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A Systematic Review of Pteridophytic Flora of the Newly Established Sikhna Jwhwlao National Park, Assam, in North-Eastern India

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Abstract: ***The present study provides a systematic review of pteridophytic flora recorded from Sikhna National Park, Bodoland Territorial Council (BTC), Assam. Extensive field surveys were conducted over a period of nearly one year, from January 2020 to September 2021, covering different seasons to document the diversity and distribution of species. A comprehensive review has been prepared based on systematic field collections, critical examination of specimens, and consultation of relevant floras, manuals, published literature, and academic thesis. As a result, a total of 39 species belonging to 29 genera and 22 families of pteridophytes have been recorded from the study area. Analysis of life-form distribution reveals that terrestrial species dominate the flora, accounting for more than 61% (24 species) of the total recorded taxa. Epiphytic species constitute about 20% (8 species), indicating the availability of suitable host trees and favourable microclimatic conditions within the forest. In addition, four species of climbers and three species of aquatic ferns were also documented, reflecting the habitat heterogeneity of Sikhna National Park. A comparative assessment of the 22 dominant families of pteridophytes occurring in the area shows that Pteridaceae is the most dominant family. The number of Stenochlaena palustries (Burm.) Bedd., Nephrolepsis radicans (Burm.f) Kuhn., Trigonospora ciliata (Wall. ex Benth.) Holtt., Angiopteris evecta (Forst.) Hoffm. species are encountered inside the National Park which is not recorded in the early work. The study emphasizes that Sikhna Jwhwlao National Park harbours a virgin forest with considerable pteridophytic diversity and underscores the need for long-term and detailed studies for more comprehensive documentation and conservation planning.***

Keywords: Pteridophytes, systematic review, Conservation, Diversity, North-east India

I. INTRODUCTION

Pteridophytes are non-flowering spore bearing vascular plants and consisted of two groups Ferns and Fern allies. Pteridophytes formed a dominant part of Earth's vegetation in the historic past 9280-230 million years ago [1]. These flourished well during the Carboniferous periods of the Palaeozoic era, this period of geological time scale may be regarded as Age of Pteridophyta. Pteridophytes are conventionally divided into four major groups Psilotatae, Lycopodiatae (Lycophytes or Club mosses), Equisetatae (Horse tails) and Filicatae or Ferns or later it five major groups when Isoetinae is also recognized [2].There are over 12000 living species of ferns and 1000 species of fern - allies in the world, of which about 1200 species of ferns and ferns - allies are expected to occur in the India [3]. The first references to Indian Pteridophytes are often in the classical Sanskrit linked to Ayurveda [4]. On a very conservative estimation 500 species of ferns and 100 species of fern allies are on record from India [5]. According to a recent census, the Pteridophytic flora of India comprises of 67 families, 191 genera and more than 1000 species [6]. A revised list of endemic and threatened pteridophytes in India, it provided a recent status mentioning 49 endemic, 160 critically endangered, 82 near threatened, 219 at risk and 113 rare species. [7] recorded 34 families, 144 genera and more than 1100 species of ferns with about 235 endemic from Indian region. Prof. [8] give detailed account of the Indian Pteridology which made most significant and valuable research by carried out floristic, monographic and revisionary studies of Indian Pteridology. He was also regarded as 'Father of Indian Pteridology'. The overall vascular flora of our country in general has about 15,000 species and as a constituent of Indian flora of vascular plants, the ferns and fern allies form only five percent part as far as the number of species is concerned [9]

The floristic account of the pteridophytic vegetation have been given by many workers from various localities of India. Some floristic works are Pteridophytic Flora of Darjeeling and Skikim Himalayas by [10], Fern and Fern - allies of Meghalaya State, India by [11], Ferns and Fern - allies of Arunachal Pradesh by [12], The Ferns of Nagaland by [13], Fern and Fern - allies of Skikim A Pictorial Hand Book Part - 1 by [14]. Pteridophytic Wealth Of Sikkim Himalaya by [15].

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In Assam, the works on Pteridophytic flora has been made by different workers viz., [16] 'An Illustrated Manual of Fern of Assam', a review of the ferns of barak valley, assam, india [17], Fern Flora of Barak Valley, Assam by [18], Forty new additions to the angiospermic flora of Assam, India [19], A Checklist of Hydrophytic Pteridophytes of Assam, India [20], Diversity Of Pteridophytes In Nazira Subdivision Of Sivasagar District, Assam, N. E. India [21]

In lower part of Assam, only a few floristic works of the Pteridophytic vegetation have been conducted in an over period of time. [16] recorded 211 species in Illustrated manual of ferns of Assam. Among of 221 species belonging to 87 genera and 43 families of fern have been recorded in Assam. The floristic work of BTAD is only by [22] and he listed 31 of species in floristic diversity of Kokrajhar district of Assam with special reference to Chakrasila wildlife sanctuary. In this work the most Pteridophytic plant are excluded because this study recorded 789 species are Angiosperms under 490 genera and 137 families where only 31 species are Pteridophytes. But majority of the Indian flora did not include the fern allies. Many taxonomic studies and workers have been done with angiosperm and local flora but unfortunately the allied fern remained as a group to be studied in most of the region specially in the newly established Sikhna Jwhwlao National Park. The present study was based on taxonomic enumeration to compilation of the updated pteridophytic flora of Assam.

II. METHODOLOGY

The present Pteridophytic diversity work is based on the field study which involves collection, identification, documentation and herbarium preparation of ferns and fern allies made regularly an interval of time from the Sikhna Jwhwlao National Park. The standard field and herbarium techniques have been followed, [23] in collection, processing and preparation of herbarium specimens. As far as possible, specimens have been collected in their mature stage from their natural habitats. In the field at the time of collection all the important morphological characters particularly on the habit, habitat, size, colour and shape of the frond, type of pinnate leaves, arrangement of sori, scales and hairs if present or visible, nature of rhizome are noted in the field note book. Usually whole plants are collected including rhizome, in case of larger ferns like *Angiopteris evecta, Cyathea* etc., Rhizome is huge so other part of (fronds, sori) was collected and approximate size of the trunk, fronds and the nature of the rhizome were noted and for fern allies, important characteristics features of the specimens like colour of leaf, stem, habit, habitat, size etc., were noted in the field during collection. Specimens were also preserved in 4% formaldehyde solution for further studies. The field data has been included on the herbarium sheets according the specimen of which this study is based, have been deposited in the Bodoland University Botanical Herbarium (BUBH), Kokrajhar.

The North Eastern (NE) region of India stands out for its exceptional ethnic and biological diversity, making it a treasure trove of cultural and natural wealth. The region spreads over an area of 255,088 km², constituting 7.7% of the total geographical area of the country [24]. The region is characterized by its rich biodiversity, hilly terrain, and heavy forest cover. A large number of different indigenous communities inhabit this region, each with distinct languages, customs, and traditional knowledge systems [25]. This region encompasses two prominent biogeographic zones as the Eastern Himalayas, which includes Arunachal Pradesh and Sikkim, and on the another hand the North East India, comprising as Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura [26]. Recognized globally for its rich biodiversity, the Eastern Himalayas biogeographic zone is classified as a megadiverse area, particularly notable for its abundant plant species.

Sikhna Jwhwlao National Park is a national park located in the Bodoland Territorial Region (BTR) of Assam, India, encompassing parts of the Chirang and Kokrajhar districts. The park is covering an area of 316.29 km², forms an integral part of the Manas Biosphere Reserve and functions as a vital ecological corridor connecting four other protected areas. Its located in between 26˚ 68.18" N to 26˚81. 18" N and 90˚24.44" E to 90˚41.90" E. The Government of Assam approved the creation of Sikhna Jwhwlao National Park during a Cabinet meeting held on 16 February 2025. The park was subsequently officially notified on 5 March 2025 by the Governor of Assam, under the provisions of the Wildlife (Protection) Act, 1972. It is the third national park in Bodoland and the eighth national park in Assam. The park is named after Sikhna Jwhwlao, also known as Joulia Dewan, a legendary Bodo warrior and leader who resisted British colonial forces during the Duar War (1864–1866) between Bhutan and the British East India Company. His capital, known as Sikhnajhar or Chiknajhar, was located in the present-day Ultapani Reserve Forest, which now lies within the boundaries of the national park. This site is regarded as sacred by the Bodo community. Traditional religious festivals such as Bathou Puja and Kherai Puja are conducted annually at this historically and culturally significant location.

The park included four ranges among them the Ultapani forest range is one of the "Hot spot" area situated under Holtugaon forest division and belongs to district Kokrajhar (BTC) of state Assam. It is bounded on the north by Bhutan hills and by Sarmanga river on the west, the NH - 31 in the south and in the east by Aie river.

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It lies in the western part of the Manas Biosphere Reserve in Assam, is one of the best place in India for observing different types of butterfly, orchids, golden langur, the great pied, wreathed hornbill and pea cocks. It is also known as "Haven of Butterfly". The region derives its name from the fact that unlike other rivers on the north bank of Brahmaputra, the river here flows from west to east. Ultapani forest range is about 46 kms. from Kokrajhar towards north via Jharbari forest range. The Samukha (Bodo) river is the main river of Ultapani forest range, almost all types of plants are occurred. Samukha river produce Pneumatophore which is one of the unique characters of the forest. Another interesting observation is the presence of a hot water spring in Samukha rivulet which can be cited another report of hot spring from Assam. It may be due to presence of sulphur, calcium carbonate and calcium silicate etc., present in the water of that spring. The park is renowned for its rich biodiversity and is home to more than 460 species of butterflies. It also provides habitat for several iconic and protected wildlife species, including the Golden langur (*Trachypithecus geei*), Royal Bengal tiger (*Panthera tigris*), and Asian elephant (*Elephas maximus*), among others.

Table 1: List of the Pteridophytes occurring in Sikhna Jwhwlao National Park with their family.
(Abbreviation: English (Eng); Assamese (Assm); Reang (Rng); Bodo (Bd); Not Found (NF))

Sl. No.	Botanical Name	Family	Genus	Vernacular Name	Conservation Status
1	*Dryopteris sparsa* (D. Don) Kuntze.	Dryopteridaceae	*Dryopteris*	Wood Fern (Eng)	Not Evaluated (NE)
2	*Asplenium falcatum* Lam.	Aspleniaceae	*Asplenium*	Sickle Fern (Eng)	Unchecked
3	*Asplenium nidus* L.			Bird's nest fern (Eng)	Least Concern (LC)
4	*Pirrosia adnascens* (Sw.) Ching.	Polypodiaceae	*Pirrosia*	Bormondi (Assm)	Not Evaluated (NE)
5	*Pirrosia piloselloides* (L.) M. G. Price			Dragon's Scale Fern (Eng)	Not Evaluated (NE)
6	*Microsorum teropus* (L.) Copel.		*Microsorum*	Java Fern (Eng)	Not Evaluated (NE)
7	*Microsorum punctatum* (L.) Copel.			Kapau dhekia (Assm)	Least Concern (LC)
8	*Drynaria quercifolia* L.	Drynariaceae	*Drynaria*	Pankhiraj (Assm)	Least Concern (LC)
9	*Pteris vittata* L.	Pteridaceae	*Pteris*	*Bon-dhekiya (Assm)*	Least Concern (LC)
10	*Pteris semipinnata* L.			*Skaiumamoidu (Rng)*	Not Evaluated (NE)
11	*Pteris biaurita* L.			*NF*	Not Evaluated (NE)
12	*Pteris quadriaurita* Retz.			*Tricolor Fern (Eng)*	Not Evaluated (NE)
13	*Pteris linearis* Poir.			*Dilim (Assm)*	Not Evaluated (NE)
14	*Pityrogramna calomelanos* (L.) Link.	Hemionitidaceae	*Pityrogramna*	*Silver Fern (Eng)*	Not Evaluated (NE)
15	*Dicranopteris linearis* (Burm.f) Undrew.	Dicranopteridaceae	*Dicranopteris*	*Bilm-tenga (Assm)*	Least Concern (LC)

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16	*Blechnum orientate* L.	Blechnaceae	*Blechnum*	*Chepti-dhekia (Assm)*	Least Concern (LC)
17	*Angiopteris evecta* (Forst.) Hoffm.	Marattiaceae	*Angiopteris*	*Hati Dhekia (Assm)*	Least Concern (LC)
18	*Lindsaea odorata* Roxb. ex Griff.	Lindsaeaceae	*Lindsaea*	*Necklace Fern (Eng)*	Not Evaluated (NE)
19	*Sphenomeris chinensis* (L.) Maxon.		*Sphenomeris*	*NF*	Not Evaluated (NE)
20	*Lygodium microphyllum* (Cav.) R. Br.	Lygodiaceae	*Lygodium*	*Climbing fern (Eng)*	Least Concern (LC)
				Kopou Dhekia (Assm)	Not Evaluated (NE)
21	*Lygodium flexuosum* L.				
22	*Lygodium japonicum* (Thunb.) Sw. Schrad			*Indrajal (Assm)*	Unchecked
23	*Tectaria caudunata* (Wall. ex Hook. et Grev.)	Aspidiaceae	*Tectaria*	*Dhekia Xak (Assm)*	Least Concerned (LC)
24	*Ptenitopsis fuscipes* (Wall. ex Bedd.) Ching.		*Ptenitopsis*	*NF*	Unchecked
25	*Cyathea henryi* (Bak.) Copel.	Cyatheaceae	*Cyathea*	*Bongreng (Rng)*	Unchecked
26	*Cyathea spinulosa* Wall. ex Hook.			*Bar Gach (Assm)*	Unchecked
27	*Microlepia speluncae* L.	Dennstaedtiaceae	*Microlepia*	*Limpleaf fern (Eng)*	Endangered (EN)
28	*Pronephrium triphyllum* (Sw.) Holtt.	Thelypteridaceae	*Pronephrium*	*Bon Dhekia (Assm)*	Critically Endangered (CR)
29	*Trigonospora ciliata* (Wall. ex Benth.) Holtt.		*Trigonospora*	*NF*	Not Evaluated (NE)
30	*Christella dentata* (Forssk.) Brownsey et Jermy		*Christella*	*NF*	Not Evaluated (NE)
31	*Nephrolepsis radicans* (Burm.f) Kuhn.	Nephrolepidaceae	*Nephrolepsis*	*NF*	Least Concern (LC)
32	*Diplazium esculentum* (Retz.) Sw.	Athyriaceae	*Dilpazium*	*Dhekia Saag (Assm)*	Least Concern (LC)
33	*Stenochlaena palustries* (Burm.)	Stenochlaenaceae	*Stenochlaena*	*Ranga Dhekia (Assm)*	Not Evaluated (NE)
34	*Bolbitis heteroclita* (Presl.) Ching.	Bolbitidaceae	*Bolbitis*	*Asian Water Fern (Eng)*	Vulnerable (VU)
35	*Marsilea minuta* L.	Marsileaceae	*Marsilea*	*Tengesi Tenga (Assm)*	Least Concern (LC)
36	*Salvinia natans* (L.)	Salviniaceae	*Salvinia*	*Pani-puni (Assm)*	Least Concern (LC)
37	*Phlegmariurus vernicosus* (Hook. & Grev.) A. Love & D. love	Lycopodiaceae	*Phlegmariurus*	*Tassel fern (Eng)*	Unchecked
38	*Lycopodiella cernua* (L.) Pic. Serm		*Lycopodiella*	*Staghorn clubmoss (Eng)*	Least Concern (LC)
39	*Huperzia phlegmaria* (L.) Rothm.		*Huperzia*	*Coarse Tassel Fern (Eng) Maoji Lanjai (Bd)*	Rare

Table 2 : Classification of Pteridophytes occurning in Sikhna Jwhwlao National Park

Categories	Families	Genera	Species	Percentage
Terrestrial	14	19	24	61.53 %
Epiphytes	3	6	8	20.51%
Aquatic	3	3	3	7.69%
Climber	2	2	4	10.25%

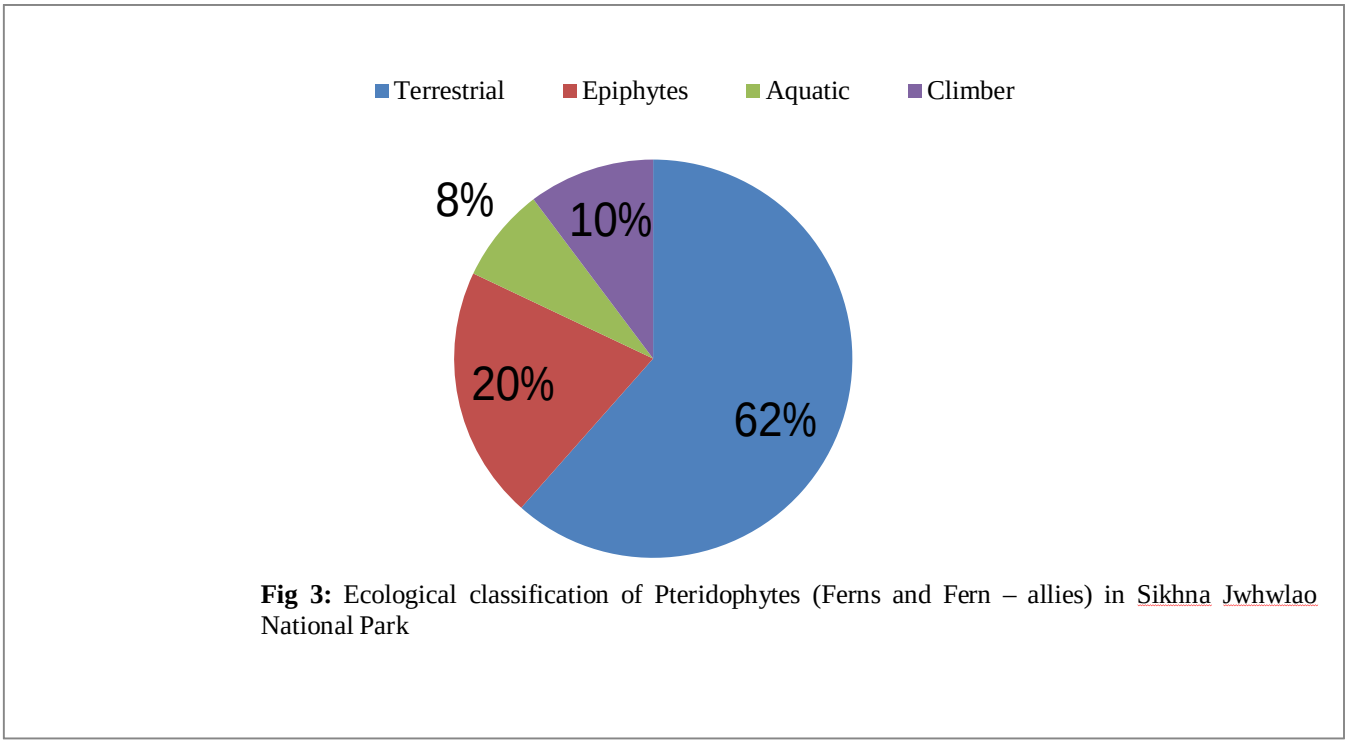


Fig 3: Ecological classification of Pteridophytes (Ferns and Fern – allies) in Sikhna Jwhwlao National Park

Fig 4: Comparison between the dominant families of Pteridophytes (Ferns and Fern – allies) occuring in Sikhna Jwhwlao National Park.

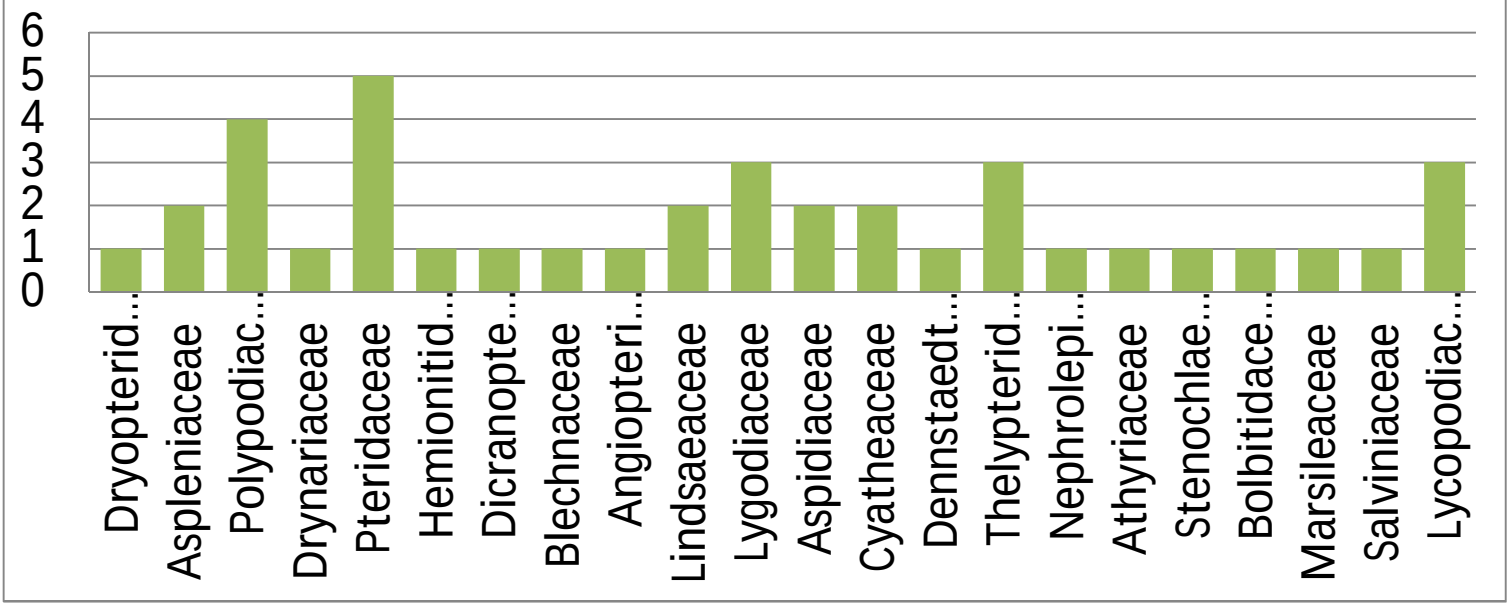




Plate 1: ***Nephrolepsis radicans*** (Burm.f) Kuhn. A - Habitat; B - Thick stolons and runners C - Rhizome short and wiry roots; D - Frond; E - Pinna showing sori and venation (20x); F - Sporangium (40x); G - Spore (40x).


A


B


C


D


E


F


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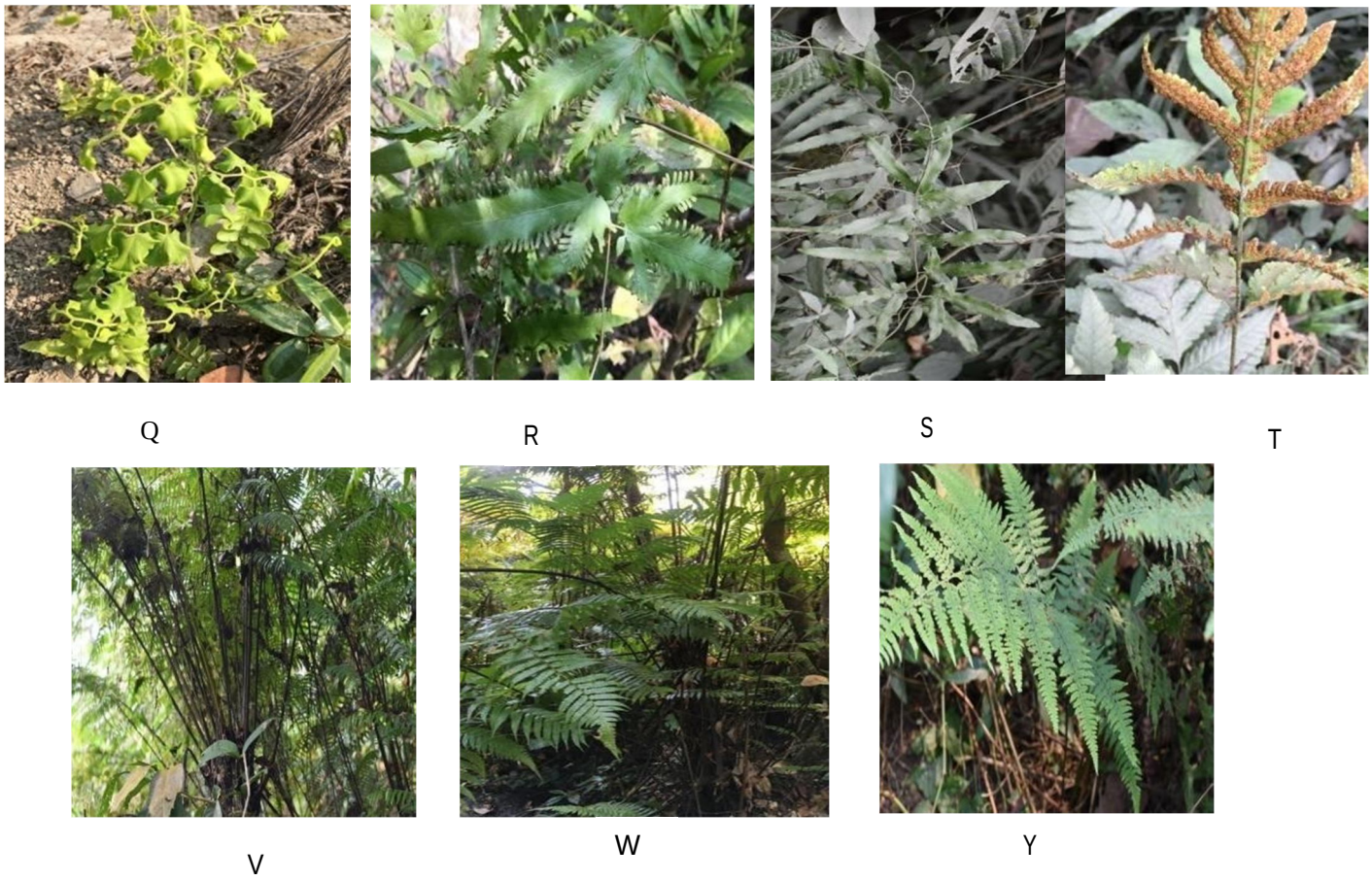


Fig 5: A. *Dryopteris sparsa*; B. *Asplenium falcatum*; C. *Asplenium nidus*; D. *Pirrosia adnascens*; E. *Microsorum Pteropus*; F. *Pteris vittata*; G. *Pteris semipinnata*; H. *Pteris biaurita*; I. *Pteris quadriurita*; J. *Pteris linearis*; K. *Pityrogramma calomelanos*; L. *Dicranopteris linearis*; M. *Blechnum orientate*; N. *Angiopteris evecta*; O. *Lindsaea odorata*; P. *Sphenomeris chinensis*; Q. *Lygodium microphyllum*; R. *Lygodium flexuosum*; S. *Lygodium japonicum*; T. *Tectaria coudunata*; V. *Ctenitopsis fuscipes*; W. *Cyathea henryi*; Y. *Microlepia speluncae*

III. DISCUSSION

The present study documents the diversity and distribution of pteridophytes in Sikhna National Park, BTC, Assam, based on extensive field collection, systematic enumeration (Plate 1), consultation of standard floras, manuals, and published thesis. A total of 39 species belonging to 29 genera and 22 families were recorded from the study area, indicating a considerable richness of pteridophytic flora. Such diversity reflects the favourable ecological conditions of the park, including high humidity, dense forest cover, and varied microhabitats, which are well known to support the luxuriant growth of ferns and fern allies. Analysis of life-form distribution revealed that terrestrial pteridophytes constituted the major component of the flora, accounting for more than 61% (24 species) of the total recorded species. This dominance of terrestrial forms may be attributed to the presence of moist forest floors, shaded slopes, and rich organic matter within the park. Epiphytic species formed about 20% (8 species) of the total flora, highlighting the availability of suitable host trees and a humid microclimate that favours epiphytic growth. In addition, the occurrence of four climbers and three aquatic ferns further emphasizes the habitat heterogeneity of Sikhna National Park, ranging from forest canopies to wetlands and water bodies.

Family-wise comparison of the 22 recorded families shows that Pteridaceae is the most dominant family in the study area. This dominance may be due to the wide ecological adaptability and efficient reproductive strategies of its members. Polypodiaceae is also well represented, particularly by species such as *Pyrrosia adnascens*, *Pyrrosia piloselloides*, *Microsorum pteropus*, and *Microsorum punctatum*, most of which occur abundantly as epiphytes. Families such as Lygodiaceae, Lycopodiaceae, and Thelypteridaceae also exhibit notable abundance, comparable to that of Polypodiaceae, suggesting their successful establishment under the prevailing environmental conditions.

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In contrast, several families, including Hemionitidaceae, Drynariaceae, Marattiaceae, Marsileaceae, Salviniaceae, and Nephrolepidaceae, are represented by only a single species each. The limited representation of these families may be related to their narrow ecological requirements, restricted distribution, or limited suitable niches within the park.

The rich diversity and varied life forms of pteridophytes recorded in Sikhna National Park indicate that the area retains characteristics of a relatively undisturbed or virgin forest ecosystem. Among the genera, *Pteris* emerged as the largest genus with five species, followed by *Pyrrosia* and *Lygodium*. However, given the complex taxonomy and seasonal variability of pteridophytes, more extensive and long-term studies are required for comprehensive documentation and accurate identification of all taxa present in the area. Such future studies would further enhance understanding of pteridophyte diversity and contribute to effective conservation planning for this ecologically significant region.

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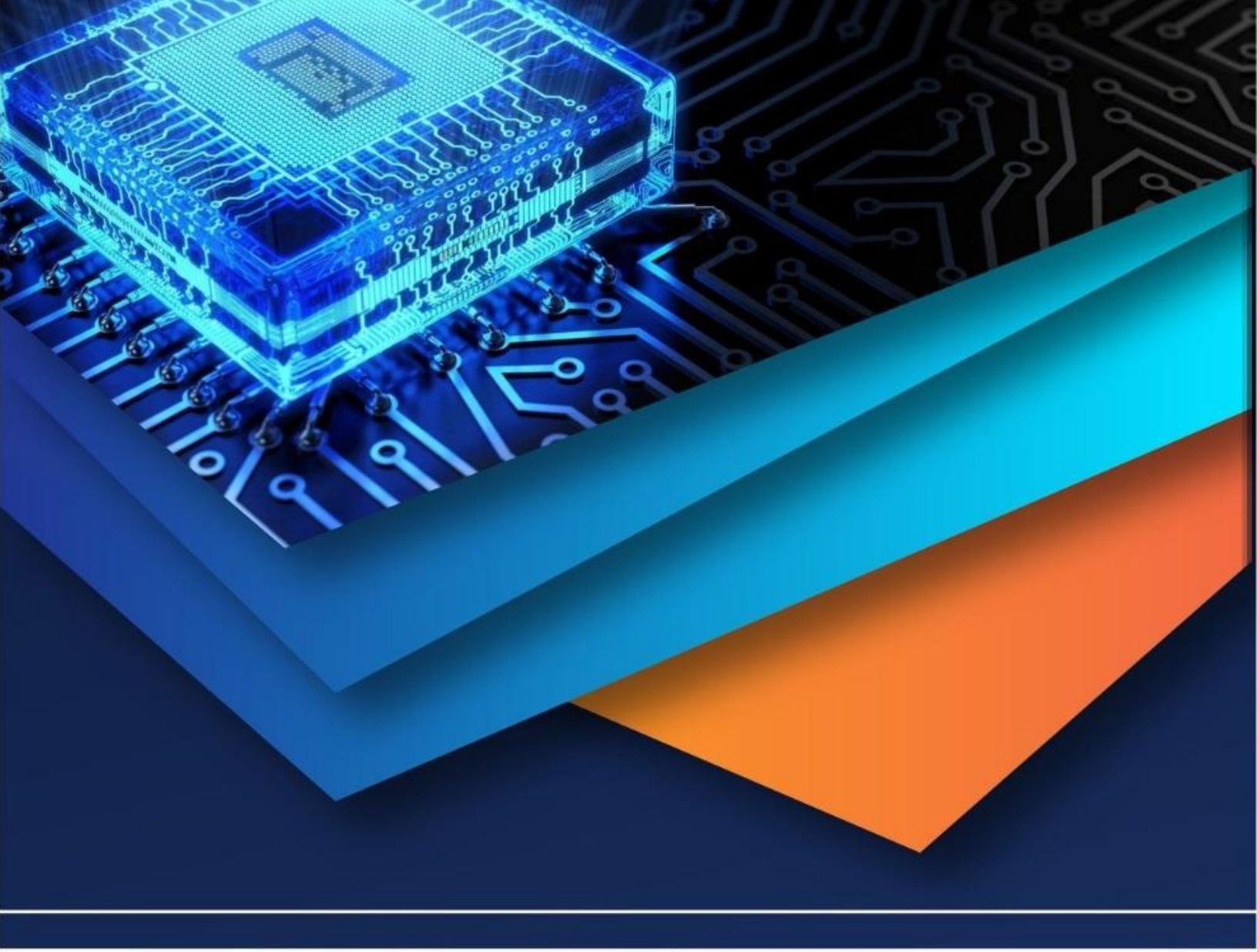
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