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An ecological enumeration of pteridophytic flora from Pithoragarh, Central Himalayan province (U.K.) India

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ABSTRACT

Terrestrial ecological survey, preparation of comprehensive checklist, soil analysis in relation to fern diversity and growth were the main objectives of the study in Pithoragarh, Uttarakhand. Classification, taxonomy, identification, nomenclature, and conservation status of Pteridophytes were done by autistic, viable and suitable literature. Soil analysis was done by a specific given protocol separately. In our study, a total of 17 families, 27 genera, and 37 species of Pteridophyta were recorded. Various types of habitat for this flora were noticed, including Lithophytes, moist places, Mesophyll, forest floor, and epiphyte. The average soil pH was 6.7, organic carbon was 1.923%, nitrogen was 0.406%, phosphorus was 3.40 ppm and potassium was 31.33 ppm, all recorded at the site of study. Most species were noticed as common in all the spots, but *Pteridium aquilinum and Christella arida* were the main rare species in the area.

Figure : 01 References : 31 Tables : 03
KEY WORDS : Biodiversity, Ecology, Himalayan flora, Pteridophyte

Introduction

The term “pteridophyte” originated in Greek literature. Because “Pteron” refers to a feather and “Phyton” refers to plants, Pteridophyte plants have feather-like fronds (leaves).Pteridophytes generally grow in shady, moist habitats[16]. Pteridophytes are cryptogms. Kryptus means hidden and Gammos means weeded or marriage in Greek, so these plants have invisible or hidden sex organs[5]. Pteridophytes have a lengthy geological history on Earth, dating back to the Silurian epoch, 380 million years ago. This broad collection of plants served as a link between non-vascular cryptogams and seed plants and they still occupy a variety of niches on land, in marshes, swamps, and even in bodies of water[7].

Some fern species grow on soil and on rocks, whereas others are restricted to rocky environments and may grow as epiphytes in tropical rain forests[2]. Ferns are an important aspect of a given area’s vegetation. Pteridophytes are well recognised for their therapeutic properties and many of them have been used for this purpose since antiquity[19]. Pteridophytes are highly affected by changes in their microclimate, which means they have their own specific temperature, humidity, soil type, moisture and pH, light levels, *etc.* Through ecological study of any area, we get an idea of its flora and its interaction with different factors of the environment, which forms the basis of information about the distribution of plant communities and their involvement with the external environment[2].

Various research in the past were done in the various aspects of ecological study of Pteridophyta[1,3,4,6,8,12,15,23,25,29,30]. Due to their unique morphology and existence as non-seed-bearing and seed-bearing plants, pteridophytes contribute to enhancing the richness of biodiversity. This place is a remote area, which is why it’s very difficult to visit and has significant value from a biodiversity and ecological point of view. There was a literature gap, especially on this research topic in this area, so aim of the study was to fill the literature gap. The study’s main goals were to conduct a terrestrial ecological survey, create a comprehensive checklist, and analyse soil in relation to fern diversity and growth.

Methodology

The main place of study was the Indo-Nepal border

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TABLE-1: List of Pteridophyta flora, comparative account of habitat, distribution and status

S. No.	Family	Genus	Species	Habitat	Distribution range 1550 to 1620 m	Conserv-ation Status
1.	Seleginelleceae	*Seleginella*	*biopteria*	Moist place	1600m	comman
2.	Equisetaceae	*Equicetum*	*diffusum*	Moist place	1550m	comman
3.	Botraychiaceae	*Botrychium*	*lanuginosum*	Moist place	1600m	common
4.	Glecheniaceae	*Dicranopteris*	*linearis*	Forsest floor	1600m	comman
5.	Lygodiaceae	*Lygodium*	*flexuosum*	Epiphyte	1570m	Comman
6.	Dennstaedtiaceae	*Microplepia*	*strigosa*	Forest floor	1570m	Common
7.	Pteridiaceae	*Pteridium*	*aquilinum*	Mesophyll	1620m	Rare
8.	Pteridaceae	*Cheilanthes*	*bicolor*	Moist place	1600m	Comman
			rufa	Lithophytes	1550m	Common
		Pteris	*aspercaulis*	Mesophyte	1560m	Common
			biaurita	Mesophyte	1610m	Common
			vittata	Forest floor	1650m	Common
			wallichiana	Mesophyte	1600m	Common
		Onychium	*japonicum*	Moist place	1570m	Common
9.	Heminiotidaceae	*Coniogramme*	*caudata*	Forest floor	1570m	Common
		Gymnopteris	*vestita*	Lithophytes	1620m	Common
10.	Aspleniaceae	*Asplenium*	*dalhousiae*	Lithophytes	1560m	Common
11.	Athyriaceae	*Athyrium*	*davidii*	Lithophytes	1610m	Rare
		Deparia	*japonica*	Moist place	1650m	Common
			boryana	Moist place	1600m	Common
		Diplazium	*esculentum*	Mesophyll	1550m	Cultivated
			polypodioides	Forest floor	1600m	Common

12.	Thelypteridaceae	*Christella*	*arida*	Forest flore	1600m	Rare
			dentata	Moist place	1600m	Common
		Glaphyropteri-dopsis	*erubescens*	Moist place	1550m	Common
13.	Dryopteridaceae	*Dryopteris*	*chochleata*	Forest floor	1560m	Common
			juxtaposita	Forest floor	1550m	Common
			sparsa	Moist place	1600m	Rare
		Polystichum	*lentum*	Lithophyte	1600m	Common
			squarrosum	Forest floor	1550m	Common
14.	Blechnaceac	*Woodwardia*	*unigemmata*	Moist place	1560m	Common
15.	Nephrolepidaceae	*Nephrolepis*	*auriculata*	Mesophyll	1560m	common
16.	Polypodiaceae	*Arthomeris*	*wallichiana*	Lithophytes	1600m	common
		Lepisorus	*nudis*	Forest floor	1550m	Common
		Micresorium	*membrana-ceum*	Epiphyte	1600m	common
		Pyrrosia	*flocculosa*	Epiphyte	1600m	common
17.	Hypodematiaceae	*Hypodematium*	*crenatum*	Lithophytes	1600m	Common

district of Pithoragarh (29.66560 N to 80.14890 E), as this area was one of the most disaster prone zones in Uttarakhand state. Samples were collected during a period of one year by the quadrate method of 10X10 metres. The five main aspects of the study were the systematic study of fauna, statistical analysis, soil analysis, faunal habitat determination and conservation status of the fauna.

Systematics included classification, taxonomy, identification and nomenclature. That was basically done with the help of sutaible literature[8-10,16,21]. Biostatistical analysis like frequency, density and abundance of the flora was done by various specific formulas in MS Excel data software tools. Six soil parameters were analysed using various methods, including water holding capacity[22], nitrogen estimation[17], phosphorus estimation, potassium estimation[24], organic carbon estimation[31] and soil pH was measured using a digital pH meter.Habitat determination of the flora was done by observation and verified by the available literature[8,11,20]. To know the conservation status, rare and endangered species were identified by referring to the Red Data Book of India, following the IUCN Red List of plants[13] and with the help of other available literature.

Results

In our study, a total of 17 families, 27 genera, and 37 species of Pteridophyta were recorded. Table-1 and

TABLE-2: Comparative account of Pteridophyta ecological statistics of the study area

S. No.	Genus	Species	Ecological analysis		
			Frequency (%)	Density	Abundance
1	*Seleginella*	*biopteria*	40	05.40	13.50
2	*Equicetum*	*diffusum*	40	03.40	8.50
3	*Botrychium*	*lanuginosum*	50	17.80	35.60
4	*Dicranopteris*	*linearis*	20	0.90	04.50
5	*Lygodium*	*flexuosum*	30	01.70	05.66
6	*Microplepia*	*strigosa*	50	03.90	07.80
7	*Pteridium*	*aquilinum*	40	03.20	08.00
8	*Cheilanthes*	*bicolor*	50	07.50	15.00
		rufa	30	04.40	14.66
9	*Pteris*	*aspercaulis*	50	15.20	30.40
		biaurita	30	13.50	45.00
		vittata	50	09.40	18.80
		wallichiana	20	00.30	01.50
10	*Onychium*	*japonicum*	10	00.30	03.00
11	*Coniogramme*	*caudata*	30	01.20	04.00
12	*Gymnopteris*	*vestita*	20	00.40	02.00
13	*Asplenium*	*dalhousiae*	40	03.80	09.50
14	*Athyrium*	*davidii*	20	01.60	08.00
15	*Deparia*	*japonica*	50	09.00	1.00
		boryana	40	05.40	13.50

16	*Diplazium*	*esculentum*	50	07.40	14.80
		polypodioides	30	03.60	12.0
17	*Christella*	*arida*	50	04.40	88.80
		dentata	30	07.50	15.00
18	*Glaphyropteridopsis*	*erubescens*	40	09.00	1.00
19	*Dryopteris*	*chochleata*	30	04.40	14.66
		juxtaposita	40	01.60	04.00
		sparsa	30	07.50	15.00
20	*Polystichum*	*lentum*	20	3.30	16.50
		squarrosum	50	44.40	88.80
21	*Woodwardia*	*unigemmata*	40	04.20	10.50
22	*Nephrolepis*	*auriculata*	40	01.60	04.00
23	*Arthomeris*	*wallichiana*	50	2.80	5.60
24	*Lepisorus*	*nudis*	20	3.30	16.50
25	*Micresorium*	*membranaceum*	40	5.70	14.23
26	*Pyrrosia*	*flocculosa*	30	2.40	8.00
27	*Hypodematium*	*crenatum*	40	2.80	7.00

Fig. 1 show a list of Pteridophyta flora, as well as a comparative account of habitat, distribution, and status.Various types of habitats were recorded, including lithophytes, moist places, mesophyll, forest floor, and epiphytes (Table-1). The family Polypodiaceae dominated in this region, with four genera and four species (Table-1). The main sampling area of our study was Pithoragarh, ranging from 1550 to 1620 metres in elevation (Table-1).

At the highest frequency, *Botrychium lanuginosum, Microplepia strigosa, Cheilanthes bicolor, Pteris aspercaulis, Pteris vittata, Deparia japonica, Diplazium esculentum, Christella Arida, Polystichum squarrosum,* and *Arthomeris wallichian*a have the highest frequency with a value of 50 (Table-2). *Pteris aspercaulis* has the highest "density" with a value of 15.20 (Table -2). *Christella arida* has the highest 'Abundance' with a value of 88.80 (Table-2).

The average soil pH was 6.7, organic carbon was 1.923%, nitrogen was 0.406%, phosphorus was 3.40 ppm, and potassium was 31.33 ppm, all recorded at the site of study (Table-3). Pteridophyta of the study area show variation in their niche; that variation shows the adaptive property. Five major types of Pteridophytan habitats were noticed. As shown in (Table-1), the various pteridophytic niches were epiphyte (08%), lithophytes (19%), forest

TABLE-3. Soil analysis of the study area

S. No.	Content	Unit	Observations			
			Spot 1	Spot 2	Spot 3	Average
1	pH of soil	-	6.8	6.2	7.1	6.7
2	organic carbon	%	1.12	2.11	2.54	1.923
3	Nitrogen	%	0.31	0.50	0.41	0.406
4	Phosphorous	ppm	3.2	4.1	2.9	3.40
5	Potassium	ppm	39	24	31	31.33

floor (27%), moist place (30%), and Mesophyll (16%).Most species were noticed as common in all the spots, but *Pteridium aquilinum and Christella arida* were the main rare species in the area (Table-1).

Discussion

Due to climatic conditions, the Central Himalayan region is very rich in floral diversity. In our study, a total of 14 families, 24 genera, and 34 species of Pteridophyta were recorded. These findings of our study were supported by various research reports as they found out that the Himalayan region was full of Pteridophyten diversity[8-10,16,25].

Diversity and variation in the Pteridophyta species are due to climatic factors, environmental factors, elevational gradients and geographical variation. Other research says that geographical variation[31], elevational gradients[14], climatic variables along with elevational gradients[1,11] are the key factors for species richness.

In the soil analysis, the pH of soil, organic carbon, nitrogen, phosphorus, and potassium were estimated, analysed and observed by specific methods. In the present study, soil was rich in nutrients for floral growth. The distribution of species is influenced by nutrient availability as well as climatic factors such as growing season length, humidity, air pressure, and rainfall[18].

The ecological study included various ecological parameter calculations, such as frequency, density, abundance, and determination of habitat niche. Previous studies on fern ecology were also similar to the findings of the present work[12,14], which were in support of our findings. Because each species of fern has different microhabitat preferences, they serve as indicators of the conditions they require[26]. Some species were found to be rare and variation in the habitats of fauna was also noticed. In our study, those were epiphytes, lithophytes, forest floor, moist places, and mesophyll. The Himalayan region is rich in various rare species of fern that occupy various ecological niches[20,21].

Conclusions

Pteridophytic plant diversity was abundant in the study area. The area's ever-changing soil environment aided in the development of remarkable floral variety. Various edaphic factors have a positive impact on Pteridophytic fauna in the examined habitat (biotic factor). A few rare species were also noticed along with fern habitat variation and well demarked in the study area.

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Fig. 1 : All species of Pteridophyta from the study area, numbering of the species according to the sequence in Table-1.

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