

## Ecological and phytogeographical observations on the fern flora of Pithoragarh district (north-west Himalaya)

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**Abstract.** A detailed account of ecology and phytogeography of the ferns of Pithoragarh district of Kumaon (north-west Himalaya) is discussed. Common mesophytic ferns are the species of *Adiantum*, *Athyrium*, *Cheilanthes*, *Christella*, *Dryopteris*, *Lygodium*, *Osmunda*, *Pseudocyclosorus* and *Pteris*. Polypodiaceous ferns are either epiphytes or lithophytes. *Ceratopteris thalictroides* is the only aquatic fern. From phytogeographical point of view it is observed that on the one hand the fern flora of this region bridges the floristics of eastern and western Himalaya, and on the other it resembles much with the fern flora of south China. About 70% ferns are common with Simla hills and 85% with Darjeeling and Sikkim Himalaya.

**Keywords.** Ecology; ferns; Kumaon; phytogeography.

### 1. Introduction

Roxburgh's successor Wallich (1828–1849) of the Calcutta Botanic Garden made very large collections of herbarium specimens from north-east India, Burma and the Malay Peninsula and named many ferns but the names were not validated until descriptions were later published, mostly by Hooker (1844–1864). Meanwhile Kunze (1851) described ferns from the Nilgiri hills collected by German botanists and Beddome published his ferns of southern India (1863) and ferns of British India (1865–1870). After his retirement Beddome wrote his 'Handbook' (1883) and added a supplement to it in 1892. During his studies Beddome also made observations on specimens in Hooker's herbarium. He modified Hooker's classification, and also tried to correct some misidentifications. Beddome's contemporary in north India was Clarke (1880). Both Beddome and Clarke took assistance from Hooker's descriptions. Blanford (1888) and Hope (1899–1905) were also among the pioneer workers on Indian ferns. Blanford listed the ferns of Simla whereas Hope gave an exhaustive account of north-western Himalayan ferns.

Our knowledge of the fern vegetation of this area is based only on the classical literatures of Watson (1882), Hope (1899–1905) and Duthie (1906). Watson listed 127 species of ferns from Kumaon. Hope however, made serious efforts and described the ferns of north-western India including Kumaon. Based on the collections of Sir R Strachey and Mr J E Winterbottom, the former prepared a list of ferns of Kumaon which was later revised by Duthie (1906), who prepared a catalogue of 189 ferns from Kumaon. As many as 251 species of ferns from Kumaon have been listed recently by Pangtey and Punetha (1987) and of these 113 species have been reported from Pithoragarh alone by Punetha and Kaur (1987). This number easily gives the idea of the richness of the ferns in this area but remained neglected primarily on account of the remoteness of the region. The present communication forms a part of the taxonomic revision of pteridophytic

flora of Pithoragarh district of Kumaon. From phytogeography point of view also, the fern flora of Pithoragarh district is of significance because this region being the easternmost section of western Himalaya comprises mainly the western himalayan elements but many eastern himalayan species also extend to this area.

## 2. Geographical note

Three hill districts (Almora, Naini Tal and Pithoragarh) form the present day Kumaon which is more often accepted as part of central Himalaya. Geologically, Meddicott (1888) termed this region as Kumaon section under lower Himalaya and Wadia (1957) referred to it as Kumaon Himalaya. The district Pithoragarh was formed in 1960 and is spreaded in an area of about 7220 sq km (figure 1). In the north it is separated from Tibet by the snow capped Panchachuli and Nandakote and the Kali river forms the boundary in the east separating it from Nepal. In the south it borders with the Bhabar and Tarai region of Naini Tal district whereas in the west it borders with the districts of Almora and Garhwal. The north-south extension of the district ranges about 350 km which is twice as much as its east-west stretch.

## 3. Climate and physiography

From altitude point of view the climate of the district shares characteristics of both the temperate and tropical regions. The area can be classified into 4 categories: (i) Sub-tropical (400–1500 m), (ii) temperate (1500–2500 m), (iii) sub-alpine (2500–3000 m) and (iv) alpine (above 3000 m). This region, having snow covered peaks on the one hand, and on the other the comparatively warm valleys like Chalthi, Dharchula, Ghat and Thal offer striking contrast in climate. In the dense forests of Bogdwar, Champawat, Didihat, Gangolihat and Thalkedar are to be found the fern flora.

Limestone rocks and slates are frequent in the district, and so is the granitoid gneiss. The soil in some parts sandy, in others it is brownish-black and alkaline, and in still others dark brown and acidic. The humid forest soil has abundance of organic matter. The altitudinal variations of the region have contributed to the richness of the vegetation.

## 4. Ecological observations

Although the majority of ferns in this area are mesophytes, a very high degree of diversity is seen in the growth habit and various habitats they occupy.

### 4.1 Hydrophytes

*Ceratopteris thalictroides* (Linn.) Brongn. is the only aquatic fern in this region. It grows in paddy fields behind Government PG College, Pithoragarh.

### 4.2 Epiphytes

The epiphytic vegetation in this area is by no means poor. Orchids and epiphytic

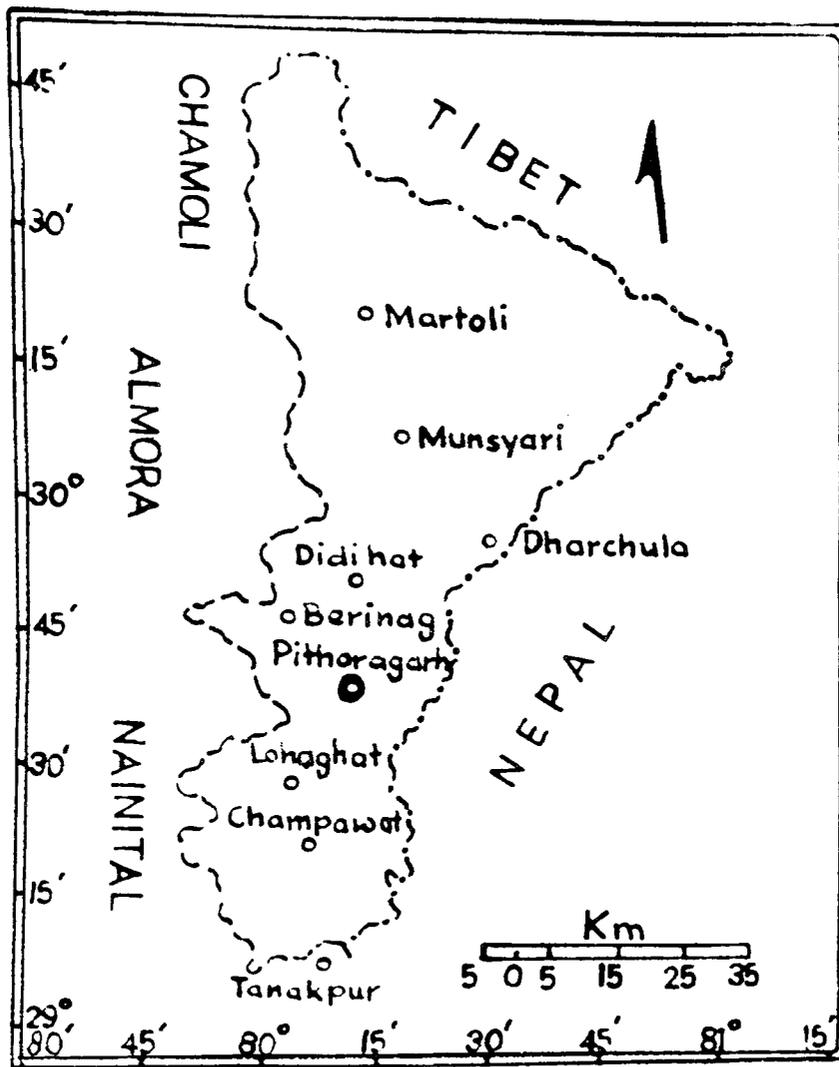


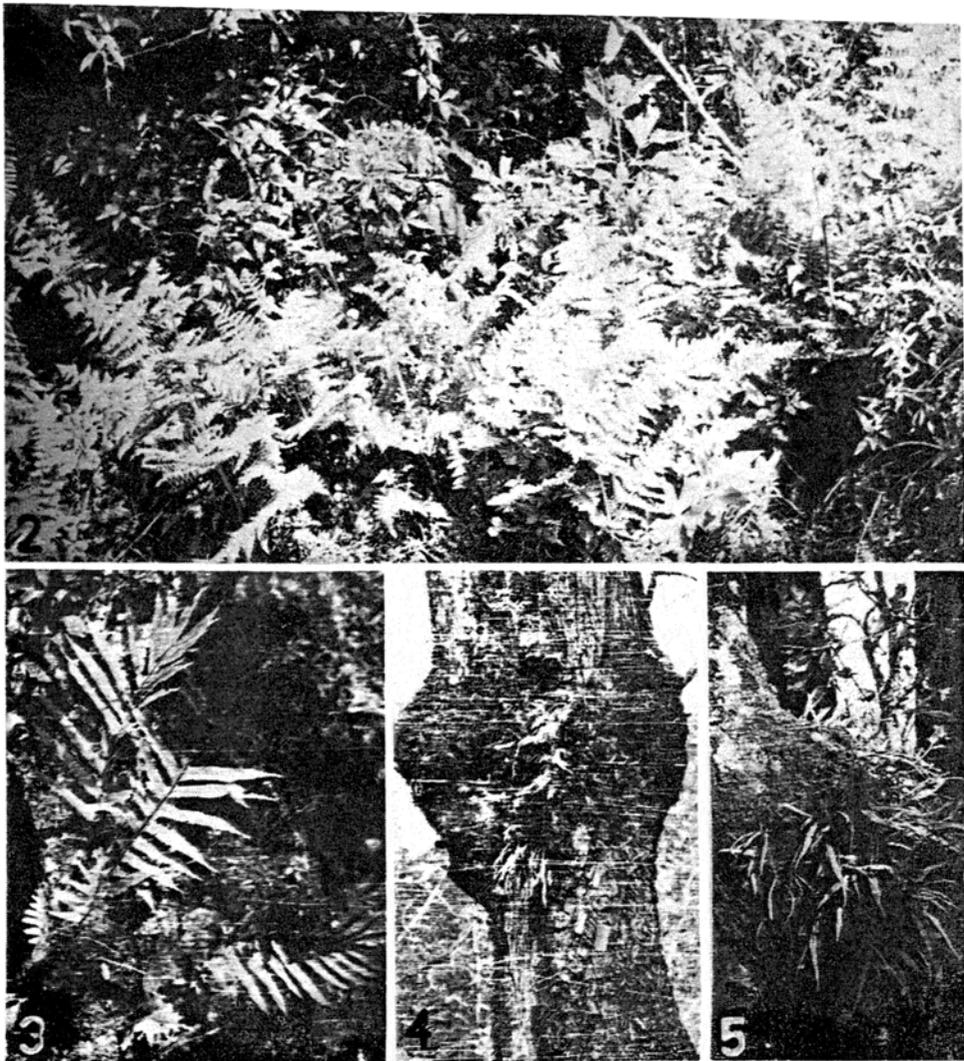
Figure 1. Map of Pithoragarh.

ferns are abundant throughout the district. Champawat, Didihat, Lilam-Bogdwar, Thal-Nachni valley are rich with epiphytic ferns. *Lepisorus amaurolepidus* (Sledge) Bir ex Trikha (figure 4), *L. nudus* (Hook.) Ching, *L. pseudonudus* Ching, *Drynaria mollis* Bedd., *Pyrosia adnascens* (Sw.) Ching, *P. mollis* (Kunze) Ching, *Polypodium atkinsonii* (Atkinson ex Bedd.) Ching (figure 4) are among those epiphytic ferns which usually do not grow as lithophytes. These ferns grow on the trunks of *Mangifera indica* Linn., *Myrica nagi* Thunb., *Quercus leucotrichophora* A Camus ex Bahadur, *Q. semicarpifolia* Sm., *Rhododendron arboreum* Sm., *Shorea robusta* Gaerth. and on other broad leaved trees.

4.3 Lithophytes

*Arthromeris lungtauensis* Ching, *Microsorium membranaceum* (D Don) Ching, *Phymatodes ebenipes* (Hook.) Ching and *Pyrrosia subfurfuracea* (Hook.) Ching are true lithophytes which grow on humid, mossy rocks.

*Arthromeris wallichiana* (Spr.) Ching, *Drynaria propinqua* (Wall. ex Mett.) J. Sm. (figure 3), *Lepisorus bicolor* Ching, *L. kashyapii* (Mehra) Mehra et Bir (figure 5), *Loxogramme involuta* (D Don) Pr. *Polypodium amoenum* Wall. ex. Mett.,



Figures 2-5. 2. A population of *Deparia japonica*, *Hypolepis punctata* and *Pseudophegopteris pyrhorachis* along a hill stream ( $\times 0.1$ ). 3. *Drynaria propinqua* on a rock ( $\times 0.1$ ). 4. A population of epiphytic ferns on an oak tree ( $\times 0.02$ ). 5. *Lepisorus kashyapii* on the base of a tree trunk ( $\times 0.02$ ).

*P. lachnopus* Wall. ex Hook., *Pyrrhosia flocculosa* (D Don) Ching, *P. stigmosa* (Sw.) Ching grow either as epiphyte or as lithophyte.

#### 4.4 Terrestrial ferns

Majority of the ferns are terrestrial. These can be classified into following categories:

4.4a *Thicket forming species*: In contrast to other ferns *Dicranopteris linearis* (Burm. f.) Underw. grows on exposed localities at the margins of forests. This fern grows almost in pure formations and sometimes climbs to a considerable height on neighbouring shrubs. Askote-Ogla-Didihat range is very rich with this fern.

4.4b *Climbers*: *Lygodium flexuosum* (L.) Sw. and *L. japonicum* (L.) Sw. are the only climbers which prefer exposed sides. These species climb with the help of their specialized climbing rachis on neighbouring shrubs or trees.

4.4c *Chasmophytes*: *Adiantum incisum* Forssk., *Asplenium dalhausiae* Hook., *Cheilanthes rufa* D Don, *Hypodematium crenatum* (Forssk.) Kuhn usually grow on rock crevices, they also prefer walls for growth.

4.4d *Ravine ferns*: *Athyrium pectinatum* (Wall.) Presl, *A. tenuifrons* (Wall. ex Hope) Punetha, *Christella appendiculata* (Presl) Holttum, *C. arida* (D Don) Holttum, *Coniogramme fraxinea* (D Don) Diels, *Deparia japonica* (Thunb.) Kato, *Glaphyrop-teridopsis erubescens* (Wall. ex Hook.) Ching, *Hypolepis punctata* (Thunb.) Mett. ex Kuhn, *Polystichum obliquum* (D Don) Moore, *Pseudocyclosorus canus* (Baker) Holttum ex Grimes and *Pteris excelsa* Gaud. commonly grow either along hill streams or near minor canals or on shady humid rocks (figure 2).

Luxuriant growth of *Adiantum incisum* Forssk. and *Polystichum squarrosus* (D Don) Fee is seen in burnt soil. Many species of *Dryopteris*, *Polystichum*, *Pteris* and *Tectaria* and also *Hypodematium crenatum* (Forssk.) Kuhn grow on exposed well lighted localities. *Adiantum lunulatum* Burm., *Athyrium pectinatum* (Wall.) Presl, *A. tenuifrons* (Wall. ex Hope) Punetha, *Cheilanthes dalhausiae* Hook., *Leucostegia immersa* (Wall.) Presl, *Microlepia strigosa* (Thunb.) Presl, *Ophioglossum vulgatum* Linn. *Palaea nitidula* (Wall.) Baker ex Hook., *Vittaria flexuosa* Fee and a large number of polypodiaceous ferns are short lived. The lamina of these ferns generally dries-up in autumn and winter but the rhizome perennates till the next rainy season. *Botrychium lanuginosum* Wall., *B. virginianum* (Linn.) Sw., *Hymenophyllum* sp. and *Ophioglossum vulgatum* Linn. grow in humid places in dense forests. Among ornamental ferns *Nephrolepis cordifolia* (Linn.) Presl is very common in Askote-Sualekh range and near Barakote whereas *Diplazium polypodioides* Bl. is occasionally used as green vegetable during rainy season.

#### 5. Phytogeographical note

This region being intermediate to the eastern and western Himalaya, the fern vegetation of this area bridges the floristics of both the Himalaya. Also, quite a

large number of ferns of this region share characteristics with the ferns of southern China. Based on the studies on the Chinese ferns, Ching (1978) constituted 210 genera of ferns, of these 58 genera are represented by about 180 species in this area. About 70% of fern vegetation of this area is common with Simla hills and about 85% of ferns from Pithoragarh district are common with Darjeeling and Sikkim Himalaya (Mehra and Bir 1964). Chandra (1980) recorded 85 species of ferns from Tawang sub-division of Arunachal Pradesh (NEFA), of these 47 species occur in this region. About 62% of ferns from Pithoragarh district are common with Meghalaya (Baishya and Rao 1982). Fourteen ferns out of 22 known from Mt. Abu (Bir and Verma 1963) occur in this region. Bir and Vasudeva (1972) reported 56 ferns from Pachmari hills, of these 23 species are found here.

On the one hand this region is the easternmost limit for the western Himalayan ferns, on the other it makes westward limit for many eastern Himalayan elements. Interestingly, *Drynaria mollis* Bedd. is known to occur frequently in the western Himalaya, this fern grows as an epiphyte on *Rhododendron arboreum* trees at many places in this district but its occurrence in the eastern Himalaya is not known, however, its presence in the central Himalaya is reported by Sinha and Gurung (1985). *Arthromeris lungtauensis* Ching, *Dicranopteris linearis* (Burm. f.) Underw., *Pyrrhosia subfurfuracea* (Hook.) Ching and *Vittaria himalayensis* Ching are either known only from the eastern Himalaya or their westward limit reaches to this region. As far as known their presence in the western Himalaya beyond this region has not yet come into light. *Arthromeris lungtauensis* Ching is so far known only from China (Ching 1933) and Darjeeling (Tagawa 1966), its sparse distribution in this district is reported by Kaur and Punetha (1984). *Dicranopteris linearis* (Burm. f.) Underw. is a common gleichenia of the eastern Himalaya and is also known from central India (Pachmari), it is abundant at various places in this district but not known from other places in the western Himalaya, Bir *et al* (1983) believe its westward limit in Nepal Himalaya. Another eastern Himalayan fern which occurs here is *Pyrrhosia subfurfuracea* (Hook.) Ching, this lithophyte is locally common at Sualekh and Chheena in this district.

While giving the detailed account of evolution and phytogeography of Indian ferns, Bir (1988) emphasized the role of Himalaya in the distribution of ferns in Japan, China and India. Occurrence of *Dryopteris conjugata*, *Polystichum makinoi* and *P. luctuosum* in this district seems to be of significance as far as the phytogeography of Himalayan ferns is concerned. *D. conjugata* is so far known only from the Yunnan province of China, it is locally common at Dhaj in this district. *P. makinoi* is an extremely rare fern and according to Fraser-Jenkins and Khullar (1985) a handful number of specimens collected from Sikkim and Bhutan are available in Kathmandu herbarium. It is, however, sparsely distributed at Munsyari in this district. Similarly *P. luctuosum*, so far known only from Simla westward (Fraser-Jenkins C R, unpublished results) is also found at Munsyari in this district.

Ching and Wu (1980) opined that the migration of central Asian ferns to west or vice-versa would have taken place via Himalaya. This statement is very true in the context of many ferns of this area because these ferns (*A. lungtauensis*, *D. conjugata*, *P. makinoi* and *P. subfurfuracea*) were reported from the eastern parts of the Asia only. Similarly, *D. ramosa* and *P. luctuosum* are among those common ferns of western Himalaya which do not extend to eastern parts but these are found in this district.

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### References

- Baishya A K and Rao R R 1982 *Ferns and fern-allies of Meghalaya state, India* (Jodhpur: Scientific Publishers)
- Beddome R H 1863–1865 *The ferns of southern India* (Madras: Gantz Brothers)
- Beddome R H 1865–1870 *The ferns of British India* (Madras: Gantz Brothers)
- Beddome R H 1892 *Handbook to the ferns of British India, Ceylon and Malay peninsula, with supplement* (Calcutta: Thacker Spink and Co.)
- Bir S S 1988 Evolutionary trends in the pteridophytic flora of India; *Indian Sci. Congr.* 75 1–56
- Bir S S, Satija C K, Vasudeva S M and Pramod Goyal 1983 *Pteridophytic flora of Garhwal Himalayas* (Dehradun: Jugal Kishore and Co.)
- Bir S S and Vasudeva S M 1972 Ecological and phytogeographical observations on the pteridophytic flora of Pachmari Hills (Central India); *J. Indian Bot. Soc.* 51 297–304
- Bir S S and Verma S C 1963 Ferns of Mount Abu; *Res. Bull. Panjab Univ. Sci.* 14, 187–202
- Blanford H P 1888 A list of ferns of Simla in the N W Himalayas, between levels of 4500 ft and 10,500 ft; *Proc. Asiat. Soc. Bengal* 57 297–315
- Chandra P 1980 Botanical exploration in Tawang: Ferns and Fern-allies; *Nova Hedwigia* 32 399–414
- Ching R C 1933 Studies of Chinese ferns, XI. *Polypodium, Phymatodes, Arthromeris*; *Contrib. Inst. Bot. Natl. Acad. Peiping* 2 31–1000
- Ching R C 1978 The Chinese fern families and genera: Systematic arrangement and origin; *Acta Phytotax Sin* 16 1–37
- Ching R C and Wu S K 1980 The floristic characteristics of the Xizan (Tibet) Pteridophytic flora in relation to the upheaval of the Himalayas; *Acta Bot. Yunnanica* 2 382–389
- Clarke C B 1880 A review of ferns of Northern India; *Trans Linn. Soc. London* 2 (Bot) 1 425–611
- Duthie J F 1906 *Catalogue to the plants of Kumaon and of the adjacent portions of Garhwal and Tibet* (London: Lovell Reeve and Co. Ltd.)
- Fraser-Jenkins C R and Khullar S P 1985 The nomenclature of some confused himalayan species of *Polystichum* Roth; *Indian Fern J.* 2 1–16
- Hooker W J 1844–1864 *Species Filicum* Vols. 1–4
- Hope C W 1899–1905 The Ferns of North-Western India; *J. Bombay Nat. Hist. Soc.* 12 315, 527–538, 621–633; 13 25–36, 236–251, 443–461, 657–671; 14 119–127, 252–266, 458–480, 720–749; 15 67–111, 415–429
- Kaur S and Punetha N 1984 *Arthromeris lungtauensis* Ching, A new record for western Himalayas, India; *J. Bombay Nat. Hist. Soc.* 81 737–738
- Kunze G 1851 *Linnaea* 24; Filices Niagiricae p 239
- Meddicott H B (1973) Geology; in *The Himalayan Gazetteer* (ed.) E T Atkinson (Delhi: Cosmo Publications) vol. 1, part 1, pp 111–168
- Mehra P N and Bir S S 1964 Pteridophytic flora of Darjeeling and Sikkim Himalayas; *Res. Bull. Punjab Univ. Sci.* 15 69–182
- Pangtey Y P S and Punetha N 1987 Pteridophytic flora of Kumaon Himalayas. An updated list; in *Western Himalayas: Environment, problems and development* (eds) Y P S Pangtey and S C Joshi (Nainital: Gyanoday Prakashan) pp 289–412
- Punetha N and Kaur S 1987 Pteridophytic flora of Pithoragarh district of Kumaon (West Himalayas); *J. Econ. Tax. Bot.* 9 269–286
- Sinha B M B and Gurung V L 1985 Phytogeographical distribution of pteridophyte flora of Nepal Himalaya in relation to Central Nepal; *Indian Fern J.* 2 17–21
- Tagawa M 1966 Polypodiaceae; in *The flora of eastern Himalayas* (ed.) H Hara (Japan: Univ. of Tokyo) pp 489–499
- Wadia D N 1957 *Geology of India* (London: Macmillan and Co.)
- Wallich N 1828–1849 *A numerical list of dried specimens of plants in the East India Company's museum* (collected under the supervision of Dr Wallich) Nos 1–2159 (1828), 2160–4361 (1829), 4362–7683 (1830), 7684–9148 (1847–1849)
- Watson W 1882 Plants of Kumaon; in *The Himalayan Gazetteer* (ed.) E T Atkinson (Delhi: Cosmo Publications) vol. 1, part 1, pp 323–402