

Floristic Study of Fern and Fern Allies Along Altitudinal Gradient from Besishahar to Lower Manang, Central Nepal

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Abstract

Pteridophytes is a group of plants comprising of fern and fern allies has drawn attention of many botanists relating to the systematic of pteridophytic flora. This study aimed for documenting floristic information of fern and fern allies along altitudinal gradient from Besishahar to Lower Manang, Central Nepal. A total number of 99 species of pteridophytes belonging to 20 families and 48 genera are recorded. Among 20 families, Pteridaceae was the largest family having 11 genera while *Thelypteris* is the largest genera occupying nine species. On the basis of habitat, majority has shown by terrestrial followed by epiphytic and remaining by lithophytes. From the above study, Oak- Laurels- Rhododendron shows the highest diversification on the distribution of pteridophytes with an elevation range from 2000-2600m.

Keywords: *Distribution, Diversification, Flora, Floristic information, Pteridophytes*

Introduction

Fern and Fern allies are extremely fascinating for their both phylogenetic and morphological aspects, for the unique position occur between non-seed bearing and seed bearing plants. Flora of fern and fern allies from the Himalayan region considered to be basic requirements for knowledge in field of Pteridology (Gurung 1994). Thereby, fully annotated checklist critical account of 550 species and an addition 30 subspecies of pteridophytes with 580 taxa have been recently published from Nepal in the book entitled "Ferns and Fern allies of Nepal" by Fraser- Jenkins et al. (2015).

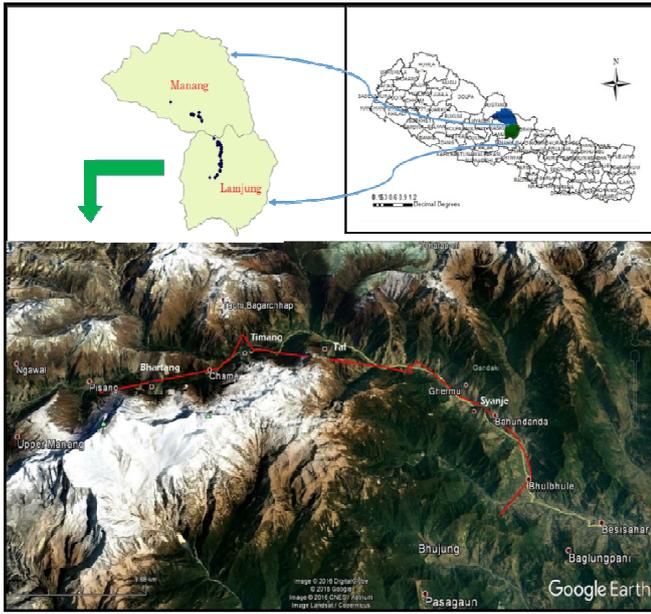
History on study of Pteridophytes begin after the publication of "Species Plantarum" by Linnaeus in 1753, having 140 genera with 182 species of Pteridophytes. The pioneer plant exploration and taxonomic study of Nepalese Pteridophytes, along with other groups of plants, started since the work of British botanists. The famous botanist Franchis Buchannan (Later Franchis Hamilton) was the first collector of Nepalese plants in 1802-1803 who published a book "An account of kingdom of Nepal" including 34 species of pteridophytes collected by him. After that, many works on exploration was done and has been doing till date by different pteridologist

in the field of documentation along with molecular study for the sake of evolutionary history of pteridophytes. As earlier reports also mentioned that the exploration and care of fern flora really deserves attention (Shrestha, 1999) therefore, this research is foremost step to fulfill the gap experienced, especially on the floristic study keeping in mind to add new information as far as possible and working in areas which have not been explored so far which can be equally helpful for biodiversity management and conservation of pteridophytic species before it get vanished from the Nepal's land. In addition, this study aims on documentation of the floristic information of pteridophytes along altitudinal gradient from Besishahar to Lower Manang, Central Nepal (Fig. 1)

Materials and Methods

Study area

The study area Lamjung district is situated between 27°55'N and 28°25'N latitude and 85°00'E and 85°50'E longitude and its elevation varies from 596 - 7893 m above sea level. It has an area of 1692 km² and a population of 167,724. Lamjung lies in the mid-hills of Nepal with spanning from tropical to Trans-Himalayan geo-ecological belts. It has mixed



Source: GIS, Google earth

Figure 1: Map of the study area showing route from Besishahar to Pisang

habitation of different caste and ethnicity - host probably the highest density of Gurung ethnic population in the country. Manang district is a part of Annapurna Conservation Area, lies in the northwest Central Himalayas of Nepal. The U-shaped inner valley extends east to west and is situated between $28^{\circ}37'56''$ and $28^{\circ}39'55''$ N latitude and $83^{\circ}59'83''$ and $84^{\circ}07'97''$ E longitude. The elevation ranges from 3000 to 3500 m has dry climatic condition, characteristic of the Trans-Himalayan region. The mean annual precipitation about 400 mm is due to the rain shadow of Annapurna massif (ICIMOD 1995). Vegetation of the study area was quite distinct from tropical (900m) to high altitude (3560m) ranging from farm-lands to almost alpine meadows (3650m), including various type of forest from *Schima*, *Alnus*, Laurels, *Picea*, *Larix*, *Quercus*, *Pinus*, *Rhododendron*, *Acer*, *Juniperus*.

Field visit, Collection of Pteridophytes

As research is oriented for floristic study of fern and fern allies along altitudinal gradient thus for the collection of Pteridophytes, frequent field trips were arranged in different seasons viz; June, August and October so as to record all the diversity of fern and fern allies from Besishahar to Lower Manang.

Before collection photography of the plant habitat along with dorsal and ventral view of plant was taken. Digger was used for the digging a rhizome or to plug it out. However, if the specimen is very large then it was cut into a suitable size with the help of secateurs for the collection without losing the information. Jewel tag was put on the specimen with code number. After collection the photograph was again taken comparing dorsal and ventral side of the fern and field information was noted down. The information included latitude, longitude, slope, aspect, habitat, locality and rhizome types, presence of spore or any special characters have been observed and noted. The collected specimen was kept into a large polythene bag to keep specimen fresh and safe. Ecological as well as ethno botanical knowledge, medicinal or other values was collected from the local people. Other information noted was Collection number, Locality, Date of collections, Distribution of the plant, Local name, Color of spores, and Uses.

Before pressing, large size plants were cut into required size without losing any important characteristic features. The field note was written and the specimen was folded as M or Z or N shape for not letting to lose any part of the specimen. Collected specimens were pressed in the blotting paper or newspaper and corrugated sheets were kept between every specimen for quick drying. The newspaper was changed daily until the plants were dried. For preservation both dry and wet method was adopted i.e. solution of 4% Formalin, 50% Ethyl alcohol and FAA solution were used for wet preservation while well dried plant specimens were mounted on herbarium sheets having standard size i.e. 45cm length and 30cm wide, with proper arrangement and labels.

Identification

The specimens collected from the field were identified using available relevant literatures: Beddome (1865-70, 1883, 1892); Iwatsuki (1988); Gurung (1991); Khullar (1994); Khullar (2000); Borthakur et al., (2001); Bista et al., (2002); Fraser-Jenkins (2008); Fraser-Jenkins et al., (2015) etc. The specimen which were not be identified in the lab,

was identified by comparing the herbarium specimen deposited in Tribhuvan University Central Herbarium (TUCH) and National Herbarium and Plant Laboratories, Godawari (KATH) and was also consulted with fern expert C. R. Fraser-Jenkins and Dhan Raj Kandel for some complicated specimens.

Results and Discussion

Total number of families and genera

A total number of 99 species of pteridophytes belonging to 20 families and 48 genera were recorded. Among 20 families, Polypodiaceae and Pteridaceae were largest having nine genera. Similarly, Dennstaedtiaceae represented four genera while Dryopteridaceae and Davalliaceae represented three genera. Blechnaceae, Lycopodiaceae, Ophioglossaceae and Woodsiaceae represented by two genera and remaining other families were monotypic represented by single genus.

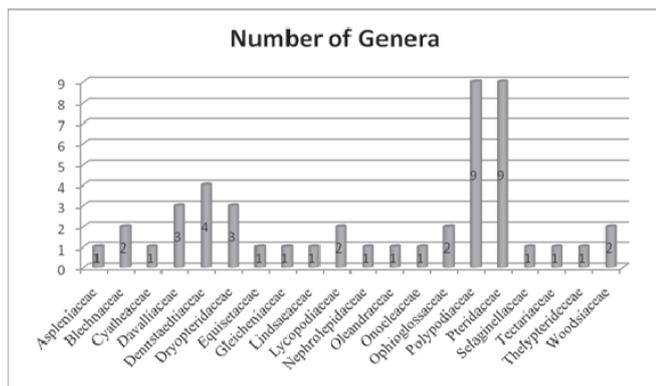


Figure 2: Total number of families with number of genera

Distribution of species among various habitats

On the basis of habitat, out of 99 species of pteridophytes, 55.21% species were terrestrial, 23.96% species epiphytic and remaining 20.83% species were lithophytes.

The higher number of epiphytes may be due to altitude and composition of forest (Rajbhandary, 2013). As *Quercus* species may be favorable substrate for having thick.

Similarly, some of the species were found growing in more than one habitat. Out of the total species

only one species *Nephrolepis cordifolia* was found on all three habitats viz; terrestrial, epiphytic and lithophytes. *Tectaria coadunata* and *Adiantum philippense* subsp. *philippense* were found on both terrestrial and lithophytes in the present study. *Pichisermolodes quasidivariata*, *Pichisermolodes ebenipes*, *Polypodiodes amoena*, *Botrychium lanuginosum* and *Drynaria propinqua* were found growing on both habitats i.e. epiphytic and terrestrial.

Some of the epiphytes ferns *Pyrossia costata*, *Goniophlebium argutum*, *Drynaria mollis*, *Phymatopteris ebenipes*, *Oleandra wallichii*, *Asplenium ensiforme*, *Katoella pulchra* and *Pyrrhosia porrosa* were found on tree trunks of cool and shady place while *Adiantum capillus-veneris*, *Microsorium membranaceum*, *Lycopodium japonicum*, *Pteris vittata* subsp. *vittata*, *Pteris biaurita* subsp. *walkeriana*, *Tectaria coadunata*, *Selaginella involvens* as lithophytes. Most of the epiphytic species were dominant on Schima- Castanopsis, Quercus- Laurels- Rhododendron, Acer- Juglans, Subalpine forest type with *Schima wallachii*, *Ilex* sp., *Sorbus* sp., *Acer spectabilis*, *Coraria nepalensis*, *Quercus semicarpifolia*, *Pinus wallichiana* and *Betula utilis* as dominant species. Most of the species were found on the *Quercus* sp., *Acer* sp., *Betula utilis* compare to the *Pinus wallichiana*. Mehra and Bir (1964) and Gurung (1997) proposed most of the epiphytes had poor growth on conifers is due to the inhibitory effect of resinous nature content on the trees while most were found on the mixed forest types as it support good environmental condition.

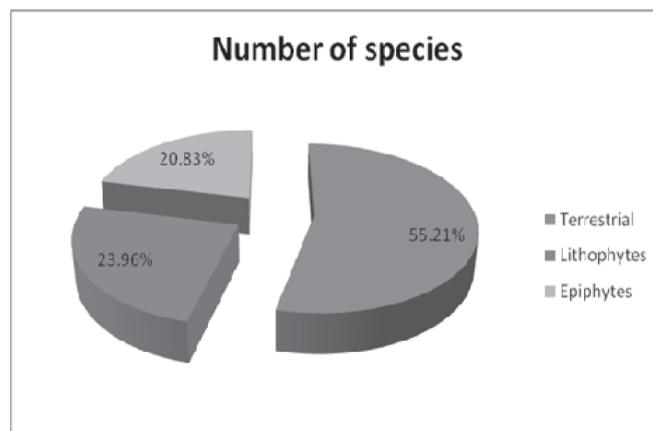


Figure 3: Distribution of families among various habitats

pteridophytes thus results into the decrease of species from 2600 - 3200m.

These result helped to see that there is correlation between species with altitude, habitat and forest type answering the research question. Similar type of distribution of species along altitudinal gradient and habitat has also been discussed Bista et al. (2002), Watkins (2006) and by Fraser-Jenkins et al. (2015) which support the present findings.

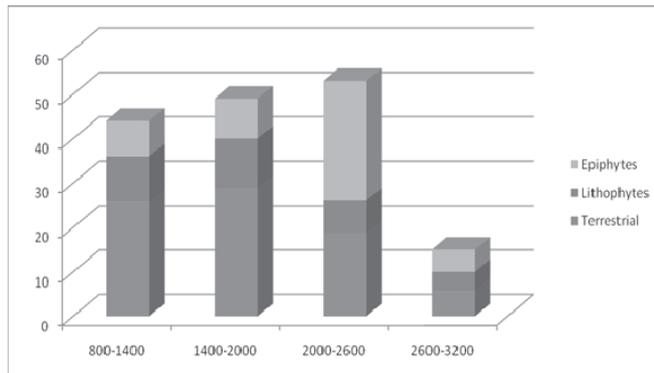


Figure 5: Distribution of species in different habitat along altitudinal gradient

Conclusion

On floristic study on fern and fern allies, total of 99 species of pteridophytes belonging to 20 families and 48 genera were recorded. Among 20 families, Polypodiaceae and Pteridaceae was the largest family having nine genera followed belonging to these two families are common pteridophytes in Nepal. Most of the species were terrestrial followed by epiphytic and lithophytes. Furthermore, among nine different types *Quercus-Laurels-Rhododendron* shows the highest diversification at an elevation of 2000 - 2600m on the distribution of pteridophytes.

Acknowledgements

The authors acknowledge Central Department of Botany, Tribhuvan University and National Herbarium and Plant Laboratories, Lalitpur (KATH), for granting permission to study the herbarium materials. We sincerely thank Department of National Parks, Wildlife and Plant Conservation for issuing the permission for the collection. We are also thankful to the Department of Plant Resources for providing the Global Taxonomy Initiative (GTI)

grant as a financial support for this work. Special thanks go to C.R. Fraser-Jenkins and Dhan Raj Kandel for their help to identify and all my friends for accompanying during the field trip.

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