Research Article

Biodiversity and conservation Ferns Diversity in different forests of Dehradun district

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ABSTRACT
The present study was undertaken to document the detail account of the 98 ferns growing in 16 different forest types. In this context, substantial field surveys were carried to identify their natural habitat, their distribution pattern and analysis their threat causes.The maximum fern diversity is observed in Moru Oak forest. The genus *Pteris* is reported to be the most diverse and dominant fern. The forest also encompasses some of the rare fern of the area. Anthropogenic activites is the main cause of depletion of its natural habitat .Some of the conservation measures includes establishment of fern house, Eco-restoration areas, Construction of green houses to protect the rare species.

Key words: Fern diversity, Moru Oak forest, Dehradun district.

INTRODUCTION

The Pteridophytes are the oldest land plants on earth, flourished so well in past and dominated the earth vegetation about 280–230 million years ago. Presently, Pteridophytes do not form dominant vegetation anywhere in the world flora. They further grouped in to two broad groups Fern-allies and Ferns. Among these the ferns constitute a major element of the Pteridophytic flora. They are most dominating and diverse group of pteridophytes throughout the world and includesca 300 genera and *ca.* 12000 known species (Chandra 2000). Most of the fern species are distributed in tropical and subtropical areas with limited distribution in temperate regions. They prefer to grow in cool, moist and shady places. In monsoon season, they luxuriously grow with varied range of habitats like trees, boulders, rocks, walls, crevices, deep ravines, and forest floors, open and dry slopes and in aquatic environment also. Forest is a complex ecosystem composed of communities of plants, animals, micro-organisms interacting with each other and their environment which consists of abiotic components such as soil, water, air. Of the total geographical area of 3088km^2 the forest cover of the district is divided into dense forest with 1239 km^2, open forest with 331 km^2 and that of scrub with 90 km^2 with total of 1570 km^2.Most of the part of the district is dominated by shorea robusta upto 1000m while 1000-1500m are covered by mixed forest of *Lannea coromandelica, Toona ciliata, Terminalia alata, Bombax ceiba, Acaia catechu* and many more common trees and shrubs.While 1500-2000m are replaced by gymnosperms such as *Pinus rouxburghii, Quercus leucotrichophora and Rhododendron arboretum* and between 2500-2800m the trees of *Pinus wallichiana, Cedrus deodara, Quercus semicarpifolia, Picea smithiana* etc are observed. The Classification of Champion & Seth (1968) provides an elaborate description of forest types of India in six major groups which are further divided into 16 type groups and finally into 200types including subtypes and variations of forests. As per Champion & Seth, the determining factors of the forest types are climate, soil, vegetation and the past treatment (including biotic interference).The image1 is the map showing different types of forest in the district

The forest types of the district according to Champion & Seth are:

Moist Shivalik Sal forest

1. Dry Shivalik Sal forest
2. Western Gangetic moist mixed deciduous
3. Northern Dry-Mixed Decidous Forests
4. KhairSisso forest
5. Dry deciduous Scrub
6. Lower or ShiwalikChir Pine forest
7. BanjOak Forest
8. MoruOak forest
9. Western mixed Coniferous forest
10. Moist temperate deciduous forest
11. Sub- tropical Euphorbia scrub
12. Himalayan temperate secondary scrub forest
13. Low level Blue pine forest
14. Western Himalayan upper Oak-Fir forest
15. Alder forest

Material And Methods

Study area

Dehradun district including Chakrata hills, lies between 2957′–312′N latitude and 7757′–7920′E longitude, in the South-West of Uttarakhand state. The altitude of the distict varies from 250 to 2850m. A major part of the district is covered by forest. The *Shorea robusta* (Sal) is the principal species in Doon valley. Pteridophytic vegetation in the district is also rich and diverse specially, above 1500m like Chakrata and Mussoorie hills.

Extensive field visit was carried out during 2009–2012 of the district. During the field exploration of the specimen's habitat, morphological characters and types of forest was documented of the collected specimens. The identification of the collected specimen was done in consultation with different literatures (Kanjilal 1956, Chowdhery 1973, Bir 1963, 1977, 1987, Clarke 1880, Dhir 1980, Dixit 1992, Rana *et al.* 2001).

Figure 1. Forest Cover Map of Dehradun district Source: India State of Forest Report, 2009, Forest Survey of India.

Result And Discussion

The present study records 98 species of ferns from the 16 different types of forests of Dehradun district (Table-1). The species diversity of ferns in the different forest types of the district is represented by figure2.which indicates that maximum diversity is been reported from the Moru Oak forest with 33 species followed by Alder forest having 27 species. Then Banj Oak Forest with 25 species followed by Northern Dry Mixed Deciduous Forests with 20 species of fern distributed in the forest area.It is followed by Western mixed coniferous forest with 19 fern species, then Moist temperate deciduous forestwith 16 species. Fig.3 shows the images of some of the dominant fern species reported from the forest of the study area. Further study of the fern diversity in different forest types of the district reveals that the *Pteris* is dominant genus among the all the fern diversityand the species belonging to this genus is *Pteris vittata* the most common species distributed in 9 different types of forest followed *Pteris cretica*, *Pteris aspercularis* 7, 6 respectively. The other dominant genus includes *Adiantum* where species of *Adiantum edgeworthii and Adiantum incisum* distributed in 6 different types of forest as represented in the Fig 4.The composition, density and distribution of Pteridophytic flora vary with the altitudinal zonation, climatic condition, humidity, soil, amount of light and nature of forests. The observation also depicts the ecological diversity of the fern in forest such as terrestrial, epiphytic, lithophytic, ravine ferns etc. The dominant terrestrial fern found are *Athyrium schimperi, Coinogramme pubescens, Dryopteris chrysocoma, Dryopteris nigropalacea, Polystichum squarrosum* while dominant, epiphytic and lithophytic ferns are *Drynaria mollis, Hypodematium crenatum, Microsorum membranaceum, Polypodiodes microrhizoma*. Ravine fern such as *Conoiogramme pubescens. The forest also dwells some of the* rare species such as *Araiostegia beddomei, A.hookeri, Asplenium adiantum-nigrum, Asplenium yunnanense, Botrychium ternatum, Cystopteris dickineana, Cyrtomium macrophyllum, Deparia allantodioides, Dryopteris barbigera, D.justaposita, D.xanthomelas, D.wallichiana, Polystichum yunnanense, Leptochilus decurrens*. Thus the covered and shaded forest with dense canopy and moist condition harbors maximum fern diversity that is 33 species of ferns is reported from the Moru Oak forest; while minimum4 from the Sub-tropical Euphorbia scrub forest types. It could be inferred that the ferns are found most abundantly in moist shaded damp and humid condition and which is provided by the dense canopy covered forest

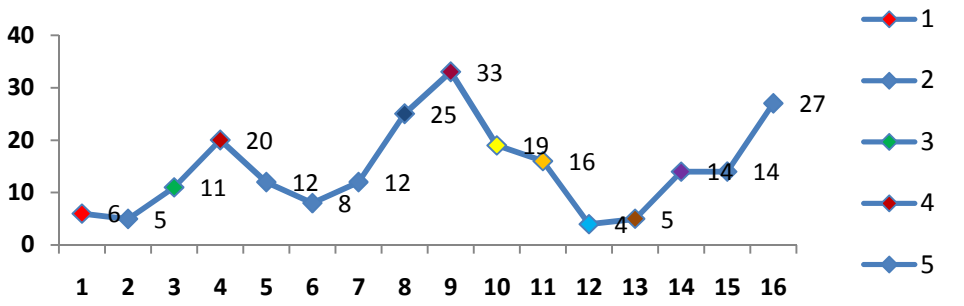

Figure 2.Fern species diversity in different forest types. (1, Moist Shivalik Sal forest; 2, Dry Shivalik Sal forest; 3, Western Gangetic moist mixed deciduous forest; 4, Northern DryMixedDecidous Forests; 5,KhairSisso forest; 6, Dry deciduous Scrub; 7, Lower or ShiwalikChir Pine forest; 8,BanjOak Forest; 9,MoruOak forest; 10, Western mixed Coniferous forest; 11, Moist temperate deciduous forest; 12, Sub-tropical Euphorbia scrub; 13, Himalayan temperate secondary scrub forest; 14, Low level Blue pine forest; 15, Western Himalayan upper Oak-Fir forest; 16, Alder forest.)

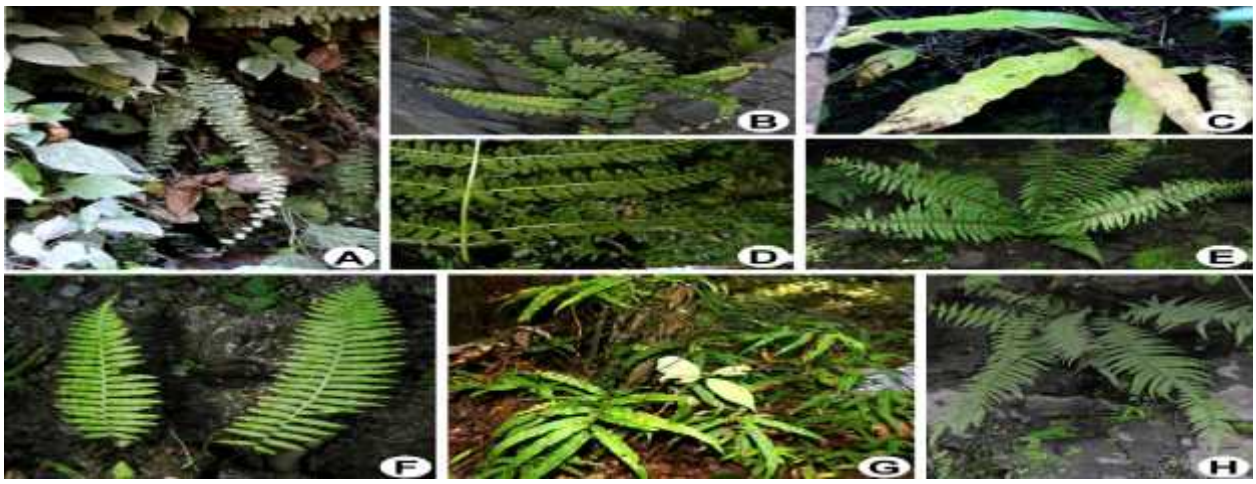

Figure 3. Photo of some dominant fern species: A. Adiantumedgeworthii; B. Adiantumincisum; C. Athyriumschimperi; D. Microsorummembranaceum; E. Polystichumsquarrosum; F. Polypodiodesmicrorhizoma; G. Pteriscretica; H. Pterisvittata.

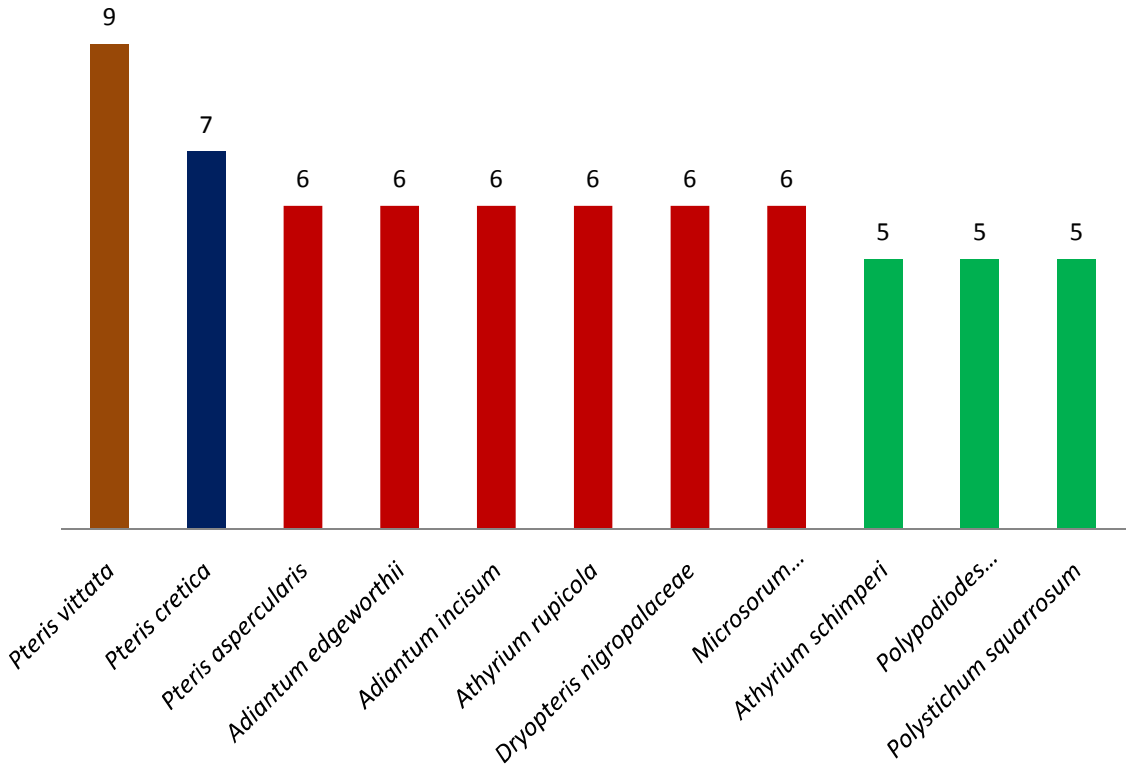

Figure 4. Dominant fern species in reported from number of localities (forest types).

Table 1. Distribution of fern species in 16 different forests of Dehradun district.

Name of the species	Forest Types															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Family *Adiantum edgeworthii* Hook	+	-	+	+	+							+				
*Adiantum incisum*Forssk	+		+	+			+					+		+		
Adiantum philipenses L.						+	+									
*Adiantum venustum*D.Don								+	+	+						
Aleuropterisrufa(D.Don) Ching		+	+													
Araiostegia beddomei(C.Hope) Ching															+	

Araiostegia hookeri(Moore ex Bedd.) Ching																+
Arthromeriswallichiana (Spreng.) Ching								+								+
Asplenium adiantum-nigrum L.																
Asplenium dalhousiae Hook.		+			+											
*Asplenium laciniatum*D.Don								+	+							
Asplenium trichomanes L.									+							+
Asplenium unilaterale Lam.														+		
*Asplenium yunnanense*Franch.									+							
Athyrium fimbriatum. Moore																
Athyrium mackinnoniorum (C.Hope) C.Chr											+				+	
Athyrium rupicola (C. Hope) C.Chr														+		
*Athyrium schimperi*Moug.						+		+		+	+					+
Botrychium ternatum(Thunb.) Sw										+					+	
Coniogramme fraxinea(D.Don.) Fee ex Diels															+	
Coniogramme affinis (C.Presl) Hieron														+		
*Coniogramme pubescens*Hieron								+	+	+	+					
Coniogramme serrulata (Blume.) Fee											+			+		
*Cyrtomium caryotideum*C.Presl															+	
Cyrtomium macrophyllum(Makino)Tagawa															+	
*Cystopterisdickineana*Sim															+	
Deparia allantodioides (Bedd.)M.Kato															+	
Diplazium esculentum (Retz.) Sw.			+	+												
*Diplazium longifolium*Moore								+	+							
Diplazium maximum (D.Don) C.Chr								+	+							
*Drynaria mollis*Bedd.																
Drynaria propniqua(Wall. ex Mett.) Smith			+	+				+								
Dryopteris barbigera (Moore) Kuntze	+	+		+		+							+		+	
*Dryopteris caroli-hopei*Fraser-Jenk.										+						
Dryopteris chrysocoma (Christ) C.Chr				+			+	+	+	+						+
*Dryopteris juxtaposita*Christ									+							+
Dryopteris nigropaleacea (Fraser-Jenk) Fraser-Jenk.									+							
Dryopteris ramosa (Hope) C.Chr									+							
Dryopteris wallichiana (Spreng.) Hyl.								+	+	+					+	
Dryopteris xanthomelas (Christ) C.Chr																
Gymnopteris vestita (Hook.) Underw.							+									
Hypodematium crenatum Kuhn & Decken													+			
Hypolepis polypodioides (Blume) Hook				+		+						+	+			
Leptochilus decurrens(Blume)							+									

Panigrahi																
Loxogramma involuta (D.Don) C.Presl.				+				+								
Lygodium flexuosum (L.) Sw.		+			+											
Lygodium japonicum (Thunb.) Sw.				+										+		
Metathelypteris gracilescens(Blume) Ching								+	+	+	+				+	
Microsorum membranaceum (D.Don) Ching																
Nephrolepisauriculata(L.) Trimen				+		+										
Odontosoria chinensis(L.) J. Sm.											+					
Oleandra wallichii (Hook.) C.Presl									+							
*Onychium cryptogrammoides*Christ											+					
*Ophioglossum reticulatum*L.																
*Ophioglossum petiolatum*Hook.						+										
Osmunda claytonia L.									+							
Pellaea nitidula(Wall.ex Hook) Baker									+							+
Pichisermollia ebenipes(Hook) Fraser-Jenk.									+	+	+				+	+
Pichsermollia malacodon(Hook) Fraser-Jenk.										+	+				+	
Polypodiodeslachnopus(Wall.ex Hook.) Ching					+		+		+							+
Polypodiodesamonea (Wall.exMett.) Ching							+		+							+
Polypodiodesmicrorhizoma (Clarke) Ching					+	+			+		+					+
Polystichum discretum J. Sm										+				+		
Polystichum lentum (Don) T.Moore								+								
Polystichum luctuosum (Kunze) T.Moore									+							
*Polystichum mehrae*Fraser-Jenk&Khullar								+								
*Polystichum neolobatum*Nakai									+							
Polystichum squarrosum Fee.							+	+	+	+	+					
*Polystichum stimulans*C.Presl.								+	+							
*Polystichum yunnanense*Christ																
Pronephrium nudatum(Roxb.) Holttum.			+					+								
Pronephrium penangianum (Hook.) Holttum			+						+							
Pseudocyclosorus canus(Baker) Holttum&JeffW.Grimes														+		
Pseudocyclosorus tylodes(Kunze) Ching							+									
Pseudophegopteris levingei (C.B.Clarke) Ching								+								
*Pseudophegopteris pyrrhorachis*ssp. *distans*Fraser.									+							
Pseudophegopteris pyrrhorhacis (Kunze) Ching									+							
Pteridium revolutum (Blume.) Nakai								+	+	+						+
*Pteris aspericaulis*Wall. ex				+						+						

Agardh																
*Pteris biaurita*L.	+				+			+	+	+			+			+
*Pteris cretica*L.								+	+							+
*Pteris dactylina*Hook.							+	+								+
*Pteris vittata*L.					+	+										
Pyrrosia flocculosa (D.Don) Ching	+	+		+												
Pyrrosia porosa (C.Presl.) Hovenkamp.				+										+		
Selliguea oxyloba(Wall. ex Kunze) Fraser-Jenk.											+					
Tectaria coadunate C.Chr			+	+										+		
Thelypteris arida(D.Don) Morton			+	+												
Thelypteris dentate (Forssk.) E.P.St.John				+												
Thelypteris erubescens (Wall.ex Hook.) Ching				+	+											
Thelypteris papilio(C.Hope) K.Iwats								+								
Thelypteris parasitica(L.) Fosb.				+	+											
Thelypteris appendiculata(Blume) C.F.Reed .									+							+
Thelypteris auriculata(J.Sm) K.Iwats				+	+											
Thelypteris prolifera (Retz.) Voster			+	+	+											
Vittaria flexuosa Fee									+							+
Woodsia elongata Hook.									+							+
*Woodwardia biserrata*C.Presl							+	+								+

1- Moist Shivalik Sal forest; **2-**Dry Shivalik Sal forest; **3-**Western Gangetic moist mixed deciduous forest; **4-** Northern DryMixed Decidous Forests; **5-**KhairSisso forest; **6-** Dry deciduous Scrub; **7-** Lower or ShiwalikChir Pine forest; **8-**BanjOak Forest; **9-**Moru Oak forest; **10-** Western mixed Coniferous forest; **11-** Moist temperate deciduous forest; **12-** Sub-tropical Euphorbia scrub; **13-** Himalayan temperate secondary scrub forest; **14-** Low level Blue pine forest; **15-** Western Himalayan upper Oak-Fir forest; **16-** Alder forest.

Thus the study draws it attention that diversity of the forest in the district is depleting at very high rate. The major cause is the anthropogenic activities. Since the district is capital of the state which is under high pressure of industrialisation, commercialisation etc. leading to minimising of the forest area thus damaging the indigenous flora and endangering its ecological balance. The issue is of major concern and the conservation using steps should be taken as early as possible. Some of the measure includes:

1.In-situ conservation by establishment of fern house in botanical garden

2.Human interference in the forest area should be prevented

3.Active participation of local people by setting up of floricultural center for the fern too along with other plant species

4.Identification of hot-spots and rare ferns and their proper management should be implemented

5.Construction of green houses to protect the rare species

6.Promotion of establishment of forest conservatories to protect this valuable bioresource in natural conditions.

7.Eco-restoration areas to be established in the district to conserve the habitat of lithophytic ferns.

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