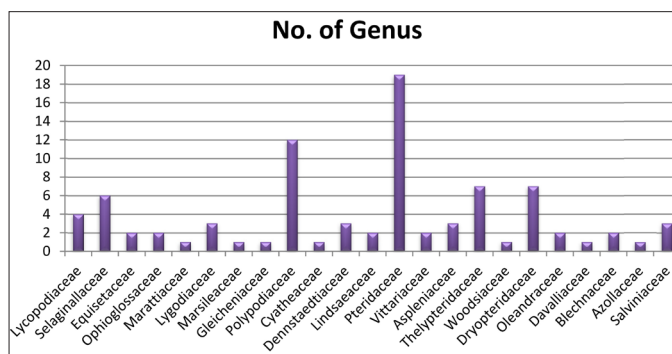


Figure 2: Graphical representation of the pteridophyte family and genus.

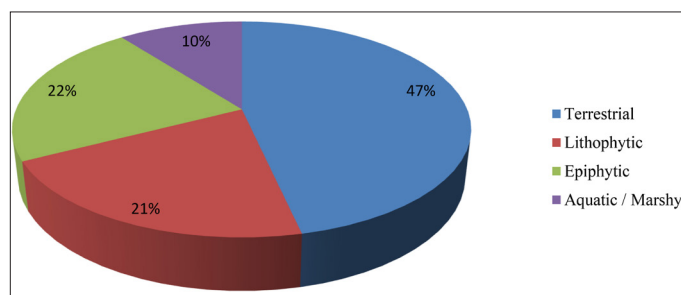


Figure 3: Graphical representation of habitat distribution of pteridophytes of Jalpaiguri.

protected area specifically designated for this purpose. The majority of research on pteridophytes has focused on their ecological structure, with limited attention given to the variation in diversity that occurs along gradients of elevation.

6. CONCLUSION

The study revealed the presence of various fern species as well as allied species, inside the territory of the district Jalpaiguri which holds significant importance in the context of plant biodiversity. Our findings state that diversity of pteridophytes is remarkable and the distribution of the species changes according to the habitats, sediment properties, orientation and coexistence of other plants within the same niche. Within this region pteridophytes are able to survive in a wide range of habitats where most flowering plants would perish, including cracks in rocks and branches. Currently, numerous ecological niches face significant threats as a result of diverse anthropogenic activities, posing a substantial challenge to the survival of pteridophytes in the region. The outcomes of the study would ultimately establish a foundational investigation into the variety of Pteridophytes in Jalpaiguri, encompassing their habitats and conservation status. Additionally, it would serve as a main data resource for subsequent research conducted by the scientific community.

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All the authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication. All the authors had the idea for the article; MD, AKSo and AKSa performed the research work and data analysis; MD, SSA and AKSa drafted; figures were prepared by MD and AKSa; SSA and AKSa critically revised the work.

10. CONFLICTS OF INTEREST

The authors report no financial or other conflicts of interest in this work.

11. DATA AVAILABILITY

Data supporting this study are included within the article.

12. ETHICAL APPROVALS

This study does not involve experiments on animals or human subjects.

13. PUBLISHER'S NOTE

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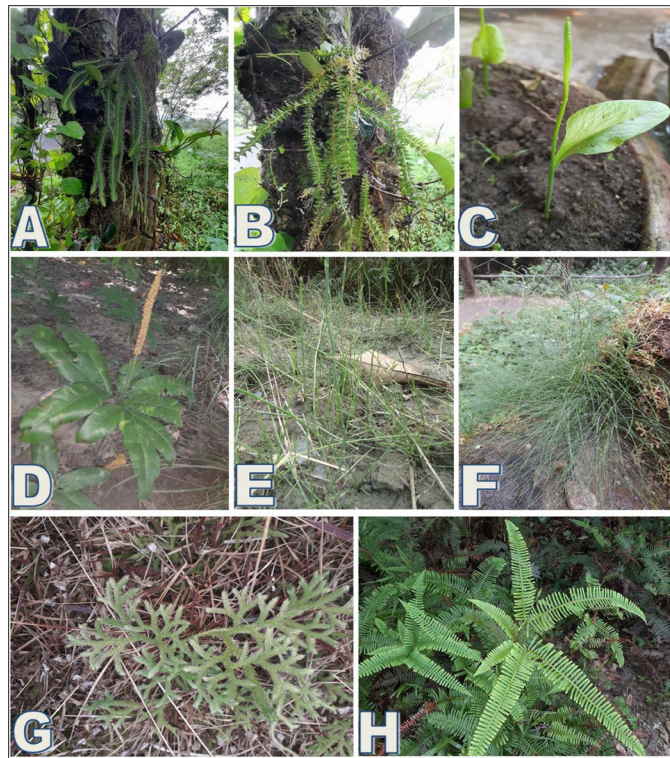


Plate 1: (A) *Huperzia squarrosa* (Froster) Trevisan; (B) *Huperzia phlegmaria* (L.) Rothm.; (C) *Ophioglossum reticulatum* L.; (D) *Helminthostachys zeylanica* (L.) Hook.; (E) *Equisetum ramosissimum* Desf.; (F) *Equisetum arvense* L. subsp. *Diffusum* (D. Don) Fraser-Jenkins; (G) *Lycopodium japonicum* Thunberg.; (H) *Dicranopteris linearis* (Burm. f.) Underw.

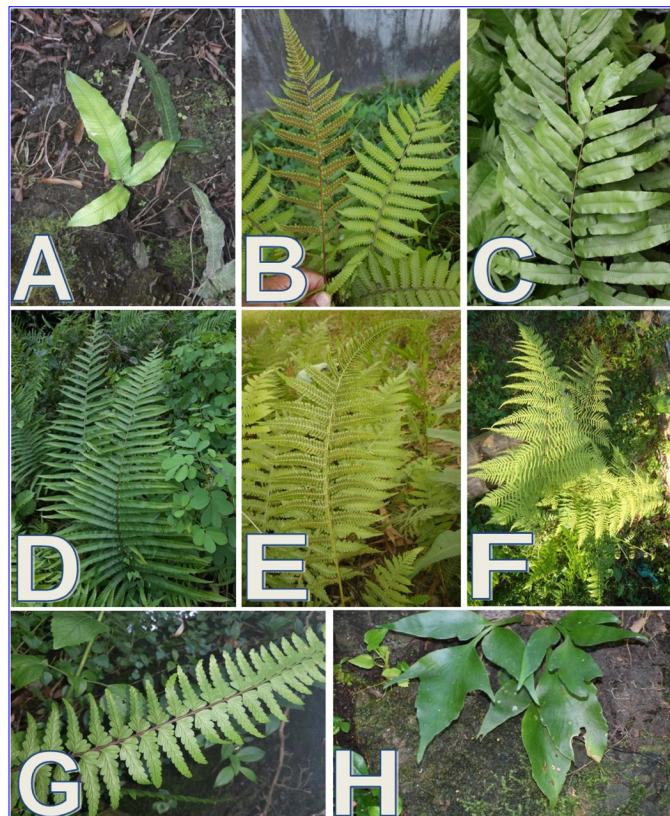


Plate 2: (A) *Thelypteris triphylla* (Sw.) Iwatsuki; (B) *Thelypteris dentata* (Forssk.) Brown. & Jermy, (C) *Thelypteris nudata* (Roxb.) Morton; (D) *Thelypteris arida* (Don) Morton; (E) *Thelypteris procera* (D. Don) Fraser-Jenk.; (F) *Thelypteris torresiana* (Gaudich) Alston; (G) *Asplenium crinicaule* Hance; (H) *Asplenium finlaysonianum* Wall. ex Hook et Grev.



Plate 3: (A) *Nephrolepis cordifolia* (L.) C. Presl.; (B) *Nephrolepis radicans* (Burm. f.) Kuhn.; (C) *Vittaria elongata* Swartz; (D) *Drynaria quercifolia* (L.) J. Sm.; (E) *Antrophyum reticulatum* (G. Forst.) Kaulf.; (F) *Microsorium cuspidatum* (D. Don) Tagawa; (G) *Microsorium punctatum* (L.) Copeland; (H) *Leptochilus decurrens* Blume ssp. *hemionitideus* Fraser-Jenk.



Plate 4: (A) *Salvinia natans* (L.) All.; (B) *Salvinia cucullata* Bory.; (C) *Salvinia molesta* D. Mitch.; (D) *Azolla pinnata* R. Br.; (E) *Adiantum philippense* L.; (F) *Adiantum incisum* Forssk. subsp. *incisum* Fraser-Jenk.; (G) *Adiantum caudatum* Klotz.; (H) *Adiantum capillus-veneris* L.; (I) *Ceratopteris thalictroides* (L.) Brongn.

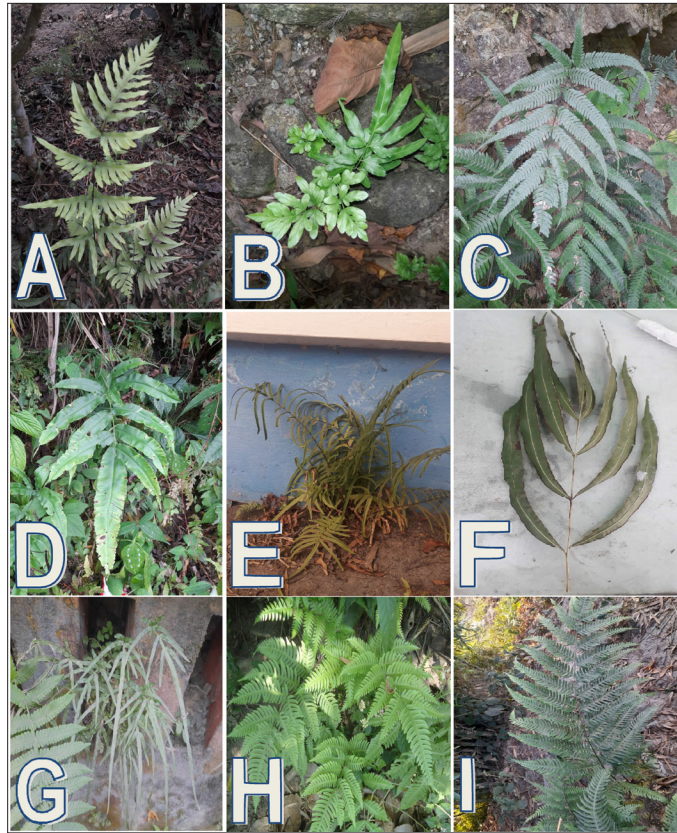


Plate 5: (A) *Pteris alata* L.; (B) *Pteris ensiformis* Burm. f.; (C) *Pteris scabrigens* Fraser-Jenk. & S.C. Verma; (D) *Coniogramme serrulata* (Blume) Fee.; (E) *Pteris vittata* L. subsp. *vittata*; (F) *Pteris cretica* L. ssp. *Cretica*; (G) *Pteris multifida* Poir.; (H) *Pteris biaurita* L. subsp. *Walkeriana* Fraser-Jenk. & Dom. Rajkumar; (I) *Pteris kathmanduensis* Fraser-Jenk. & T.G.Walker. .

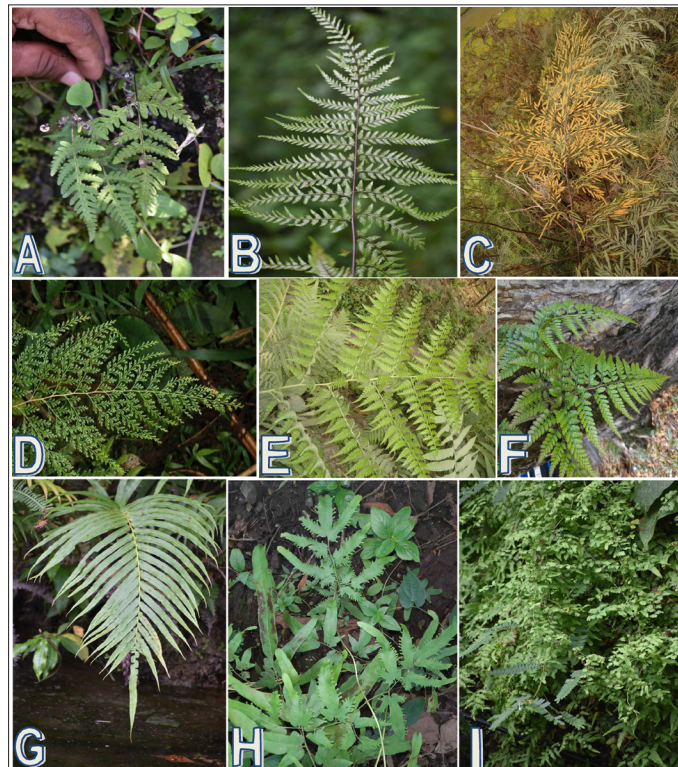


Plate 6: (A) *Aleuritopteris bicolor* (Roxb.) Fraser-Jenk.; (B) *Pityrogramma calomelanos* (L.) Link.; (C) *Onychium siliculosum* (Desv.) Christ.; (D) *Odontosoria chinensis* subsp. *chinensiss* (L.) Smith; (E) *Microlepia rhomboidea* (Wall. ex Kunz.) Prantl; (F) *Davallia trichomanoides* Blume; (G) *Blechnum orientale* L.; (H) *Lygodium flexuosum* (L.) Sw.; (I) *Lygodium microphyllum* (Cav.) R. Br.

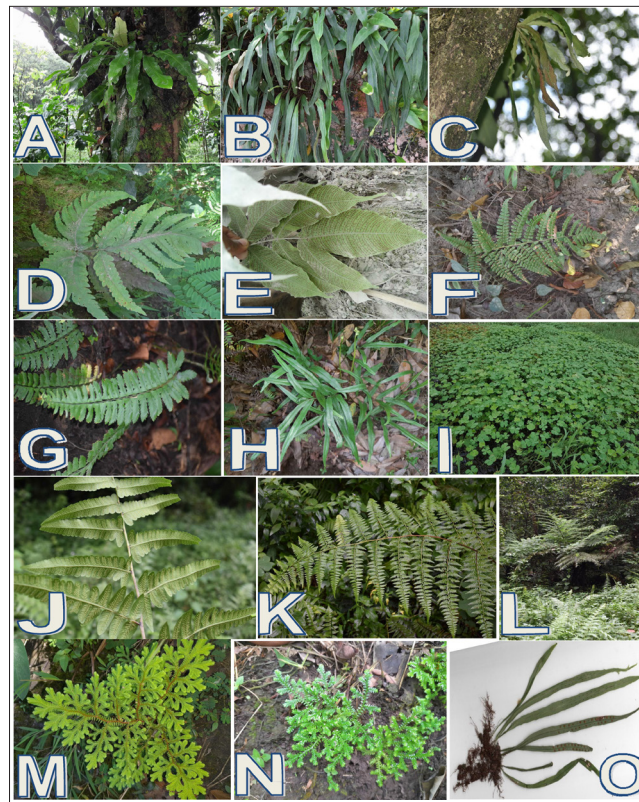


Plate 7: (A) *Pyrrosia costata* (C. Presl ex Bedd.) Tagawa & K. Iwats; (B) *Pyrrosia mannii* (Giesenh) Ching.; (C) *Pyrrosia stenophylla* (Bedd.) Ching.; (D) *Tectaria codnuta* (J. Smith) C. Christensen.; (E) *Tectaria polymorpha* (Wall. ex Hook.) Copeland; (F) *Dryopteris cochleata* (D. Don) C. Chr.; (G) *Polystichum lentum* (D. Don) T. Moore; (H) *Lindsaea ensifolia* Sw.; (I) *Marsilea minuta* L.; (J) *Diplazium esculentum* (Retz.) Sw.; (K) *Microlepia speluncae* (Linn.) Moore; (L) *Cyathea gigantea* (Wal. ex. Hook.) Holttum.; (M) *Selaginella repanda* (Desv. ex Poir.) Spring.; (N) *Selaginella chrysocaulos* (Hooker & Greville) Spring.; (O) *Lepisorus contortus* (Christ.) Ching.