



## Floristic Diversity of Pteridophytes in High-Altitude Zones of the Namik Region and Surrounding Areas, Pithoragarh, Uttarakhand (Western Himalayas)

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**Abstract:** Exploratory surveys in 2021 and 2022 around the Namik Glacier, at altitudes over 7000 feet, uncovered significant pteridophytic biodiversity during the monsoon season. Extensive fieldwork from Rhugair to Thala and Namik Village to Chafu Top identified fifty-five species of pteridophytes across twenty-eight genera and fourteen families, primarily terrestrial. This region was chosen for its rich floral diversity and lack of thorough species inventories. The surveys revealed a high concentration of ferns and lycophytes between 7000 and 9500 feet, with species richness declining at higher altitudes. Lower zones, transitioning from tropical to temperate forests, were abundant in epiphytic species, which became scarce at higher elevations. Soil analyses from two sites showed alkaline pH, high organic carbon, and good levels of phosphorus and potassium, favorable for pteridophyte growth. A gradient in soil alkalinity was observed, decreasing with elevation.

**Keywords:** Pteridophyte Diversity • Namik Glacier • Uttarakhand • Western Himalayas

### Introduction

The Western Himalayan region, celebrated for its breathtaking landscapes and rich biodiversity, serves as a nurturing ground for the proliferation of ferns and their allies. This area's dense forests and diverse ecosystems create a canopy that maintains a moist and shaded environment conducive to the growth and development of these species.

Globally, approximately 1,2000 species of ferns and their associates are known, with India, encompassing both the Eastern and Western Himalayas, being home to nearly 1,000–1,200 of these species. In the Western Himalayas, Khuller (1994, 2000) documented over 361 species, while Fraser-Jenkins (2013) cataloged 184 species of ferns and lycophytes in Jammu & Kashmir. The Namik Glacier region is distinguished by its abundant floral diversity.

**Vegetation of Namik glacier regions:** The vegetation diversity in the Namik Glacier region

can be attributed to human activities, regional conditions, and microclimates. Despite these influences, the area boasts a rich array of flora. Notable higher plant species in the Namik region include *Rhododendron arboreum*, *Neolitsea pallens*, *Ficus auriculata*, *Quercus semicarpifolia*, *Taxus baccata*, *Quercus leucotrichophora*, *Celtis eriocarpa*, *Betula utilis*, and *Aesculus indica*, among others.

**Climatic conditions:** The altitude significantly impacts the local climatic conditions, leading to a wide range of weather patterns from tropical to extremely frigid temperatures. The lower elevations experience severe cold during winter, while the higher altitudes, including the glacier range, are perpetually snow-covered.

**Soil Composition:** The soil in the Namik Glacier Region is alkaline, enriched with substantial amounts of organic carbon, available phosphorus, and potassium, creating an optimal



environment for the growth and development of pteridophytes. (Table 2)

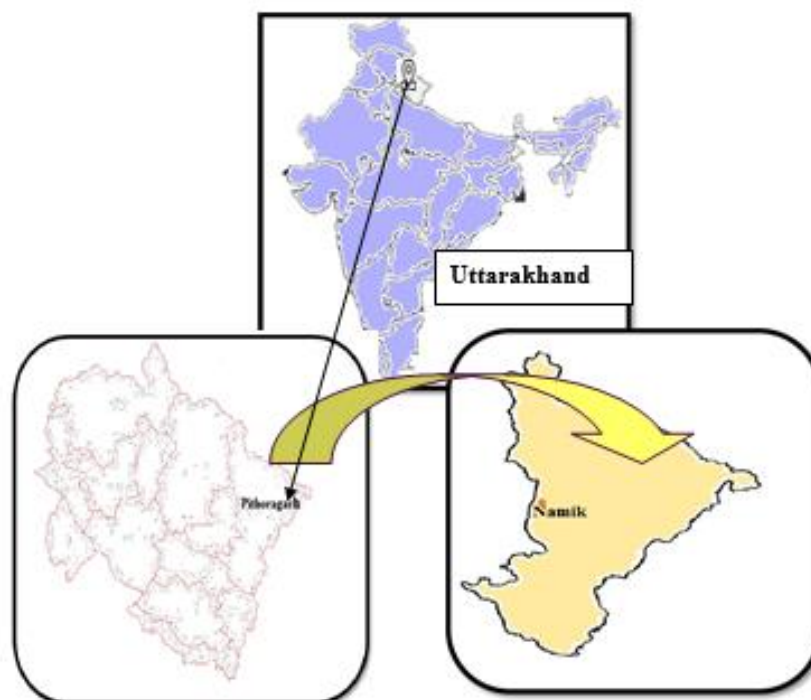
### Materials and Methods

**Field Survey and data collections:** Field surveys were conducted in September 2021 and October 2022, with comprehensive data collection from various locations within the study area. Essential data were meticulously recorded, and photographic documentation was carried out using a Nikon D 3100 camera. Species identification was facilitated by taxonomic experts, herbarium references, and related floras. The identified species were authenticated by Dr. Kamlesh Kumar Bhakuni from the Department of Botany at L.S.M. Campus, Pithoragarh. Specimens were collected personally, and a detailed list was compiled, including habitat descriptions and elevation ranges.

Plant specimens were collected, pressed, and preserved following the method described by Jain and Rao (1977). The resulting herbarium was housed at the Government Post Graduate College, Berinag, Pithoragarh. Soil samples were also obtained from two distinct sites: Thala Bugyal and Nanda Temple, and subsequently analyzed at a soil testing laboratory in Bhowali, Nainital.

### Observations and Discussion

The taxonomic nomenclature and family delimitation proposed by Fraser-Jenkins et al. (2020) have been extensively adopted. Fifty-five species were collected from altitudes exceeding 7,000 feet in the Namik Glacier Region. The genera within each family and the species within each genus are systematically presented in alphabetical order, with all families, genera, and species duly cited.



**Fig 1 Map Showing location of study area (source: Google earth and field map.)**

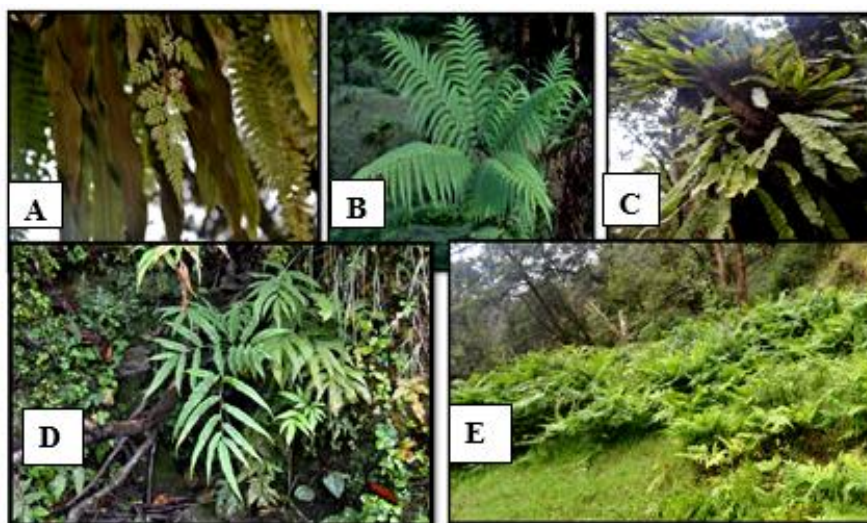


**Table 1: List of Family, Genera and Species along with altitude and Habitat of Ferns**

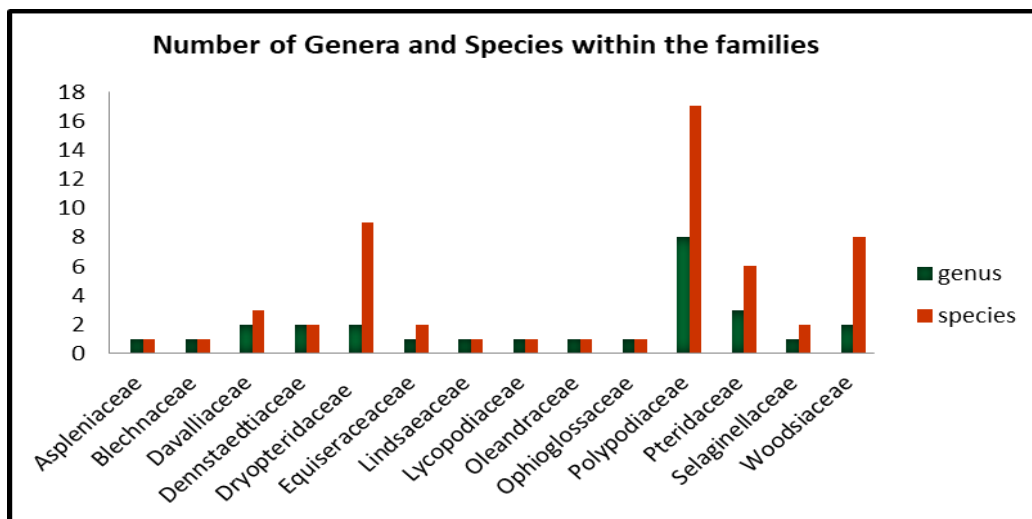
Family	Genus	Species	Elevation (In feet)	Habitat
Aspleniaceae	Asplenium	<i>Asplenium capillipes</i>	8700	Lithophyte
Blechnaceae	Woodwardia	<i>Woodwardia unigemmata</i>	7500	Terrestrial
Davalliaceae	Katoella	<i>Katoella beddomei</i>	8858	Epiphyte/Lithophyte
Davalliaceae	Katoella	<i>Katoella pulchra</i>	9049	Epiphyte
Davalliaceae	Leucostegis	<i>Leucostegia truncata</i>	7200	Epiphyte
Dennstaedtiaceae	Dennstaedtia	<i>Dennstaedtia appendiculata</i>	9437	Terrestrial
Dennstaedtiaceae	Pteridium	<i>Pteridium revolutum</i>	9825	Terrestrial
Dryopteridaceae	Dryopteris	<i>Dryopteris caroli-hopei</i>	9890	Terrestrial
Dryopteridaceae	Dryopteris	<i>Dryopteris cochleata</i>	9714	Terrestrial
Dryopteridaceae	Dryopteris	<i>Dryopteris panda</i>	9870	Terrestrial
Dryopteridaceae	Dryopteris	<i>Dryopteris redactopinnata</i>	9663	Terrestrial
Dryopteridaceae	Dryopteris	<i>Dryopteris sparsa</i>	8590	Terrestrial
Dryopteridaceae	Dryopteris	<i>Dryopteris wallichiana</i>	9590	Terrestrial
Dryopteridaceae	Polystichum	<i>Polystichum discretum</i>	10005	Terrestrial
Dryopteridaceae	Polystichum	<i>Polystichum nepalense</i>	9586	Terrestrial and Lithophyte
Dryopteridaceae	Polystichum	<i>Polystichum mehrae</i>	10081	Terrestrial and Lithophyte
Equisetaceaceae	Equisetum	<i>Equisetum arvense ssp arvense</i>	8950	Terrestrial
Equisetaceaceae	Equisetum	<i>Equisetum diffusum</i>	7210	Terrestrial
Lindsaeaceae	Odontosoria	<i>Odontosoria chinensis</i>	7600	Terrestrial
Lycopodiaceae	Lycopodium	<i>Lycopodium japonicum</i>	9000	Terrestrial
Oleandraceae	Oleandra	<i>Oleandra wallichii</i>	8612	Epiphyte, Lithophyte and Terrestrial
Ophioglossaceae	Botrychium	<i>Botrychium lanuginosum</i>	8200	Terrestrial
Polypodiaceae	Arthromeris	<i>Arthromeris lehmannii</i>	8600	Lithophyte
Polypodiaceae	Arthromeris	<i>Arthromeris wallichiana.</i>	7896	Lithophyte
Polypodiaceae	Drynaria	<i>Drynaria mollis</i>	9372	Epiphyte
Polypodiaceae	Goniophlebium	<i>Goniophlebium argutum</i>	9800	Terrestrial
Polypodiaceae	Lepisorus	<i>Lepisorus loriformis</i>	9611	Lithophyte
Polypodiaceae	Lepisorus	<i>Lepisorus mehrae</i>	10011	Epiphyte/Lithophyte
Polypodiaceae	Lepisorus	<i>Lepisorus morrisonensis</i>	7500	Epiphyte
Polypodiaceae	Lepisorus	<i>Lepisorus nudus</i>	7900	Epiphyte/Lithophyte
Polypodiaceae	Lepisorus	<i>Lepisorus scolopendrium</i>	8590	Epiphyte/Lithophyte
Polypodiaceae	Loxogramme	<i>Loxogramme involute</i>	7896	Epiphyte/Lithophyte
Polypodiaceae	Loxogramme	<i>Loxogramme porcata</i>	7250	Epiphyte
Polypodiaceae	Microsorium	<i>Microsorium membranaceum</i>	7600	Epiphyte/Lithophyte
Polypodiaceae	Pichisermollodes	<i>Pichisermollodes</i>	8600	Epiphyte



Family	Genus	Species	Elevation (In feet)	Habitat
		<i>ebenipes</i>		
Polypodiaceae	Pichisermollodes	<i>Pichisermollodes malacodon</i>	8400	Lithophyte
Polypodiaceae	Pichisermollodes	<i>Pichisermollodes stewartia</i>	8600	Epiphyte
Polypodiaceae	Pichisermollodes	<i>Pichisermollodes stracheyii</i>	9202	Epiphyte/Lithophyte
Polypodiaceae	Polypodiodes	<i>Polypodiodes lachnopus</i>	9200	Epiphyte/Lithophyte
Polypodiaceae	Selliguea	<i>Selliguea oxyloba</i>	7874	Epiphyte/Lithophyte
Pteridaceae	Aleuritopteris	<i>Aleuritopteris bicolor</i>	9700	Terrestrial
Pteridaceae	Aleuritopteris	<i>Aleuritopteris grisea</i>	9800	Terrestrial
Pteridaceae	Coniogramme	<i>Coniogramme intermedia</i>	9437	Terrestrial
Pteridaceae	Pteris	<i>Pteris cretica</i>	9000	Terrestrial
Pteridaceae	Pteris	<i>Pteris wallichiana</i>	10078	Terrestrial
Selaginellaceae	Sellaginella	<i>Sellaginella chrysocaulos</i>	8530	Terrestrial
Selaginellaceae	Sellaginella	<i>Sellaginella vaginata</i>	8250	Terrestrial & Lithophytes
Woodsiaceae	Athyrium	<i>Athyrium atkinsonii</i>	10005	Terrestrial
Woodsiaceae	Athyrium	<i>Athyrium attenuatm</i>	9437	Terrestrial
Woodsiaceae	Athyrium	<i>Athyrium fimbriatum</i>	9663	Terrestrial
Woodsiaceae	Athyrium	<i>Athyrium mackinnoniorum</i>	8670	Terrestrial
Woodsiaceae	Athyrium	<i>Athyrium rubricaula</i>	9576	Terrestrial
Woodsiaceae	Athyrium	<i>Athyrium schimperi</i>	7860	Terrestrial
Woodsiaceae	Athyrium	<i>Athyrium strigillosum</i>	9581	Terrestrial
Woodsiaceae	Woodsia	<i>Woodsia elongata</i>	10091	Epiphyte/ Lithophyte and Terrestrial



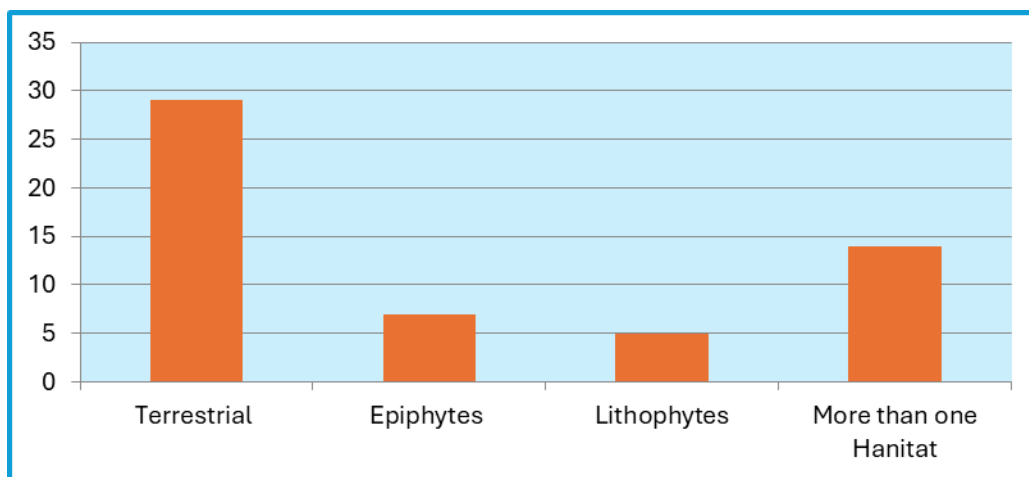
**Fig 2:** A. *Katoella pulchra* B. *Pteris wallichiana* C. *Oleandra wallichii* D. *Coniogramme intermedia* E. Population of *Pteris wallichiana*



**Fig 3: Number of Genera and Species within Families**

During the field studies conducted in 2021 and 2022, a total of 55 species of ferns and their allies were recorded, spanning 28 genera and 14 families (**Table 1**) The Polypodiaceae family was the most represented with 16 species (accounting for 30% of the total species), followed by the Dryopteridaceae family with 9 species (17%), the Woodsiaceae family with 8 species (15%), and the Pteridaceae family with 6

species (11%). These four families collectively accounted for 74% of the total species observed, indicating their dominance in the upper elevation ranges and surrounding areas of the Namik Glacier. The habitat distribution of the species was primarily terrestrial with 29 species, while epiphytes and lithophytes were represented by 7 and 5 species, respectively.



**Fig 4: Diagram displaying the Number of species in different habitat types**

**Table 2: Results of Soil sample analysis:**

Sampling area (Namik)	pH	Organic C (%)	Available-P (Kg/ha)	Available -K (Kg/ha)
Nanda-temple 8000 ft	7.2	1.63	27.1	211





<b>Thala 10000 ft</b>	6.9	1.49	26.5	270

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