

Ferns and fern allies of District Shopian, Kashmir Valley, India

SHAKOOR A. MIR¹, ANAND K. MISHRA¹, SHAUKET AHMAD PALA², ZAFAR A. RESHI², M.P. SHARMA¹

¹Department of Botany, Jamia Hamdard, Hamdard Nagar, New Delhi-110062, India. Tel: +91-9968172445; email: shakoorsam@gmail.com.

²Department of Botany, University of Kashmir, Hazratbal, Srinagar-190006, Jammu and Kashmir, India

Manuscript received: 11 November 2014. Revision accepted: 9 December 2014.

Abstract. *Mir SA, Mishra AK, Pala SA, Reshi ZA, Sharma MP. Ferns and fern allies of District Shopian, Kashmir Valley, India Biodiversitas 16: 27-43.* Shopian, recently created hilly district of Kashmir valley, Jammu and Kashmir is surrounded by the lofty mountains of Pir-Panjral range. More than half area of district is occupied by different forests, subalpine, alpine and mountainous zones. Great altitudinal variation, adequate rainfall, high forest cover, large number of streams, springs and topographic variations render the district worthy for supporting rich fern flora. Therefore, the current study was aimed to undertake in-depth systematic survey of different habitats of Shopian for the collection of diversity of pteridophytes. Specimens were collected during 2010, 2011 and 2012 growing seasons from June to November. A total 81 species of ferns and fern allies belonging 27 genera and 11 families were reported. The dominant families of the region are Dryopteridaceae (25 species) followed by Woodsiaceae (16 species), Aspleniaceae (13 species) and Pteridaceae (12 species). Similarly, the dominant genera collected from here are *Dryopteris* (14 species), *Asplenium* (13), *Polystichum* (11 species) and *Athyrium* (6 species). A list of the fern and fern allies, along with update nomenclature, their selected Synonym, diagnostic features, distributional and ecological notes have been provided here.

Key words: distribution, diversity, ferns, Kashmir valley, lycophytes, Shopian, survey.

INTRODUCTION

Pteridophytes comprise a group of seedless but spore producing plants, formed by two lineages, lycophytes-fronds with no leaf gap in the stem stele (Lycophylls) and Monilophytes or ferns- fronds with leaf gap in the stem stele (Euphylls) (Pryer et al. 2001, 2004; Smith et al. 2006). They constitute an important component of earth's flora for millions of years (Pryer et al. 2001). Presently there are about 300 genera of pteridophytes containing approximately 9600 ferns and about 1400 lycophytes worldwide (Smith et al. 2006, 2008), with highest diversity in the tropics (Jacobsen and Jacobsen 1989; Kornas 1993; Linder 2001). The current revised treatment of fern and fern allies from India revealed 1150 species (Fraser-Jenkins 2008; Fraser-Jenkins and Benniamin 2010). The west Himalayas is the fourth richest area for pteridophytes in India after the east Indo-Himalayas, the Manipur-Khasi range and south India, and harbours about 402 species, which constitute 40%, over one-third of pteridoflora of whole country (Kumari et al. 2010). Kashmir Himalaya, a picturesque south Asian region, is unique biospheric unit located in the northwestern extreme of the Himalayan biodiversity hotspot (Rodgers and Panwar 1988).

One of the main features contributing to the worldwide fame of Kashmir is the rich biodiversity that decorates its captivating landscape (Lawrence 1895). Owing to the vast variety of edapho-climatic and physiographic heterogeneity and diverse habitats including lakes, springs, swamps, marshes, rivers, cultivated fields, orchards, subalpine and alpine meadows, mountain slopes and terraces, permanent glaciers, etc., the valley harbors almost all groups of land

plants; many species are distinct from those in the rest of the country and are endemic to this region. However, the published literature on the flora of Kashmir reveals that only the Phanerogams have been well documented. The cryptogams, particularly pteridophytes have met little attention in the past with regards to their survey and inventorization (Dar et al. 2002).

The valley has been occasionally explored in the past for pteridophyte diversity by Clarke (1880), Beddome (1883, 1992) and Hope (1899-1904). Some isolated fern collections have also been made in this region by the botanists of botanical survey of India, like R.B. Keshavanand, T.A. Rao, P.K. Hajra, U.C. Bhattacharayya, B.M. Wadhwa, M.V. Vishwanathan, etc. (Wani et al. 2012) The other studies particularly relevant to the pteridophytic flora of Kashmir are of Stewart (1945, 1951, 1957 1972, 1984); Javeid (1965), Kaul and Zutshi (1966, 1967), Kapur and Sarin (1977), Dhir (1980), Kapur (1985), Khullar (1984, 1994, 2000), Razdan et al. (1986); Khullar and Sharma (1987), Fraser-Jenkins (1989, 1991, 1992, 1993, 1997, 2008) and Singh and Pande (2002). Recently, an up-to-date account of fern and fern allies has been published collectively for Kashmir valley, Gurez (Kishanganag valley) and Ladakh by Wani et al. (2012) yet representing only 106 taxa of fern and fern allies. The present authors have, therefore, undertaken to explore in-depth pteridophytic wealth and possibility of new records in the Kashmir valley, and have restricted their study to district Shopian, which possesses the majority of topographical features of the large expanse of valley.

MATERIAL AND METHODS

Shopian, one of the ten districts of Kashmir division of Jammu and Kashmir State (Figure 1) is located in the south and south-west extremity of Kashmir valley within the coordinates of $33^{\circ} 20'$ and $34^{\circ} 54'$ North latitude and $73^{\circ} 35'$ and $75^{\circ} 35'$ East longitude. The district has been created in 2006. Total area of the region is 812.70 km^2 , of which more than half about 442.98 km^2 is occupied by alpine zone with a considerable portion under meadowlands and glaciers. The forest cover of different forests viz, deodar, kail, fir and broad leaved forests is approximately 316.60 km^2 . The temperature ranges from an average daily maximum of 31°C and minimum of 15°C during summer to an average daily maximum of 4°C and minimum of -4°C during winter (Bhat et al. 2012). The long and cold winter season is dominated by the western atmospheric depressions called Western Disturbances (Jeelani et al. 2010), which cause snowfall and rainfall. The annual precipitation of is about 1,050 mm; by and large in the form of snow during the winter months and rain during the late winter and early spring (Raza et al. 1978). According to Raza et al. (1978) the district possesses rich soil diversity, having three major categories of soils namely hill soils, alluvial soils and Karewa soils. With the gradual ascending slope from its north and north-eastern sides and loft Pir Panjal mountain range falling on its south and south-west periphery, the district has most of its areas of hilly character with the altitudinal range varying from 1600 to 4562 meters. Most of the vegetation met in this

region is deciduous type. The low land zone is mostly under cultivation and habitation, supporting crop fields- kharief crop fields, orchards, kitchen gardens and natural fields- roadsides, pastures, grasslands, graveyards, rocky meadows, streams, waste-lands, ponds, small ditches and spring sites. Mountain zone which is the maximum portion of the district includes broad-leaved deciduous forests, mixed conifer forest, kail forests, scrub forests, meadows and bare snow laden mountains. Each of these habitats has a peculiar type of vegetation, thus making the whole district biologically diverse. All these remarked features support a rich flora of cryptogams, particularly pteridophytes. However, during the last decades the floras published from this region including Flora of Pulwama (Kashmir) (Navchoo and Kachroo 1995) reported only flowering plants and therefore, no keen interest has been laid on Pteridophytic flora and as such no published pterido-flora is available from this district.

Diverse habitats such as plains, streams, rivulets, rivers, small valleys, dense forests, meadows, sub-alpine, alpine, mountains etc. of study area were surveyed for the collection of fern diversity during the years 2010 – 2012. The major research sites are shown in Figure 1. Each specimen was photographed, numbered as it was collected and the detailed notes were entered in the notebook. The collected specimens were pressed and dried in the standard way and described and identified with the relevant literature (Beddome 1976, 1983; Clarke 1880; Fraser-Jenkins 1989; Khullar 1994, 2000; Ghosh et al. 2004). The identity of specimens was authenticated from Botanical

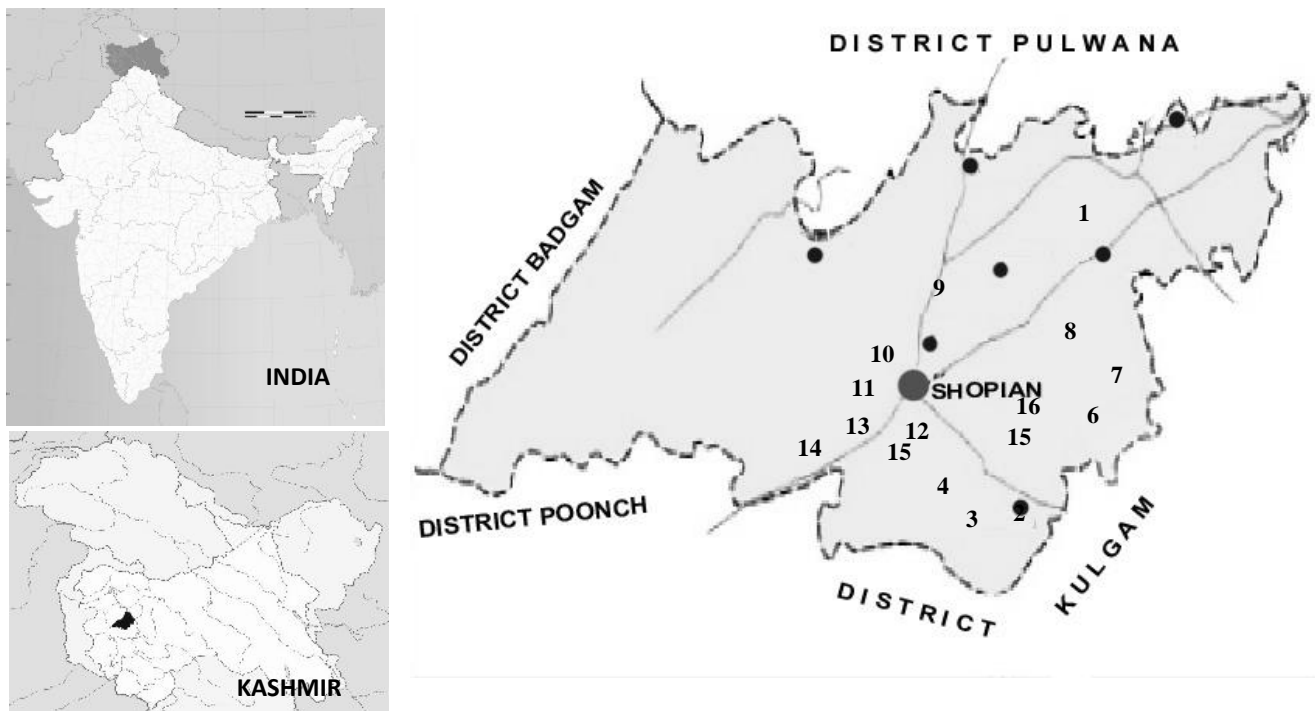


Figure 1. Research sites in district Shopian of Jammu and Kashmir State, India. 1. Zainapora; 2. Kaunsernag; 3. Huran; 4. Secjan; 5. Reshi Nagar; 6. D. K. Pora; 7. Narwani; 8. Imamsahib; 9. Rambi Ara; 10. Rambi Ara; 11. Heerpur; 12. Sedow; 13. Dubjan; 14. Peergali; 15. Aharbal; 16. Lahanthoor.

Survey of India, Northern Circle, Dehradun. One set of voucher specimens are deposited in Department of Botany, Jamia Hamdard and another in the Herbarium, Centre for Biodiversity and Plant Taxonomy, University of Kashmir (KASH). The identified plants are listed according to the classification system of Smith et al. (2008), followed by selected Synonym, habitat and taxonomic notes, range of distribution and Specimen examined

RESULTS AND DISCUSSION

An interesting feature of the Shopian is occurrence of varying topography and great altitudinal range that develops immense habitat variation, that facilitated luxurious growth of pteridophyte flora and therefore, as many as 81 pteridophyte species belonging to 27 genera, 11 families, 4 orders and 2 classes were collected from here. The richest fern families of this area are *Dryopteridaceae* sharing 25 species followed by *Woodsiaceae* (15 species), *Aspleniaceae* (13 species) and *Pteridaceae* (12 species). Besides these, the families *Thelypteridaceae* and *Equisetaceae* have 5 and 3 species, respectively; *Marsileaceae* and *Osmundaceae* are represented by 1 species each and *Dennstaedtiaceae*, *Polypodiaceae* and *Salviniaceae* with 2 species each. Similarly, the dominant genera reported from here are *Dryopteris* (14 species), *Asplenium* (13 species) and *Polystichum* (11 species).

The collected species also showed a range of ecological distribution varying from aquatic (*Marsilea*, *Azolla*) to terrestrial (*Athyrium*, *Dryopteris*) to lithophytic (*Lepisorus*, some species of *Asplenium*); and from low-land to forests to sub-alpine to alpine zones. Except for some lowland ferns, namely *Dryopteris filix-mas* and *D. pulvinulifera* that mature fairly earlier, the appropriate time of maturation is from mid-June to ending October. Within these 3-4 months, the ferns produce sori and complete their life cycle. However, *Equisetum arvense* produce cone i.e. reproductive stage earlier than the vegetative stage from earlier April to mid-May.

Based on personal observation and data available from literature (Stewart 1972; Khullar 1994, 2000; Wani et al. 2012), a rough estimate of status of collected taxa has also been figured. The most common species of the area are *Adiantum venustum*, *Asplenium trichomanes*, *A. pseudofontanum*, *Athyrium attenuatum*, *A. mackinnoni*, *Deparia allantodioides*, *Equisetum arvense*, *Polystichum prescottianum*, *Pseudophegopteris levingei*. On the contrary, *Adiantum pedatum*, *Asplenium viride*, *Athyrium strigillosum*, *Cyclosorus erubescens*, *Cryptogramma stelleri*, *Lepisorus clathratus*, *L. stewartii*, *Onychium plumosum*, *Pellaea nitidula*, *Polystichum lonchitis* and *Woodsia alpina* have been reported only with 1-3 specimens, whereas other species range in status from occasional to frequent. Out of 81 taxa, 29 taxa were recorded to be rare and just only 3 taxa, namely *Adiantum venustum*, *Asplenium trichomanes*, and *Equisetum arvense* were abundant in this region.

The pteridophyte species were reported within the altitudinal range of 1600 to 4100 m. 51 species were found

growing luxuriously between 1600-2500; 18 were reported within the range of 2500-3200 m; and 12 were found within the altitudinal range of 3300-4100 m. However, *Adiantum venustum*, *Asplenium adiantum-nigrum*, *A. trichomanes*, *Athyrium mackinnoni*, *Cystopteris fragilis* and *Equisetum arvense* were collected throughout the ranges of altitudes and were numerically the most abundant and wide-spread species among all pteridophytes recorded from the region. The species *Asplenium viride*, *Cryptogramma brunoniana*, *C. stelleri*, *Lepisorus clathratus*, *Polystichum lachenense*, *P. shensiense* and *Woodsia alpina* were rarest and restricted to higher altitudes in alpine meadows and rocky mountains.

As per the distribution of pteridophyte species recorded by Dixit (1984), Chandra (2000) and Khullar (1994, 2000), out of 81 species, 61 (75%) are common with the list of fern and fern allies of Jammu and 67 species (82%) are common with fern flora of Himachal Pradesh. 59 species (72%) are common with the Garhwal region, 41 species (50%) with Dehradun and 42 species (52%) with Sikkim. Summing up, 71 species (87%) and 52 species (64%) resemble with pteridoflora of Western Himalaya (Almora, Chamoli, Dehradun, Garhwal, Himachal Pradesh, Jammu, Kinnaur, Kumaun, Nanital, Pithogarh, Shimla, Uttar Pradesh) and Eastern Himalaya (Arunachal Pradesh, Assam, Darjeeling hills, Meghalaya, Mizoram, Nagaland, Sikkim, West Bengal), respectively. 16 species (19%) ferns of this region resemble those met within the South India.

The fern species collected in this region are ethnically insignificant. The crosiers of two ferns, *Diplazium allantodioides* and *Pteridium aquilinum* are used as vegetable by the tribal people. Few others such as *Adiantum capillus-veneris*, *Adiantum venustum*, *Asplenium adiantum-nigrum*, *Asplenium pseudofontanum*, *Asplenium trichomanes*, *Athyrium wallichianum*, *Deparia allantodioides*, *Equisetum arvense*, *Pteridium aquilinum* have various medicinal uses.

Out of 81 species, eight have been recently added by authors to the pteridoflora of Kashmir Valley as new records. These are *Dryopteris caroli-hopei* Fraser-Jenk., *Dryopteris blanfordii* subsp. *nigrosquamosa* (Ching) Fraser-Jenk., *Dryopteris pulvinulifera* (Bedd.) Kuntze and *Polystichum Nepalense* (Spreng) C. Ch (Mir et al. 2014a); *Hypolepis polypodioides* (Blume) Hook., *Pteris stenophylla* Wall. ex Hook. & Grev., *Dryopteris subimpressa* Loyal and *Dryopteris wallichiana* (Spreng.) Hylander (Mir et al. 2014b).

Two species *Asplenium punjabense* Bir & Fraser-Jenk. (Figure 2) and *Pseudophegopteris pyrhorachis* (Kunze) Ching, subsp. *distans* (Mett.) Fraser-Jenk. (Figure 3) reported here has been recorded first time from the Kashmir valley. There are no earlier reports of their collection from the valley, but have been collected from Jammu division of J & K State. *Asplenium punjabense* differs from its closely related species *Asplenium ceterach* in having long stipes (more than 3 cm) with sparse scaly lamina on abaxial surface which do not fringe the edges of lamina; whereas the later has short stipes (less than 3 cm) with dense scaly lamina on abaxial surface and fringing the edges of lamina. The *P. pyrhorachis* subsp. *distans*

contrasts from its close relatives, *P. pyrhorachis* subsp. *laterepens* in having long rhizome, castaneous stipe and pinnules with acute apex, whereas the later has rhizome short, stipe stramineous with very base brownish and pinnules with rounded apex.

Enumeration of species

Equisetaceae Michx. Ex De Candolle

1. *Equisetum arvense* L., Sp. Pl. 2: 1061 (1753).

Synonym: *Equisetum calderi* B. Boivin; *E. saxicola* Suksd.

Terrestrial, medium sized fern ally, grows along the moist stream banks, shady marshes and fields, stem erect, dimorphic, fertile stem unbranched, sterile stem branched, abundant with altitudinal range of 1650-3500 m.

Distribution: America, Bhutan, Canada, Iran, Turkey, Japan, Korea, Mongolia, Nepal, Russia, Europe, North America, India (Northern India).

Specimen examined: D. K. Pora (SAM 801), 20/07/2011, 1750 m; Aharbal (SAM 817), 02/08/2011, 2350 m; Heerpur (SAM 929), 15/04/2012, 2650 m.

2. *Equisetum diffusum* D. Don, Prodr. Fl. Nepal. 19 (1825).

Synonym: *Equisetum diffusum* var. *paucidentatum* C.N. Page; *E. mekongense* C.N. Page

Medium size fern ally occurring along road in thickets or in semi-shaded places usually on wet ground in lowland, monomorphic, stem much branched bearing 6-12 ridges, occasional from 1700-2500 m altitude.

Distribution: Bhutan, Japan, Myanmar, Nepal, Pakistan, Vietnam, India (Jammu and Kashmir, Assam, Sikkim, Himalayan Mountains from Shimla to Tibet, Meghalaya, South India).

Specimen examined: Narwani (SAM 821), 20/08/2011, 1740 m.

3. *Equisetum palustre* L., Sp. Pl. 2: 1061 (1753).

Synonym: *Equisetum palustre* var. *polystachion* Weigel; *E. palustre* var. *szechuanense* C. N. Page.

Medium size fern-ally growing in marshes, amongst sand and boulders of river valleys, under bushes, aerial stems monomorphic, green, branched, hollow center, sheath tubes long, teeth dark, 5-9, teeth margins white, scarious, rare from 2000-3600 m altitude.

Distribution: Bhutan, China, Japan, Korea, Nepal, North America, Russia, Pakistan, Tibet, India (Kashmir).

Specimen examined: Rambani Ara (SAM 942), 17/09/2012, 1950 m.

Osmundaceae Martinov

4. *Osmunda claytoniana* L., Sp. Pl. 2: 1066 (1753).

Synonym: *Osmundastrum claytonianum* (L.) Tagawa

Terrestrial, large, thick textured, hemi-dimorphic fern, naturally growing in open sunny and rocky slopes in populations, occasional from 2600-3800 m altitude.

Distribution: Bhutan, China, Japan, Korea, Nepal, North America, Russia, Pakistan, Siberia, Tibet, India (Assam, Himachal Pradesh, Kashmir, Sikkim, Meghalaya, Dehradun, Garhwal, West Bengal).

Specimen examined: Huran (SAM 840), 3350, 15/07/2011; Dubjan (SAM 876), 23/07/2011, 3150 m.

Salviniaceae Martynov

5. *Salvinia natans* (L.) All., Fl. Pedem 2: 289 (1785).

Synonym: *Marsilea natans* L.

Aquatic, free floating small fern, stem dichotomously branched, leaves in whorls of three: 2 floating green entire and one submerged finely dissected into linear root-like structure, common in water bodies with altitudinal range from 1700-2000 m.

Distribution: Africa, Asia, China, Europe, Thailand, Vietnam, India (Kashmir).

Specimen examined: Zainapora (SAM 902), 10/09/2012, 1630 m.

6. *Azolla cristata* Kaulf., Enum. Fil.: 274 (1824).

(Previously mis-identified as *Azolla pinnata* R. Br., Prodr. Fl. Nov. Holland. 167 (1810).

Very small aquatic fern, polygonal in outline, stem pseudodichotomously branched bearing long feathery roots, leaves minute, overlapping, bilobed; dorsal lobe brown-green or reddish, ventral lobe translucent submerged, fairly common in rice fields and ponds from 1700-2000 m altitude.

Distribution: India (Kashmir)

Specimen examined: 10/09/2012, 1630 m.

Marsileaceae Mirb.

7. *Marsilea quadrifolia* L. Sp. pl. 2: 1099 (1753)

Medium size aquatic/terrestrial fern bearing long, slender, creeping and branched rhizome, leaves with 4 triangular leaflets in cross-shape; common in rice fields and ponds from 1600-2200 m altitude.

Distribution: China, Europe, Japan, Korea, North America, India (Kashmir, Tamil Nadu).

Specimen examined: Herman (SAM 918), 20/06/2011, 1800 m; Narwani (SAM 824), 01/07/2011, 1750 m.

Polypodiaceae J. Presl

8. *Lepisorus clathratus* (C. B. Clarke) Ching, Bull. Fan Mem. Inst. Biol. Bot. 4: 71 (1933).

Synonym: *Lepisorus nepalensis* K. Iwats.; *Pleopeltis clathrata* (C.B. Clarke) Bedd.; *Polypodium clathratum* C.B. Clarke

Lithophytic small fern having long creeping rhizome, stipe straw colored, lamina lanceolate, widest at or below middle, costa raised on both sides, veins visible, anastomosing to form areolae; rare growing from 2000-4300 m altitude.

Distribution: Bhutan, China, Japan, Nepal India (Kashmir).

Specimen examined: Huran (SAM 864), 15/07/2011, 3455 m; Kongwatan (SAM 940), 20/09/2012, 2650 m.

9. *Lepisorus stewartii* Ching, in Acta Bot. Austro Sinica, 1: 23 (1983).

Lithophytic small fern appearing in colonies on large rocks along streams, stipe very short, green, lamina narrowly linear, pale green, margin revolute, veins obscure, midrib raised abaxially, rare with altitudinal range 2200-4000 m.

Distribution: India (West Himalaya).

Specimen examined: Aharbal (SAM 895), 06/09/2011, 2500 m.

Pteridaceae E. D. M. Kirchn.

10. *Adiantum capillus-veneris* L., Sp. Pl. 2: 1096 (1753).

Synonym: *Adiantum formosum* R. Br.; *A. michelii* H. Christ; *A. modestum* Underw.; *A. remyanum* Esp. Bustos; *A. schaffneri* E. Fourn.; *A. wattii* Baker

Lithophytic medium size fern occurring on moist walls and rocks, rhizome long-creeping, stipe castaneous black, polished, pinnules or ultimate lobes fan shaped or rhombic, sori covered with false, yellow or yellowish brown, narrowly reniform or orbicular- reniform indusia, occasional with altitudinal range of 1700-2800 m.

Distribution: China, Japan, Vietnam, widely distributed in temperate and tropical regions in Africa, America, Asia, Europe, Oceania, India (throughout India).

Specimen examined: Munad SAM (841), 14/07/2011, 1760 m; Zainapora SAM (943), 20/08/2012, 1630 m.

11. *Adiantum pedatum* L. Sp. Pl. 2: 1095 (1753).

Synonym: *Adiantum boreale* C. Presl; *A. pedatum* var. *aleuticum* Rupr.; *A. pedatum* subsp. *aleuticum* (Rupr.) Calder & Roy L. Taylor; *A. pedatum* f. *billingsae* Kittr.; *A. pedatum* var. *glaucinum* C. Chr.; *A. pedatum* var. *kamtschaticum* Rupr.; *A. pedatum* f. *laciniatum* Weath.

Lithophytic medium sized fern growing on moist, cool, shaded areas, fronds clustered, herb green, fan shaped, dichotomously branching from end of the stipe, with 4-6 lateral pinnae, veins multi-dichotomously forked, rare from 1750-3000 m altitude among rocky seeps.

Distribution: Bhutan, Canada, China, Japan, Korea, Nepal, North America, India (Jammu and Kashmir, Himachal Pradesh, Garhwal, Kumaun, Sikkim).

Specimen examined: Secjan (SAM 898), 09/09/2011, 2520 m; Kund (SAM 946), 14/08/2012, 2260 m.

12. *Adiantum venustum* D. Don, Prod. Fil. Nepal 17 (1825).

Synonym: *Adiantum fimbriatum*, *A. venustum* var. *wuliangense* Ching & Y. X. Lin.

Terrestrial or lithophytic growing on moist shady humus rich but well drained soils, rock crevices, stipes dark-purple to nearly black, glossy, lamina triangular, light-green, pinnules wedge shaped, margin regularly toothed, fertile lobes with 2-3 notches, each notch bearing a sorus, abundant having wide altitudinal range from 2000-3300 m.

Distribution: Afghanistan, Bhutan, Myanmar, Nepal, Pakistan, Tibet, China, India (Jammu and Kashmir, Himachal Pradesh, Garhwal, Arunachal Pradesh, West Bengal, Assam, Meghalaya, Uttar Pradesh).

Specimen examined: Aharbal (SAM 805), 14/07/2011, 1900 m; Dubjan (SAM 838), 28/08/2011, 3410 m; Heerpur (SAM 892), 02/09/2011, 2420 m.

13. *Cheilanthes persica* (Bory) Mett. ex Kuhn, Fil. Afr. 73 (1868).

Synonym: *Notholaena persica* Bory; *Cheilanthes szovitsii* Fish. & Meyer

Lithophytic small size fern occurring in rock crevices, fronds clustered, stipe erect, ebenous, shiny, hairy, lamina with abaxial dense white hairs, pinnae triangular to deltate,

sessile, pinnules linear-oblong, incised into small round bead-like segments, occasional with altitudinal range of 1700-2500 m.

Distribution: Afghanistan, Asia, Europe, Iran, Italia, Pakistan, Persia, Turkey, Tibet, India (Kashmir Himachal Pradesh).

Specimen examined: Lahanthoor (SAM 887) 15/08/2011, 2000 m.

14. *Coniogramme affinis* Wall ex Hieron. Hedwigia, 57: 279 (1916).

Synonym: *C. affinis* var. *pilosa* H. S. Kung; *C. argutiserrata* Ching & K. H. Shing. *Grammitis affinis* Wall.; *Gymnogramme affinis* C. Presl; *G. javanica sensu* Hook.; *Syngramme fraxinea* (D. Don) Bedd.

Terrestrial, medium size fern naturally growing in rocky meadows, rhizome long-creeping, scaly, lamina thinly herbaceous, pinnae linear to lanceolate, base sub-cunate to rotundate, margin with sharp teeth, Sori exindusiate extending from costa up to near margin, frequently distributed from 2000- 3500 m altitude.

Distribution: China, Myanmar, Nepal, Tibet, India (Jammu and Kashmir, Himachal Pradesh, Garhwal, Kumaun, Meghalaya).

Specimen examined: Secjan (SAM 891), 16/09/2011, 2500 m; Kund (SAM 924), 02/09/2012, 2050 m; Kongwatan (SAM 941), 20/10/2012, 2360 m.

14. *Cryptogramma brunoniana* Wall. ex Hook. & Grev. Icon. Fil. t. 158 (1829)

Synonym: *Cryptogramma crispa* Bedd.; *C. crispa* var. *brunoniana* (Wall. ex Hook. & Grev.) Hook. & Baker; *C. crispa* f. *indica* Hook.; *Phorolobus brunonianus* (Wall. ex Hook. & Grev.) Fee; *C. emeiensis* Ching & K. H. Shing; *C. shensiensis* Ching.

Lithophytic small size plants occurring at higher altitudes in rock crevices or under rocks in areas with late-lying snow, fronds dimorphic; sterile tufted, many and short, fertile fronds one or two with longer stipes, occasional with altitudinal range of 3000-4000 m.

Distribution: Afghanistan, Bhutan, China, Japan, Nepal, Pakistan, Siberia, Taiwan, India (Kashmir, Himachal Pradesh, Garhwal, Kumaun, Sikkim, Andaman & Nicobar).

Specimen examined: Dubjan (SAM 863), 10/07/2011, 3560 m, Huran (SAM 915), 12/08/2012, 3220 m.

16. *Cryptogramma stelleri* (S. G. Gmel.) Prantl in Bot. Jahrb. Syst. 3: 413 (1882).

Synonym: *Allosorus gracilis* (Michx.) C. Presl; *A. minutus* Turcz. ex Trautv.; *A. stelleri* (S.G. Gmel.) Rupr.; *Cheilanthes gracilis* (Michx.) Kaulf.; *Pellaea gracilis* (Michx.) Hook.; *P. stelleri* (S.G. Gmel.) Baker; *Pteris gracilis* Michx.; *P. stelleri* S.G. Gmel.

Lithophytic high altitudinal small size fern grows on cool moist and shady calcareous rocks, rock lodges and cliffs, fronds remote, dimorphic, sterile shorter than fertile ones, sori elongate, submarginal indusiate, indusium false, pale-green, occasional from 2700-4000 m altitude.

Distribution: Afghanistan, China, Japan, Nepal, Russia, North America, India (Kashmir, Kumaun).

Specimen examined: Dubjan (SAM 867); 10/07/2011; 3550 m. Huran (914), 12/08/2012, 3120 m.

17. *Onychium contiguum* Wall. ex Hope, Journ. Bombay Nat. Hist. Soc., 13: 444 (1901).

Synonym: *Cheilanthes contiguum* Wall.; *Onychium cryptogrammoides* H. Christ; *O. japonicum* var. *intermedia* C. B. Clarke; *O. japonicum* var. *multisecta* C.B. Clarke

Terrestrial medium size fern growing in open rocky meadows along stream banks, stipe long, base black, straw colored distally, lamina finely dissected 4 pinnate-pinnatifid or more; sterile ultimate lobes linear with acute apex, entire margin, fertile ultimate lobes broader than sterile ones, frequent with altitudinal range of 1800-2700 m altitude.

Distribution: Bhutan, China, Cambodia, Laos, Myanmar, Nepal, Thailand, Vietnam, Pakistan, Taiwan, Tibet, India (Jammu and Kashmir, Himachal Pradesh, Garhwal, Sikkim, West Bengal).

Specimen examined: Secjan (SAM 822), 15/07/2011, 2430 m; Aharbal (SAM 831), 19/07/2011, 2340 m; Kongwatan (SAM 871), 13/09/2011, 2360 m.

18. *Onychium japonicum* (Thunb.) Kunze Bot. Zeitung (Berlin) 6: 507 (1848).

Synonym: *Caenopteris japonica* (Thunb.) Thunb.; *Cryptogramma japonica* (Thunb.) Prantl; *Trichomanes japonicum* Thunb.

Medium size fern growing on open rocky meadows near streams, rhizome long-creeping, branched, fronds slightly dimorphic (fertile fronds more coarsely divided than sterile), stipes similar in length or shorter than the lamina, lamina 3-4 pinnate, deltate-oblong, olive-green, papery when dry, rarely occurring from 1700-2500 m altitude.

Distribution: Bhutan, China, Indonesia, Japan, Korea, Myanmar, Nepal, Pakistan, Philippines, Thailand, Vietnam; Pacific islands, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, West Bengal, Meghalaya, Assam, Nagaland).

Specimen examined: Kund (SAM 909), 27/09/2012, 2300 m.

19. *Pellaea nitidula* Wall. ex Hope, Journ. Bombay Nat. Hist. Soc., 13: 444 (1901).

Synonym: *Allosorus nitidulus* C. Presl; *Cheilanthes nitidula* Hook.; *Mildella henryi* (H. Christ) Hall & Lellinger; *Pellaea henryi* H. Christ; *P. nitidula* Wall. ex Hope; *Pteris nitidula* Wall.

Small terrestrial fern growing amongst large boulders, stipes dark-brown, shiny, covered with reddish-brown hairs, lamina brownish-green, ultimate segments linear to lanceolate, simple, indusiate false, continuous, brown, membranous with irregularly dentate margin, rare with altitudinal range from 1700-2500 m.

Distribution: China, Nepal, Pakistan, Taiwan, Tibet, India (Kashmir, Himachal Pradesh, Garhwal, Kumaun).

Specimen examined: Kund (SAM 905), 20/17/2011, 2017 m.

20. *Pteris cretica* L., Mant. Pl. 1: 130 (1767).

Synonym: *Pteris serraria* Sw.; *P. treacheriana* Baker; *P. trifoliata* Fee.; *P. triphylla* M. Martens & Galeotti; *P. nervosa* Thunb.; *Pycnodoria cretica* (L.) Small.

Commonly occur in open rocky meadows having dimorphic fronds, sterile fronds usually small and bending

backwards, fertile fronds with longer and stronger stipes, lamina imparipinnate, herbaceous-sub-coriaceous, pinnae lanceolate, margin spinulose-serrate, sori continuous, sub-marginal covered by false indusium of reflexed pinnae margin, common from 1800-3000 m altitude.

Distribution: Afghanistan, Australia, Africa, Europe, Iran, Bhutan, Burma, China, Nepal, Sri Lanka, Pakistan, Philippines, Korea, Taiwan, Thailand, Japan, India (Kashmir, Himachal Pradesh, Garhwal, Kumaun, West Bengal, Assam, Nagaland, Madhya Pradesh, Tamil Nadu, Kerala).

Specimen examined: Secjan (SAM 830), 15/07/2011, 2400 m; Aharbal (SAM 913), 17/08/2012, 2270 m; Heerpur (SAM 942), 29/09/2012, 2520 m.

21. *Pteris stenophylla* Wall. ex Hook. et Grev., Icon. Filic., t. 130 (1829).

Synonym: *Pteris cretica* L. var. *stenophylla* (Wall. ex Hook. & Grev.) Baker; *P. digitata* Wall.; *P. pellucid* C. Presl. var. *stenophylla* (Wall. ex Hook. & Grev.) C. B. Clarke.

Terrestrial fern growing amongst dry rocks in open forests, pinnae 3-5 clustered at stipe apex, fronds dimorphic, apex of sterile pinnae small and coarsely dentate-serrate, fertile pinnae longer and narrower than sterile, rare with altitudinal range of 2500-3000 m.

Distribution: Bhutan, Nepal, Philippines, India (Jammu and Kashmir, Himachal Pradesh, Garhwal, Sikkim, West Bengal, Dehra Dun).

Specimen examined: Kellar (SAM 820); 28/08/2011; 2230 m.

Dennstaedtiaceae Lotsy

22. *Pteridium revolutum* (Blume) Nakai, Bot. Mag. (Tokyo) 39: 109 (1925).

(Previously mis-identified as *Pteridium aquilinum* (L.) Kuhn., Bot. Ost-Afrika 3: 11 (1879).

Synonym: *Pteridium aquilinum* subsp. *wightianum* (J. Agardh) W.C. Shieh; *Pteridium aquilinum* var. *wightianum* (J. Agardh) R.M. Tryon; *Pteridium capense* var. *densa* Nakai; *Pteris recurvata* var. *wightiana* J. Agardh; *Pteris revoluta* Blume.

Terrestrial large fern grows in open, sunny slopes, forest floor and edges, rhizome subterranean, lamina hairy, nectaries on the underside at the base of pinnae and costae, sori continuous along margins, covered with double indusium, outer made of reflexed margin, inner obsolete, membranous, common with altitudinal range of 1800-2700 m.

Distribution: North-Australia, tropical and subtropical regions of Asia including Bangladesh, Bhutan, China, Taiwan, Indonesia, Malaysia, Philippines, Thailand, Viet Nam, Nepal, Pakistan, Sri Lanka, India (Himachal Pradesh, Jammu and Kashmir, Kumaun, Assam, Meghalaya, Tamil Nadu, Kerala, Sikkim, Arunachal Pradesh, Manipur).

Specimen examined: Aharbal (SAM 814), 05/06/2011, 2225 m; Secjan (SAM 832), 14/07/2011, 2400 m; Heerpur (SAM 930), 05/09/2012, 2540 m.

23. *Hypolepis polypodioides* (Blume) Hook., Sp. Fil. 2: 63 (1852).

Synonym: *Cheilanthes polypodioides* Blume

Large fern occurring on wet sandy slopes and open rocky areas near streams, rhizome long-creeping, hairy, stipes very long 50 cm or more, eglandular hairy, lamina hairy on both surfaces, sori exindusiate, round, intramarginal, partially protected by marginal reflexed teeth, rare growing from 1650-2200 m altitude.

Distribution: Bangladesh, Burma, China, Indonesia, Laos, Malaysia, Myanmar, Nepal, Philippines, Taiwan, Thailand, Vietnam, India (Arunachal Pradesh, Himachal Pradesh, Manipur, Sikkim, South India, Uttar Pradesh, Uttarakhand).

Specimen examined: Kund (SAM 907), 27/09/2011; 2025 m.

Thelypteridaceae Pichi Sermolli

24. *Phegopteris connectilis* (Michx.) Watt., Canad. Nat. 29 (1866).

Synonym: *Aspidium Phegopteris* (L.) Baumg.; *Dryopteris phegopteris* (L.) C. Chr.; *Gymnocarpium phegopteris* (L.) Newman; *Lastrea phegopteris* (L.) Bory; *Nephrodium phegopteris* (L.) Prantl; *N. phegopteris* (L.) Baumg. ex Diels; *Phegopteris phegopteris* (L.) Keyserl.; *P. vulgaris* Mett.; *P. polypodioides* Fee; *Polypodium connectile* Michx.; *P. phegopteris* L.; *Polystichum phegopteris* (L.) Roth; *Thelypteris phegopteris* (L.) Sloss. ex Rydb.

Medium size fern growing on cool moist cliffs and woods along stream banks, rhizome black, stipe clothed with unicellular white hairs, rachis winged, lamina triangular, hairy, hairs transparent, needle-like, pinnae adnate to the rachis, lowest pair drooping down and out, frequent with distributional range from 2700-3100 m altitude.

Distribution: China, Caucasus, Europe, Japan, Siberia, Pakistan, India (Kashmir, Himachal Pradesh, Garhwal, Uttar Pradesh, Kumaun, Sikkim).

Specimen examined: Dubjan (SAM 834), 27/07/2011, 3000 m; Kund (SAM 877), 07/09/2011, 2450 m.

25. *Pseudophegopteris levingei* (C.B. Clarke) Ching, Acta Phytotax. Sin. 8: 314 (1963).

Synonym: *D. levingei* (C. B. Clarke) C. Chr.; *D. purdomii* C. Chr.; *Gymnogramma aurita* var. *levingei* C. B. Clarke; *G. levingei* (C. B. Clarke) Baker; *Leptogramma aurita* var. *levingei* (C. B. Clarke) Bedd.; *L. levingei* (C. B. Clarke) Bedd.; *Phegopteris levingei* (C. B. Clarke) Tagawa; *Thelypteris levingei* (C. B. Clarke) Ching; *Lastrea levingei* (C.B. Clarke) Copel.

Medium size fern growing along streams in thickets, forests amongst boulders, rhizome thin, fronds remote, green, delicate, lamina lanceolate or oblong-lanceolate, herbaceous, base gradually tapering, apex acuminate, pinnae sessile, alternate, common from 2100-3000 m altitude.

Distribution: Afghanistan, Bhutan, China, Pakistan, Tibet, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Darjeeling hills).

Specimen examined: Dubjan (SAM 807), 16/06/2011, 1950 m; Aharbal (SAM 828), 01/07/2011, 2180 m; Heerpur (SAM 853), 11/07/2011, 2550 m.

26. *Pseudophegopteris pyrhorachis* (Kunze) Ching, subsp. *distans* (Mett.) Fraser-Jenk., New Sp. Synder. Indian Pterid.: 214 (1997) (Figure 3).

Synonym: *Phegopteris distans* (D. Don) Mett.

Large fern growing in rocky meadows alongside streams, rhizome thin, long-creeping, stipe base red castaneous, hairy, rachis blackish-brown, densely hairy, lamina abaxially hairy, pinnules narrow, lanceolate, rare from 2000-2800 m altitude.

Distribution: China, Malaysia, Philippines, Taiwan, Polynesia, Sri Lanka, Vietnam, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Darjeeling hills, south India).

Specimen examined: Secjan (SAM 897), 15/09/2012, 2450.

27. *Pseudophegopteris pyrhorachis* (Kunze) Ching, subsp. *laterepens* (Trotter in Hope) Fraser-Jenk.; New Sp. Synder. Indian Pterid. 215 (1997).

Synonym: *Polypodium Laterepens* Trotter in Hope; *Dryopteris Laterepens* (Trotter) C. Chr.; *Thelypteris laterepens* (Trotter) R. Stewart.

Very large fern occurring in forest under-stories near streams, rhizome shot-creeping, thick, stipe long with sparse scales, rachis stramineous, hairy, lower pinnae distant, pinnules wide, deeply lobed, occasional from 2000-2700 m altitude.

Distribution: Pakistan, India (Kashmir).

Specimen examined: Kund (SAM 925), 10/09/2012, 2400 m.

28. *Cyclosorus erubescens* (Wall. ex Hook.) C. M. Kuo, Taiwania 47: 171 (2002).

Synonym: *Asplenium glanduliferum* Wall., nom. nud.; *Christella erubescens* (Wall. ex Hook.) H. Leveille; *Dryopteris braineoides* (Baker) C. Chr.; *D. erubescens* (Wall. ex Hook.) C. Chr.; *Glaphyopteridopsis erubescens* (Wall. ex Hook.) Ching; *Glaphyopteris erubescens* (Wall. ex Hook.) Fee; *Lastrea erubescens* (Wall. ex Hook.) Copeland; *Nephrodium braineoides* Diels; *N. erubescens* Diels; *Phegopteris erubescens* (Wall. ex Hook.) J. Sm.; *Polypodium braineoides* Baker; *P. erubescens* Wall. ex Hook.; *Thelypteris erubescens* (Wall. ex Hook.) Ching.

Terrestrial large fern growing amongst boulders along stream banks, rhizomes erect, woody, stipe ribbed, rachis rectangular abaxially hairy, basal pinnae deflexed and forward, margin lobed, basal pair of lobes touching the corresponding lobes above and below; rare from 2000-3600 m altitude.

Distribution: Bhutan, China, Indonesia, Malaysia, Taiwan, Japan, Myanmar, Nepal, Pakistan, Philippines, Vietnam, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Kumaun, Sikkim, West Bengal, Meghalaya, Tamil Nadu).

Specimen examined: Kund (SAM 906), 27/09/2011, 2050 m.

Aspleniaceae Newman

29. *Asplenium adiantum-nigrum* L. Sp. Pl. 2: 1081 (1753).

Synonym: *Asplenium andrewsii* A. Nelson; *A. chihuahuense* J. G. Baker; *A. dubiosum* Davenport

Lithophytic medium size fern growing on rocky woods, hedge banks, shady walls and rocks bearing evergreen fronds, stipes clustered, lustrous, lamina 2-3 pinnate, dark-green, glossy, thick, coriaceous, margins acutely dentate to serrate, frequent with distributional range of 1700-3000 m altitude.

Distribution: Africa, Afghanistan, Europe, Japan, Iran, Java, Nepal, Taiwan, Turkey, Pakistan, North America, India (Kashmir, Himachal Pradesh, Garhwal, Kumaun).

Specimen examined: Secjan (SAM 815), 25/06/2011, 2600 m; Kellar (SAM 854), 16/08/2011, 2150 m. Narwani (SAM 889), 19/09/2011, 1720 m.

30. *Asplenium x alternifolium* Wulfen, Jacq. Misc. Austr. Bot. 2: 51 (1781).

Synonym: *Asplenium x breynii* Retz; *Asplenium x germanicum* Hope

Small lithophytic fern growing among rock crevices, a cross product of *Asplenium septentrionale* and *A. trichomanes*, lamina pinnate, up to 2x1 cm, lanceolate, pinnae alternate, petiolate, oblanceolate-cuneiform, base cunate, apex toothed; sori indusiate, linear, rare from 2200-3300 m altitude.

Distribution: Europe, India (Kashmir, Himachal Pradesh).

Specimen examined: Huran (SAM 869), 14/08/2011, 3100 m.

31. *Asplenium ceterach* L., Sp. Pl. 2: 1080 (1753)

Synonym: *Asplenium ceterach* L.; *Ceterach officinarum* Willd.; *Scolopendrium ceterach* Symons; *Vittaria ceterach* Bernh.; *Grammitis ceterach* Sw.; *Gymnogramme ceterach* Spring; *Hemidictyum ceterach* (L.) Bedd.

Small lithophytic fern growing in relatively dry conditions, stipes short, brown, densely covered with brown, concolorous scales, lamina leathery, abaxially deep green, glabrous and adaxially dense scaly, margin slightly bending upwards revealing the scales, alternately lobed, frequent from 1700-2600 m altitude.

Distribution: Afghanistan, Australia, Brazil, Scotland, Siberia, Tibet, Ireland, Pakistan, Africa, Europe, India (Kashmir, Himachal Pradesh, Uttarakhand).

Specimen examined: Kund (SAM 896), 27/09/2011, 1930 m.

32. *Asplenium dalhousiae* Hook. Icon. Pl. 2: pl. 105 (1837).

Synonym: *Asplenium alternans* Wall.; *A. rupium* Goodd.; *Ceterach alternans* Kuhn; *Ceterach dalhousiae* (Hook.) C. Chr.

Terrestrial small fern occurring in rocky meadows, stipe brown, indumenta of scales throughout, lamina deeply pinnatifid, subcoriaceous, gradually narrowed towards base, lobes alternate, spreading, lower distant, rare from 1700-2700 m.

Distribution: Afghanistan, Africa, Bhutan, Ethiopia, Nepal, Pakistan, Africa, North America, India (Jammu and Kashmir, Himachal Pradesh, Garhwal, Arunachal Pradesh, Kumaun, Sikkim, West Bengal, Meghalaya, Manipur, Rajasthan).

Specimen examined: Kund (SAM 904), 27/09/2012, 1900 m. Zainapora (SAM 931), 15/05/2012, 1630 m.

33. *Asplenium kukkonenii* Viane & Reichstein, Pteridol. New Mellenium, 18 (2003).

Very small fern grows on moist shady rocks on forest floor, lamina broadest below the middle, apex acute, bipinnate at base, pinnae triangular-ovate, pinnules rounded with acute teeth, lowest acroscopic pinnule the largest, rare with 2100-3300 m.

Distribution: Nepal, India (Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh).

Specimen examined: Aharbal (SAM 886), 37/08/2011, 2600 m.

34. *Asplenium pseudofontanum* Kossinsky, Notulae Syst. Hort. Bot. Petrop. 3: 122 (1922).

Synonym: *Athyrium fontanum* (L.) Roth; *A. halleri* Roth.; *Aspidium fontanum* (L.) Sw.; *A. halleri* (Roth) Willd.; *Asplenium fontanum* (L.) Bernh. subsp. *pseudofontanum*; *A. lanceolatum* subsp. *fontanum* (L.) P. Fourn.; *A. halleri* (Roth) DC.; *A. leptophyllum* Lag.

Lithophytic small ferns commonly occur in rock crevices in forests, fronds clustered, evergreen, lamina finely dissected, widest above the middle, narrowed towards the both ends, rare with distributional range of 1800-3000 m altitude.

Distribution: Afghanistan, Pakistan, India (Jammu and Kashmir, Himachal Pradesh, Kumaun, Garhwal, West Bengal).

Specimen examined: Aharbal (SAM 810), 11/07/2011, 2350 m, Secjan (SAM 829), 21/07/2011, 2400 m; Kongwatan (SAM 899), 14/09/2011, 2650 m.

35. *Asplenium punjabense* Bir, Fraser-Jenk. & Lovis, Fern Gaz. 13: 53-63 (1985) (Figure 2)

Lithophytic fern growing in open rocky meadows, lamina brownish-green, thick, nearly pinnate with deep rounded grooves, adaxially glabrous, abaxially scaly, scales not dense, sori with rudimentary indusia, rare from 1650-2100 m altitude.

Distribution: Afghanistan, Pakistan, India (Himachal Pradesh, Jammu and Kashmir).

Specimen examined: Kund (SAM 903), 24/09/2012; 2020 m.

36. *Asplenium ruta-muraria* L. Sp. Pl. 2: 1081 (1753)

Synonym: *Acrostichum ruta-muraria* Lam.; *Phyllitis ruta-muraria* Moench; *Amesium ruta-muraria* Newmann; *Tarachia ruta-muraria* C. Presl; *Asplenium murale* Bernh.; *A. cryptolepis* Fernald; *A. cryptolepis* Fernald var. *ohionis* Fernald; *A. ruta-muraria* var. *cryptolepis* (Fernald) Wherry.

Small lithophytic fern growing in open sites in rick crevices, pinnae imparipinnate triangular, pinnules lateral, obovate or rhomboid, apex sub-rounded, margins irregularly sharp dentate, base cuneate, sori born along veins, rare from 2000-4000 m altitude.

Distribution: Afghanistan, China, Iran, Japan, Kazakhstan, Korea, Nepal, Pakistan, Russia, Tajikistan; NW Africa, SW Asia, Europe, North America, India (Kashmir, Kumaun, Arunachal Pradesh).

Specimen examined: Secjan (SAM 855), 20/08/2011, 2400 m; Dubjan (SAM 888), 06/09/2011.

37. *Asplenium septentrionale* (L.) Hoffman, Deutschl. Fl. 2: 12 (1795).

Synonym: *Acrostichum septentrionale* L.; *Amesium sasaki* Hayata; *Scolopendrium septentrioinal* Reth; *Belvisia septentrionalis* Mirb.; *Acropteris septentrioinalis* Link; *Blahnum septentrionale* Wall.; *Amesium septentrionale* Newm.; *Asplenium septentrional* var. *sasakii* (Hayata) C. Chr.

Lithophytic fern grows higher altitudes in open sites in rocks crevices and cliffs in light forest; rhizome much branched to produce dense many stemmed, tufts or mats bearing numerous crowded leaves, lamina dichotomously 2 or 3 partite, sori confluent at maturity covering the entire surface, frequent from 2200-3500 m altitude.

Distribution: Afghanistan, China, Kazakhstan, Kyrgyzstan, W Mongolia, Nepal, Pakistan, Russia, Tajikistan; Africa, Europe, North America, India (Kashmir, Himachal Pradesh, Garhwal, Kumaun, Shimla).

Specimen examined: Aharbal (SAM 811), 10/07/2011, 2400 m; Secjan (SAM 823), 28/07/2011, 2350 m; Dubjan (SAM 843), 11/08/2011, 2800 m.

38. *Asplenium tenuicaule* Hayata, Icon. Pl. Formosan. 4: 228 (1914).

Synonym: *Gymnogramma fauriei* Christ, *Asplenium subvarians* Ching, *A. shiobarensse* Koidz

Small fern growing on moist shady rocks on forest floor, lamina bipinnate, 1 cm broad, oblong-lanceolate, pinnules alternate, born on thin delicate stalks, fan shaped to rounded-ovate, rare with altitudinal range from 2000-3600 m.

Distribution: Bhutan, China, Japan, Korea, Nepal, Pakistan, Philippines, Russia, Thailand; Africa, Pacific islands (Hawaii) India (Kashmir, Himachal Pradesh, Garhwal, Kumaun).

Specimen examined: Aharbal (SAM 922), 05/09/2012, 2600 m.

39. *Asplenium trichomanes* L. Sp. Pl. 2: 1080 (1753).

Synonym: *Asplenium melanocaulon* Will.; *A. trichomanoides* Houtt.; *A. minus* Bl.; *A. pusillum* Bl.; *A. densum* Brack.; *A. melaolepis* Col. *Chamaefilix trichomanes* (L.) Farw. *Trichomanes crenatm* Gilib.; *Pylilitis rotundifolia* Moench.

Lithophytic fern occurring in open moist areas, fronds clustered, evergreen, stipes brown- black to coppery, lustrous, brittle, lamina deep green, linear, abundant from 1650-3200 m altitude.

Distribution: worldwide in all temperate zones, in tropics on high mountains, India (Kashmir, Himachal Pradesh, Uttarakhand, Uttar Pradesh, Sikkim, Assam, Meghalaya, Arunachal Pradesh, Manipur, Rajasthan, Tamil Nadu).

Specimen examined: Aharbal (SAM 808); 25/06/2011; 2250 m; Secjan (SAM 839), 22/08/2011, 2400 m; Narwani (SAM 872), 28/09/2011, 1780 m.

40. *Asplenium varians* Wall. ex Hook. & Grev. con. Filic. 2: 172 (1830).

Synonym: *Asplenium lankongense* Ching

Small fern grows on moss covered shady rocks on forest floor, fronds erect or arching, lamina bipinnate, lanceolate, pinnae extremely short stalked, triangular-ovate, pinnules obovate, sharply dentate on the outer margin, rare with altitudinal range of 1700-2900 m.

Distribution: Afghanistan, Bhutan, Burma, China, Hawaii, Japan, Korea, Sri Lanka, Philippines, Nepal, Vietnam, Africa, Taiwan, Thailand, India (Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, West Bengal, Assam, Meghalaya, Tamil Nadu).

Specimen examined: Aharbal (SAM 923), 05/09/2012, 2190 m.

41. *Asplenium viride* Hudson, Fl. Angl. 385 (1762).

Synonym: *Asplenium ramosum* L.; *A. trichomanes-ramosum* L.

High altitudinal fern that grows on limestone rock crevices, fronds evergreen, stipe reddish-brown at base, green distally, lustrous, shallowly grooved on abaxial surface, rare from 2800-4200 m altitude.

Distribution: Afghanistan, Japan, Nepal, Pakistan, Russia, Europe, North America, India (Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh).

Specimen examined: Kaunsernag (SAM 921), 28/08/2012, 3500 m.

Woodsiaceae Herter

42. *Athyrium atkinsonii* Bedd. Ferns Brit. Ind., Suppl. 11. t. 359 (1876).

Synonym: *Aspidium senanense* Franch. & Sav.; *Asplenium atkinsonii* (Bedd.) C.B. Clarke; *A. lastreoides* Baker; *Athyrium lastreoides* (Baker) Diels; *A. microsorum* Makino; *A. monticola* Rosenst.; *A. senanense* (Franch. & Sav.) Koidz. & Tagawa; *Cystopteris grandis* C. Chr. in H. Lev.; *Davallia athyriifolia* Baker; *Dryopteris senanensis* (Franch. & Sav.) C. Chr.; *Pseudocystopteris atkinsonii* (Bedd.) Ching

Middle size fern commonly grows on moist areas above tree line, Fronds single, lamina 3-pinnate-pinnatifid, broadly ovate or triangular, shortly acuminate or almost acute; pinnae distant, petiolate; frequent from 2500-3500 m altitude.

Distribution: Bhutan, Burma China, Taiwan, Nepal, Japan, Pakistan, Tibet, Taiwan, Korea India (Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Darjeeling hills, Arunachal Pradesh).

Specimen examined: Dubjan (SAM 875), 23/07/2011, 3200 m.

43. *Athyrium attenuatum* (Wall. ex C. B. Clarke) Tagawa, Acta. Phytotax. Geobot. 16: 177 (1956).

Synonym: *Asplenium filix-femina* (L.) Bernh. var. *attenuatum* Wallich ex C. B. Clarke, *Athyrium contigens* Ching & Wu.

Terrestrial large fern growing on meadows and gentle mountain slopes, rhizome short-erect, covered with persistent leaf bases, stipe upward, stramineous, rachis succulent, sparsely scaly, lamina tapering at both ends, pinnae higher up congested, pinnule margin serrate, common from 2200-3500 m altitude.

Distribution: Afghanistan, Bhutan, China, Nepal, Pakistan, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand).

Specimen examined: Aharbal (SAM 826), 15/06/2011, 2400 m; Secjan (SAM 835), 27/06/2011, 2300 m; Dubjan (SAM 900), 27/08/2012, 3460 m; Huran (SAM 932), 19/09/2012, 3340 m.

44. *Athyrium distans* (D. Don.) T. Moore, Index Filic.: 152 (1859).

Synonym: *Asplenium distans* D. Don., *Athyrium imbricatum* Christ, *A. fangii* Ching, *A. sikkimense* Ching; *A. decorum* Ching; *A. nanyueense* Ching in Ching & Hsieh

Medium size fern grows on forest floor near water, rhizomes apex densely scaly, stipes long, purplish red to greenish stramineous, lamina 2-pinnate-pinnatisect, grass-green, widest just above the base, pinnules distant, base asymmetrical, occasional from 1700-2500 m altitude.

Distribution: China, Nepal, Japan, India (Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Darjeeling hills, Meghalaya).

Specimen examined: Aharbal (SAM 874), 18/07/2011, 2200 m.

45. *Athyrium mackinnonii* (Hope) C. Chr., Index Filic. Fasc. 3: 143 (1905).

Synonym: *Asplenium mackinnonii* Hope, *Athyrium nigrips sensu* Bedd., *A. caudipinnum* Ching

Medium size fern grows on forest floor, rhizomes covered with persistent leaf bases, densely scaly; scales bicolorous, blackish-brown in central part, brown at margin, stipes pinkish, lamina pale green, pinnae lowest pair deflexed and opposite, rest alternate, ascending, veins visible on both surfaces, common from 1700-2700 m altitude.

Distribution: Afghanistan, Myanmar, Nepal, Pakistan, Thailand, Vietnam, India (Jammu and Kashmir, Himachal Pradesh, Garhwal, Dehra Dun, Uttar Pradesh)

Specimen examined: D. K. Pora (SAM 802), 10/06/2011, 1800 m; Aharbal (SAM 845), 10/07/2011, 2300 m; Heerpur (SAM 850), 15/07/2011, 2400 m.

46. *Athyrium strigillosum* (T. Moore ex E. J. Lowe) Salomon, Nom. Gefasskrypt, 112 (1883).

Synonym: *Allantodia denticulate* Wall.; *Asplenium denticulatum* Wall. ex J. Sm.; *A. setudosum* Wall. ex J. Sm.; *A. strigillosum* T. Moore ex E.J. Lowe; *A. tenuifrons* Wall. ex Hope; *Athyrium proliferum* T. Moore; *A. viviparum* Christ

Medium size fern growing on stream sides in valleys, stipe stramineous, thin, lamina 2-pinnate, triangular-lanceolate, base hardly narrowed, apex acuminate, pinnules ascending, approximate, apex toothed, margin lobed, lobes serrate-dentate, rare from 1700-2500 m.

Distribution: Bhutan, Japan, Myanmar, Nepal, India (Kashmir).

Specimen examined: Saangran (SAM 927), 20/08/2012, 2150 m.

47. *Athyrium wallichianum* Ching. Bull. Fan Mem. Inst. Biol., Bot. 8: 497 (1938).

Synonym: *Aspidium brunonianum* Wall.; *A. brunonianum* Wall. ex Mett.; *Lastrea brunoniana* Wall. ex C. Presl.; *L. brunoniana* (Wall. ex Mett.) Bedd. *L. brunoniana* C. Presl; *Dryopteris brunoniana* (Wall. ex Mett.) Kuntz; *Nephrodium brunonianum* (Wall. ex Mett.) Hook.

Medium size growing in alpine shrub meadows, rhizome thick, black, covered with brown scales, fronds green, clustered, rachis scaly and fibrillose, lamina thick, abruptly narrowed at the apex, pinnae crowded, sessile,

pinnules round, margin serrate, duplicato-dentate, teeth triangular, common from 3300-4600 m altitude.

Distribution: Bhutan, Myanmar, Nepal, Pakistan, India (Kashmir, Himachal Pradesh, Dehra Dun, Garhwal, Kumaun, Sikkim, Arunachal Pradesh).

Specimen examined: Dubjan (SAM 836), 16/08/2011, 3500 m; Huran (SAM 890), 10/08/2012, 3360 m.

48. *Cystopteris dickieana* R. Sim, Gard. Farmers J. 2: 308 (1848).

Synonym: *Cystopteris fragilis* (L.) Bernh. f. *granulos* Bir & Trikha; *C. fragilis* (L.) Bernh. subsp. *dickieana* (Sim) Hook.; *C. fragilis* (L.) Bernh. var. *dickieana* (Sim) T. Moore; *C. sikkimensis* Ching ex Bir

Distribution: Afghanistan, China, Nepal, Pakistan, Japan, Iran, Africa, Europe, North America, Pakistan, Taiwan, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand).

Small fern growing in open slopes, forest floors and edges of forests, rhizome short-creeping, internodes beset with old petiole bases, stipes fragile, sori indusiate, round, indusium forming a hood over the sorus, spore exine rugose or verrucose, occasional with altitudinal range of 1800-2800 m.

Specimen examined: Aharbal (SAM 806), 15/06/2011, 2250 m; Secjan (SAM 852), 17/08/2011, 2350 m.

49. *Cystopteris fragilis* (L.) Bernh. Schrad. Neues J. Bot. 1: 26 (1805).

Synonym: *Aspidium dentatum* Sw.; *A. fragile* (L.) Sw.; *A. viridulum* Desv.; *A. dentatum* (Sw.) Gray; *A. fragile* (L.) Spreng.; *A. fumarioides* C. Presl; *Cyathea anthriscifolia* (Hoffm.) Roth; *C. cynapifolia* (Hoffm.) Roth; *C. fragilis* (L.) J. Sm.; *Cystea angustata* (Hoffm.) Sm.; *C. dentata* (Dicks.) Sm.; *C. fragilis* (L.) Sm.; *Cystopteris acuta* Fee.; *C. baenitzii* Dorfl.; *C. canariensis* C. Presl.; *C. dentata* (Sw.) Desv.

Morphologically similar to *Cystopteris dickieana* except in spore ornamentation, spore exine is echinate not rugose or verrucose, common from 1800-2800 m altitude.

Distribution: Afghanistan, China, Nepal, Russia, Pakistan, Japan, Iran, Africa, Europe, North America, Pakistan, Taiwan, Korea India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Nagaland)

Specimen examined: Sedow (SAM 837), 05/08/2011, 2350, m; Aharbal (SAM 851), 25/08/2011, 2250 m; Heerpur (SAM 865), 15/09/2011, 2400 m.

50. *Deparia acuta* (Ching) Fraser-Jenk., New Sp. Syndrome Indian Pterid.: 104 (1997)

Synonym: *Lunathyrium acutum* Ching

Medium size fern growing in open rocky meadow and mountain slopes, rhizome short-erect, scaly at apex, scales red-brown, stipe and rachis densely hairy, lamina much reduced towards base, apex acuminate, pinnae sessile, slightly ascending, frequent from 2300-3800 m altitude.

Distribution: China, Pakistan, India (Kashmir, Himachal Pradesh, Uttarakhand).

Specimen examined: Secjan (SAM 842), 03/07/2011, 2400 m; Huran (SAM 849), 10/08/2011, 2900 m.

51. *Deparia allantodioides* (Bedd.) M. Kato, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 13: 393 (1984).

Synonym: *Asplenium thelypteroides* sensu Clark, *Athyrium allantodioides* Bedd., *A. thelypteroides* sensu Bedd., *Deparia sikkimensis* (Ching) Nakaike & Malk, *Lunathyrium allantodioides* (Bedd.) Ching, *L. mackinnonii* Ching, *L. sikkimensis* Ching

Large fern growing on forest floor with higher levels of moisture, stipe brown, hairy, rachis fibrillose, hairy, pinnae alternate, sessile, lower pinnae reduced, sometimes up to auricles, deflexed downwards, deeply lobed, lobes connected by a narrow wing, basal basiscopic pinnule outwards; common from 1900-3700 m altitude.

Distribution: Bhutan, China, Nepal, Tibet, Pakistan, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, West Bengal).

Specimen examined: Aharbal (SAM 812), 25/06/2011, 2450 m; Dubjan (SAM 819); 12/08/2011, 2500 m; Secjan (SAM 934), 25/09/2012, 2400 m.

52. *Deparia macdonellii* (Bedd.) M. Kato, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 13: 391 (1984).

Synonym: *Asplenium macdonellii* Bedd.; *Athyrium macdonellii* Bedd.; *Cornopteris macdonellii* (Bedd.) Tardieu; *Deparia pterorachis* (Christ) kato; *Dryothyrium macdonellii* (Bedd.) Morton; *Lunathyrium macdonellii* (Bedd.) Khullar; *L. macdonellii* (Bedd.) Ching

Very large fern growing on forest slopes along streamlets, rhizome long-creeping, lamina basal pinnae triangular and opposite, deeply lobed near to the costa; lobes connected by a very narrow wing, sinus wide and cunate, apex rounded with sharp teeth, margin crenate-serrate, occasional having altitudinal range of 1800-2700 m altitude.

Distribution: Japan, Pakistan, Japan, China, India (Kashmir, Himachal Pradesh).

Specimen examined: Dubjan (SAM 911), 02/08/2012, 2500 m.

53. *Diplazium maximum* (D. Don) C. Chr. Index Filic. fasc. 1: 235 (1905).

Synonym: *Allantodia maxima* (D. Don) Ching; *Asplenium maximum* D. Don; *A. frondosum* Wall.; *Diplazium flaccidum* Christ; *Diplazium giganteum* (Bak.) Ching in C. Chr.; *Gymnogramma giganteae* Baker; *Diplazium frondosum* (Clark) Christ.; *Diplazium polymorphum* Wall. ex Mett.

Terrestrial fern occurring amongst large boulders along streamlets and ravines, rhizome ascending with dense loose scales at apex, scales brown or chestnut, frond large, up to 180x90 cm, pinnules sessile, rounded apex, margin shallowly crenate, sori linear, diplazoid, common from 1800-2500 m altitude.

Distribution: Bhutan, China, Myanmar, Nepal, Pakistan, Polynesia, Vietnam, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, West Bengal, Assam, Meghalaya).

Specimen examined: Secjan (SAM 848), 05/08/2011, 2400 m; Kund (SAM 908), 20/08/2012, 2100 m; Kongwatan (SAM 947), 28/09/2012, 2450 m.

54. *Diplazium sibiricum* (Turcz. ex Kunze) Kurata in Namekata and Kurata Enum. Jap. Pterid. 292: 340 (1961).

Synonym: *Asplenium sibiricum* Turcz. ex Kunze; *A. crenatum* Sommerf; *Athyrium crenatum* (Sommerf) Ruper

ex Nyland; *Allantodia crenata* (Sommerf) Ching; *Cystopteris crenata* Fries; *Dipazium sommerfeldtii* Love & Love

Medium size fern growing on steep forest ravines, rhizome slender, long-creeping, black, stipe longer than lamina, lamina triangular, costae and veins below hairy; basal sori paired back to back on the same vein, others singular; frequent with 2300-2800 m.

Distribution: China, Japan, Korea, Russia, Europe, Nepal, Siberia, India (Kashmir, Himachal Pradesh, Uttarakhand).

Specimen examined: Dubjan (SAM 885), 28/07/2011, 2600 m.

55. *Gymnocarpium dryopteris* (L.) Newman, Phytologist 4: 371 (1851).

Synonym: *Aspidium dryopteris* (L.) Baumgarten; *Carbogymnia dryopteris* (L.) A. Love & D. Love; *Currania dryopteris* (L.) Wherry; *Dryopteris dryopteris* Britton; *D. pulchella* (Salisb.) Hayek; *D. linnaeana* (L.) C. Chr.; *D. pumila* V.I. Krecz.; *Filix pumila* Gilib.; *Lastrea dryopteris* (L.) Bory.; *Nephrodium dryopteris* (L.) Michx.; *Phegopteris dryopteris* Fee; *Polypodium dryopteris* L.; *P. pulchellum* Salisb.; *Polystichum dryopteris* (L.) Roth; *Thelypteris dryopteris* (L.) Sloss

Medium size fern growing on damp areas and among rock crevices near moisture in forests, rhizomes long-creeping, black-brown, apex densely scaly, stipe base purplish, above stramineous, lamina pentagonal-ovate, veins visible abaxially, sori exindusiate, frequent from 2000-2900 m altitude.

Distribution: Japan, China, Tibet, Nepal, Korea, Europe, North America, Pakistan, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim).

Specimen examined: Aharbal (SAM 804), 23/06/2011, 2400 m; Kongwatan (SAM 816), 20/07/2011, 2450 m; Heerpur (SAM 827); 12/08/2011, 2300 m

56. *Woodsia alpina* (Bolton) Gray, Nat. Arr. Brit. Pl. 2: 17 (1821).

Synonym: *Acrostichum alpinum* Bolton; *Woodsia alpina* var. *bellii* G. Lawson; *W. bellii* (Lawson) A.E. Porsild; *W. hyperboreum* R. Br.; *W. himalaica* Ching & S. K.Wu.; *W. ilvensis* var. *alpina* Watt; *W. ilvensis* subsp. *alpina* Asch.

Small fern occurring among rock crevices and scree at high altitudes, rhizome compact with cluster of persistent stipe bases, stipe lustrous, fibrillose and hairy, lamina pinnate to pinnatifid, hairy along the margin, indusia hairy, rare from 2500-3800 m altitude.

Distribution: Afghanistan, Iran, Tibet, Europe, N Asia, Pakistan, India (Kashmir, Himachal Pradesh, Uttarakhand).

Specimen examined: Huran (SAM 868), 20/07/2011, 3200 m.

Dryopteridaceae Herter

57. *Dryopteris barbiger* (T. Moore ex Hook.) Kuntze, Revis. Gen. Pl. 2: 812 (1891).

Synonym: *Aspidium barbigerum* (T. Moore ex Hook.) H. Christ; *Dryopteris falconeri* (Hook.) Kuntze; *Lastrea barbiger* (Hook.) T. Moore ex Bedd.; *L. falconeri* (Hook.) Bedd.; *Nephrodium barbigerum* Hook.; *N. falconeri* Hook.

Terrestrial fern growing in birch forests, stipe, rachis and lamina densely scaly and fibrillose; scales reddish-brown, lamina thickly herbaceous, pinnule lobes rounded with serrate and prominent acute teeth, occasional from 2800-4700 m altitude.

Distribution: Bhutan, Pakistan, China, Tibet, Taiwan, Nepal, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Assam, Sikkim, West Bengal).

Specimen examined: Peergali (SAM 918), 18/08/2012, 3100 m; Dubjan (SAM 934), 16/09/2012.

58. *Dryopteris blanfordii* subsp. *blanfordii* (Hope) C. Chr.; Ind. Fil. 254 (1905).

Synonym: *Dryopteris gongboensis* Ching; *Nephrodium blanfordii* Hope

Terrestrial fern growing on forest floor, stipes with dark-brown base, fibrillose and scaly, scales ovate to lanceolate, brown, concolorous, glossy, margin fimbriate, lamina ca. 50x17 cm, pinnules slightly lobed or sometimes without lobes, segment apex with 2-3 sharp serratures, frequent from 1800-3500 m altitude.

Distribution: Afghanistan, China, Tibet, Pakistan, Nepal, India (Kashmir, Himachal Pradesh, Uttarakhand).

Specimen examined: Aharbal (SAM 893), 08/09/2011, 2300 m

59. *Dryopteris blanfordii* subsp. *nigrosquamosa* (Ching) Fraser-Jenk., Bull. Brit. Mus. (Nat. Hist.), Bot. 18: 388 (1989).

Synonym: *Dryopteris gushaingensis* Ching; *Dryopteris nigrosquamosa* Ching

Terrestrial fern growing in steep abies forests, stipes densely fibrillose and scaly, scales broadly ovate, fuscous-brown, concolorous, crinkled, margins with filamentous projections, lamina ca. 40x12 cm, pinnules lobed, segment apex rarely sharply serrate, rare with 2600-3400 m.

Distribution: SE Tibet, W. China, Nepal, India (Kashmir).

Specimen examined: Dubjan (SAM 847), 05/07/2011, 2750 m.

60. *Dryopteris caroli-hopei* Fraser-Jenk., Bull. Brit. Mus. Nat. Hist. Bot. 18: 422 (1989).

Synonym: *Aspidium dilatatum* var. *patuloides* H. Christ, *Dryopteris pseudomarginata* Ching; *D. pseudomarginata* Ching; *D. marginata sensu auct.* West Himalaya, non (Wall. ex C. B. Clarke) Christ; *Nephrodium marginarum sensu Hope*

Large fern growing near stream banks under shade, rhizome thick, stipe base densely scaly, scales pale-brown, broad ovate, lamina pale-green, 2-3-pinnate, elongated ovate-lanceolate, pinnules deeply lobed to the costa (sometimes becoming pinnate), apex bluntly acuminate, occasional from 1700-2300 m altitude.

Distribution: Bhutan, China, Nepal, Tibet, Yunnan, India (Jammu and Kashmir, Arunachal Pradesh, Manipur, Meghalaya, Nagaland, Himachal Pradesh, Uttarakhand).

Specimen examined: Imamsahib (SAM 844), 15/07/2011, 1866 m; D. K. Pora (SAM 860), 29/07/2011, 1800 m.

61. *Dryopteris filix-mas* (L.) Schott, Gen. Fil., sub pl. 9 1834.

Synonym: *Aspidium depastum* Schkuhr; *A. erosum* Schkuhr; *A. expansum* D. Dietr.; *A. filix-mas* (L.) Sw.; *A. mildeanum* Gopp.; *A. nemorale* (Salisb.) Gray; *A. opizii* Wierzb.; *A. umbilicatum* (Poir.) Desv.; *A. veselskii* Hazsl. ex Domin; *Dryopteris patagonica* Diem; *Filix-mas filix-mas* Farwell; *Lastrea filix-mas* (L.) C. Presl; *Nephrodium crenatum* Stokes; *N. filix-mas* (L.) Rich.; *Polypodium filix-mas* L.; *P. heleopteris* Borkh.; *P. nemorale* Salisb.; *P. umbilicatum* Poir.; *Polystichum filix-mas* (L.) Roth; *P. polysorum* Tod.; *Tectaria filix-mas* Cav.; *Thelypteris filix-mas* Nieuwl.

Terrestrial fern growing under shade near moisture, rhizome long-erect, stipe grooved, scaly and fibrillose, lamina pale to mid-green above, pinnae shortly petiolate, pinnules lobed, lobe ending in an acute tooth, sori crowded, upper part of the lamina fertile, rare from 1700-3200 m altitude.

Distribution: Africa, China, Argentina, Afghanistan, Russia, Greenland, Malaya, Peru, Mexico, Kazakhstan, Pakistan, Russia, Iran, Jamaica, Europe, North America, India (Kashmir, Uttarakhand).

Specimen examined: Narwani (SAM 879), 25/07/2011, 1775 m.

62. *Dryopteris juxtaposita* H. Christ, Bull. Acad. Int. Geogr. Bot. 17: 138 (1907)

Synonym: *Aspidium filix-mas* var. *normale* (C. B. Clarke) H. Christ; *Dryopteris odontoloma* (Bedd.) C. Chr.; *Lastrea odontoloma* Bedd.; *L. odontoloma* T. Moore; *Nephrodium filix-mas* var. *normale* C. B. Clarke.

Medium size fern growing on forest floor near water, rhizome scaly, scales brown, fronds caespitose, lamina subcoriaceous, upper surface blue-green, lower surface whitish-green, sori round, mostly upper part of lamina fertile, indusia brown, rounded-reniform, occasional from 2200-3700 m altitude.

Distribution: Afghanistan, Burma, Bhutan, Japan, Nepal, Tibet, Vietnam, China, Nepal, Thailand, India (Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, West Bengal, Assam, Nagaland, Manipur, Meghalaya, Tamil Nadu).

Specimen examined: Heerpur (SAM 883), 28/07/2011, 2715 m; Secjan (SAM 910), 05/09/2012.

63. *Dryopteris nigropaleacea* Fraser-Jenk., Bol. Soc. Brot., ser. 2, 55: 238 (1982).

Synonym: *Dryopteris pallida* Subsp. *nigropaleacea* Fraser-Jenk.; *Nephrodium filix-mas* Rich. var. *normalis* C. B. Clarke

Medium size fern growing near small streams banks, stipe very base scaly and fibrillose, lamina elongate, triangular-lanceolate, crispaceous, abaxially glaucous, adaxially blue-green, matt, glabrous; pinnae lobes rectangular with rounded-truncate and toothed apices, frequent from 1700-2800 m altitude.

Distribution: Afghanistan, Bhutan, Burma, Nepal, Pakistan, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, West Bengal, Nagaland).

Specimen examined: Dubjan (SAM 857), 27/07/2011, 2700 m; Heerpur (SAM 884), 18/08/2011, 2600 m.

64. *Dryopteris pulvinulifera* (Bedd.) Kuntz, Revis. Gen. Pl. 2: 813 (1891).

Synonym: *Dryopteris harae* H. Ito; *D. reholtumii* M. Price; *Lastrea pulvinulifera* Bedd.; *L. sparsa* var. *zeylanica* Bedd.; *L. pulvinulifera* var. *zeylanica* Bedd.; *Nephrodium pulvinuliferum* (Bedd.) Baker; *N. sparsum* var. *squamulosum* C. B. Clarke

Plants growing on steep forest floor under shade, rhizome thin, stipe base with densely scaly, scales bright golden, narrow, linear, lamina dark-green, deltoid-lanceolate, lower part 4-pinnate, upper part 3-pinnate, pinnules pinnate, apices acute ending in few small acute teeth, pinnulets overlapping, occasional from 1700-2800 m altitude.

Distribution: Bhutan, China, Nepal, Sri Lanka, Philippines, India (Kashmir, Sikkim, West Bengal, Assam, Meghalaya, Nagaland).

Specimen examined: Heerpur (SAM 813), 08/07/2011, 2600 m; Dubjan (SAM 858), 28/08/2011, 2800 m.

65. *Dryopteris ramosa* (Hope) C. Chr., Index Filic. fasc. 5: 287 (1905).

Synonym: *Nephrodium ramosum* Hope

Terrestrial large fern growing on forest floor, rhizome densely scaly and surrounded by stipe bases, lamina 3-pinnate, deltate, apex acuminate, pale-green, pinnae distant, frequent with the altitudinal range of 2000-4000 m altitude.

Distribution: Afghanistan, Bhutan, California, Caucasus, Tibet, Europe, Nepal, Pakistan, India (Kashmir, Himachal Pradesh, Uttarakhand).

Specimen examined: Dubjan (SAM 846), 18/07/2011, 2700 m.

66. *Dryopteris redactopinnata* S.K. Basu & Panigrahi, Indian J. Forest. 3: 270 (1980).

Synonym: *Dryopteris pseudofibrillosa* Ching; *D. tsangpoensis* Ching

Medium size fern growing on forest floor, stipe densely clothed with scales, scales light to mid-brown, concolorous, not glossy, lamina ca. 30x13 cm, glossy on upper surface, upper part of lamina fertile, indusia with brown center and pale brown margin, frequent from 2400-3800 m altitude.

Distribution: Bhutan, China, Tibet, Taiwan, Nepal, Pakistan, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, West Bengal).

Specimen examined: Dubjan (SAM 878); 05/08/2011; 3320 m.

67. *Dryopteris stewartii* Fraser-Jenk., Kalikasan Philip. J. Biol. 7: 272 (1979).

Synonym: *Dryopteris odontoloma* (Bedd) C. Chr. f. *brevifolia* Mehra & Khullar

Medium size fern growing on small stream banks, stipe base densely scaly, scales blackish-brown to brown, glossy, sometimes bicolorous, margin serrate, apex acuminate, lamina widest above the base, mid-green adaxially, green abaxially, frequent with altitudinal range of 1800-3100 m.

Distribution: Afghanistan, Pakistan, Nepal, India (Kashmir, Himachal Pradesh, Uttarakhand).

Specimen examined: D. K. Pora (SAM 856); 23/07/2011, 1850 m; Heerpur (SAM 870), 08/08/2011, 2550 m; Aharbal (SAM 895), 05/07/2012, 2400 m.

68. *Dryopteris subimpresca* Loyal, Nova Hedwigia 16: 467 (1968).

Synonym: *Dryopteris lancipinnula* Ching; *D. submarginata* Loyal; *D. subodontoloma* Loyal

Medium size fern growing on small streams banks, rhizome long-ascending, stipe long, base scaly, scales pale brown, lamina deltoid-lanceolate, pale green, thinly leathery, basal pinnae pair largest, basal basiscopic pinnule of lowest pinnae largest, rare from 1800-2700 m altitude.

Distribution: Bhutan, Nepal, China, India (Kashmir, Himachal Pradesh, Kumaun, Uttarakhand, Sikkim, West Bengal).

Specimen examined: D.K. Pora (SAM 856), 06/07/2011, 1830 m

69. *Dryopteris wallichiana* (Spreng.) Hylander, Bot. Notis: 352 (1953).

Synonym: *Aspidium donianum* Spreng.; *A. paleaceum* Lag. ex Sw.; *A. paleaceum* (T. Moore) Dalla Torre & Sarnth.; *A. parallelogrammum* Kunze; *A. patentissimum* Wall. ex Kunze; *A. Wallichianum* Spreng.; *Dichasium parallelogrammum* (Kunze) Fee; *D. patentissimum* (Wall. ex Kunze) Fee; *Dryopteris cyrtolepis* Hayata; *D. doiana* Tagawa; *D. doniana* (Spreng.) Ching; *D. himalaica* (Ching & S.K. Wu) S.G. Lu; *D. pachyphylla* Hayata; *D. paleacea* (T. Moore) Hand. Mazz.; *D. parallelogramma* (Kunze) Alston; *D. patentissima* (Wall. ex Kunze) N.C. Nair; *D. quatanensis* Ching; *D. ursipes* Hayata; *D. Walliachiana* var. *himalaica* Ching & S.K. Wu; *Lastrea paleacea* (Lag. ex Sw.) T. Moore; *L. parallelogramma* (Kunze) Liebm.; *L. patentissima* C. Presl; *L. patentissima* (Wall. ex Kunze) J. Sm.; *Nephrodium parallelogrammum* (Kunze) Hope; *N. patentissimum* (Wall. ex Kunze) C.B. Clarke

Very large fern growing on forest floor, rhizome massive, stipe very densely scaly, scales at stipe base blackish mixed with pale ones, scales upwards along with rachis light-brown to paler, mixed with few blackish ones, scale base usually dark, rachis densely scaly and fibrillose; lamina green to deep-green, large, ca. 70x22 cm, sori indusiate, round, 2/3rd of frond is fertile, indusia dark-brown, reniform falling off at maturity, frequent from 2300-3500 m altitude.

Distribution: Argentina, Bhutan, Borneo, Burma, China, Malaysia, Myanmar, Nepal, Jamaica, Cuba, Brazil, Tibet, Nepal, Taiwan, Japan, Mexico, Vietnam, Philippines, Java, India (Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Meghalaya, Arunachal Pradesh, Nilgiri hills).

Specimen examined: Dubjan (SAM 929); 27/07/2011; 2725 m.

70. *Dryopteris xanthomelas* (H. Christ) C. Chr., Index Filic., Suppl. 1: 41 (1913).

Synonym: *Aspidium xanthomelas* Christ; *Dryopteris discrete* Ching & S. K. Wu; *D. omeicola* Ching; *D. canaliculata* Ching in C. Y. Wu; *D. centrochinensis* R. C. Ching; *D. chingii* Nair; *D. fibrillosa* (C. B. Clarke) Hand. Mazz.; *D. fibrillosissima* Ching in C. Y. Wu; *D. hupehensis* Ching; *D. pulcherrima* Ching; *D. qandoensis* Ching in C. Y. Wu; *D. rosthornii* (Diels) C. Chr.; *D. rosthornii sensu* Stewart; *D. sinofibrillosa* Ching; *Nephrodium rosthornii* Diels

Large fern growing on forest floor and scrub zone, stipe black, base densely scaly and fibrillose, scales black,

broadly lanceolate, glossy, apex acuminate, upper part together with rachis clothed with linear-lanceolate and linear, dentate scales, lamina ca. 30x10 cm, sori indusiate, upper part of lamina fertile, indusia brown, rounded-reniform, frequent from 2400-3800 m altitude.

Distribution: Bhutan, Nepal, Pakistan, Tibet, Taiwan, India (Kashmir, Himachal Pradesh, Arunachal Pradesh, Uttarakhand, Sikkim, West Bengal).

Specimen examined: Dubjan (SAM 880), 27/07/2011, 3320 m; Huran (SAM 945), 25/09/2012, 3450.

71. *Polystichum bakerianum* (Atk. ex C.B. Clarke) Diels, Nat. Pflanzen fam. 1: 191 (1899).

Synonym: *Aspidium bakerianum* (Atk. ex C. B. Clarke) Atk. ex Baker; *A. prescottianum* var. *bakerianum* Atk. ex C. B. Clarke; *Polystichum prescottianum* var. *bakerianum* (Atk. ex C. B. Clarke) Bedd.

Large fern growing on steep and open bushy areas at higher altitudes, stipe and rachis densely scaly and fibrillose, lamina abaxially scaly and fibrillose, pinnule margin lobed, lobes ending in a sharp long and curved tooth, frequent from 3000-3900 m altitude.

Distribution: Afghanistan, Bhutan, China, Nepal, Pakistan, India (Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh).

Specimen examined: Peergali (SAM 917), 18/08/2012; 3250 m.

72. *Polystichum castaneum* (C. B. Clarke) B. K. Nayar & S. Kaur, Comp. Bedd. Handb. Ferns Brit. India, 50 (1974).

Synonym: *Aspidium prescottianum* Wallich ex Mettenius var. *castaneum* C. B. Clarke; *Polystichum prescottianum* (Wallich ex Mettenius) T. Moore var. *castaneum* (C. B. Clarke) Beddome

Medium size fern growing in alpine meadows, stipes and rachis very densely scaly and fibrillose, scales usually light-brown with few dark streaks mixed with blackish-brown, pinnae basal pairs slightly distant and reduced, margin serrate and spinulose, occasional from 3200-4600 m altitude.

Distribution: China, Myanmar, India (Jammu and Kashmir, Himachal Pradesh, Garhwal, Sikkim, West Bengal).

Specimen examined: Dubjan (SAM 919), 10/08/2012, 3300 m

73. *Polystichum discretum* (D. Don) J. Smith, J. Bot. 3: 413 (1841).

Synonym: *Aspidium discretum* D. Don; *Polystichum discretum* (D. Don) Diels; *P. fuscopaleaceum* Alston; *P. indicum* Khullar & S. C. Gupta; *P. kathmanduense* Nakaike; *P. nigropaleaceum* (H. Christ) Diels

Large fern growing at shaded and humus rich areas, stipe densely fibrillose, scaly, scales dark-brown to almost black, lamina abaxially fibrillose, adaxially shiny, lowest pinnae pair deflexed forward and downwards, pinnule apex acute with prominent teeth curved towards pinna apex, occasional from 1700-2700 m altitude.

Distribution: Africa, Burma, China, Japan, Malaya, Sri Lanka, Bhutan, Myanmar, Nepal, Pakistan, Thailand, India, Kashmir, Himachal Pradesh, Uttarakhand, West

Bengal, Meghalaya, Bihar, Tamil Nadu, Sikkim, Manipur, Arunachal Pradesh).

Specimen examined: Narwani (SAM 881), 25/07/2011, 1775 m; Kund (SAM 945), 24/09/2012, 2350 m.

74. *Polystichum lachenense* (Hook.) Bedd, Ferns Brit. India, pl. 32 (1865).

Synonym: *Aspidium lachenense* Hook.; *Polystichum aleuticum* C. Chr. ex Holten; *P. tsuchuense* Ching in C. Y. Wu; *P. sinkiangense* Ching ex Chang Y. Yang; *P. xinjiangense* Ching ex C.Y. Yang.

Small fern growing under rocks, stipe dark brown to blackish-purple, glossy, rachis scaly and fibrillose, lamina fragile, abaxially fibrillose, pinnae deltoid-ovate, distant, lobed, lobes ending in acute tooth, upper half of frond fertile; rare from 3000-4200 m altitude.

Distribution: Burma, China, Japan, Bhutan, Myanmar, Nepal, Taiwan, Pakistan, Tibet, India, Kashmir, Himachal Pradesh, Uttarakhand, Sikkim).

Specimen examined: Huran (SAM 866), 10/07/2011, 3550 m; Kaunsernag (SAM 920), 28/08/2012, 3450 m; Dubjan (SAM 937), 20/09/2012, 3260 m.

75. *Polystichum lonchitis* (L.) Roth. Tent. Fl. Germ. 3: 71 (1799).

Synonym: *Aetopteron lonchitis* House; *Aspidium lonchitis* (L.) Sw.; *Dryopteris lonchitis* (L.) O. Kuntze; *Hypopeltis lonchitis* Tod.; *Polypodium lonchitis* L.; *Polystichum asperum* Bubani

Lithophytic fern growing at higher altitudes in alpine and subalpine regions, lamina linear to linear-lanceolate, base narrowed, drooping at tip, glossy, pinnae edges with spiny teeth, auricled at anterior and cunate at posterior bases, rare from 2700-4000 m altitude.

Distribution: Afghanistan, N. America, Iran, Ireland, China, Japan, Europe, Pakistan, India (Kashmir).

Specimen examined: Huran (SAM 862), 10/07/2011, 3550 m; Dubjan (SAM 938), 20/09/2012, 3330 m.

76. *Polystichum luctuosum* (Kunze) T. Moore Index Fil. 95 (1858).

Synonym: *Aspidium tsus-simense* Hook.; *A. luctuosum* Kunze; *A. aculeatum* var. *pallescens* Franch.; *Polystichum monotis* Christ; *P. falcilobum* Ching; *P. tsus-simense* var. *pallescens* Franch. *P. mayebarae* Tagawa

Terrestrial fern growing in shady areas along streams with partial to no sun exposure, rhizome scaly, scales brown with blackish apex, lower pinnae bending forward and downward, pinnules auriculate, ovate-trapezoid, rare from 1700-2500 m altitude.

Distribution: Japan, China, Korea, Madagascar, Nepal, Pakistan, Africa, Tibet, Taiwan, India (Jammu and Kashmir, Uttarakhand, Arunachal Pradesh).

Specimen examined: Kund (SAM 926), 16/09/2012, 1900 m.

77. *Polystichum nepalense* (Spreng) C. Chr., Index Filic. 1: 84 (1905).

Synonym: *Aspidium auriculatum* var. *marginatum* C. B. Clarke; *A. marginatum* Wall.; *A. nepalense* Spreng; *Polystichum atroviridissimum* Hayata; *P. auriculatum* var. *marginatum* Bedd.

Medium size fern growing in rocky meadows near stream, Stipes scaly and fibrillose, lamina pinnate,

narrowly lanceolate, slightly narrowed below, margin irregularly more or less entire or slightly serrate with pale colored teeth, rare from 2000-3200 m altitude.

Distribution: Afghanistan, Bhutan, Burma, China, Japan, Myanmar, Nepal, Philippines, Sri Lanka, Tibet, Vietnam, Yunnan, India (Arunachal Pradesh, Darjeeling hill, Himachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Uttarakhand).

Specimen examined: Secjan (SAM 928), 08/09/2012, 2400 m.

78. *Polystichum piceopaleaceum* Tagawa in Acta Phytotax. Geobot. 5: 255 (1936).

Synonym: *Aspidium angular sensu* Hope; *Polystichum aculeatum* var. *fargesii* H. Christ; *P. bicolor* Ching & S.K. Wu; *P. doianum* Tagawa; *P. setiferum* var. *fargesii* (H. Christ) C. Chr.; *P. yunnanense* var. *fargesii* (H. Christ) C. Chr.

Terrestrial fern growing on forest floor, rocky meadows, lamina bipinnate, abaxially scaly and fibrillose, apex acuminate, lower pinnae pairs deflexed downwards; pinnules rhomboidal-ovate, frequent from 1800-3200 m altitude.

Distribution: Afghanistan, Bhutan, Burma, China, Japan, Myanmar, Nepal, Pakistan, Sri Lanka, Taiwan, India (Jammu and Kashmir, Himachal Pradesh, Arunachal Pradesh, Uttarakhand, Assam, Manipur, Meghalaya, Nilgiri hills, Nagaland).

Specimen examined: Aharbal (SAM 825) 05/07/2011, 2650 m; Heerpur (SAM 933), 24/07/2011, 2500 m; Secjan (SAM 894), 06/08/2012, 2450 m.

79. *Polystichum prescottianum* (Wall. ex Mett.) T. Moore. Ind. Fill.: 101 (1858).

Synonym: *Aspidium mouoinense* Franch.; *Aspidium prescottianum* Wall. ex Mett.; *Polystichum erinaceum* Ching & S.K. Wu.; *P. mouoinense* (Franchet) Bedd.

Large fern forming colonies in open meadows above the tree line, fronds clustered, stipe base dark-blue, densely scaly and fibrillose, lamina densely fibrillose, pinnae margin deeply lobed, lobes/pinnules serrate with each lobe ending in an awn or spine, upper part of the frond fertile, common from 2800-3900 m altitude.

Distribution: Afghanistan, Bhutan, China, Pakistan, Taiwan, Nepal; India (Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, West Bengal).

Specimen examined: Huran (SAM 861), 08/07/2011, 3200 m; Dubjan (SAM 939), 10/08/2012, 3300 m.

80. *Polystichum shensiense* Christ, Bull. Acad. Geogr. Bot. Mans. 16: 113 (1906).

Synonym: *Dryopteris lichiangensis* (Wright) C. Chr.; *Nephrodium lichiangense* C.H. Wright; *Polystichum lichiangense* (Wright) Ching ex H.S. Kung; *P. obtusipinum* Ching & H.S. Kung; *P. prescottianum* var. *shensiense* (H. Christ) C. Chr.

Terrestrial fern growing above tree line, stipe and rachis scaly and fibrillose, scales light-brown, broad-ovate intermixed with lanceolate ones, pinnae sessile, alternate, triangular-lanceolate, margin deeply segmented or becoming pinnate, segments small with few marginal teeth, rare with the range of 3200-4500 m altitude.

Distribution: Bhutan, China, Taiwan, Tibet, Nepal, Pakistan, India (Kashmir, Uttarakhand, Himachal Pradesh).

Specimen examined: Kaunsernag (SAM 816), 15/07/2012, 3450 m; Dubjan (SAM 936), 26/09/2012, 3350 m.

81. *Polystichum yunnanense* H. Christ, Notul. Syst. (Paris) 1: 34 (1909).

Synonym: *Polystichum gyirongense* Ching; *P. jizhushanense* Ching; *P. yunnanense* var. *submuticum* C. Chr.; *P. makino sensu* Frase-Jenkins & Khullar

Large fern growing on forest floor, stipes long brown, stipe base scaly, rachis densely fibrillose, scaly, lamina broadly lanceolate, dark bluish-green upper surface with little depressions opposite the sorus, basal acroscopic pinnule largest, margin deeply lobed, lowest lobe largest and parallel to the costa facing towards apex, margin with sharp teeth, frequent from 2000-3200 m altitude.

Distribution: Afghanistan, China, Tibet, Burma, Bhutan, Myanmar, Nepal, Pakistan, India (Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Tamil Nadu, Sikkim, Arunachal Pradesh, Meghalaya, Manipur, Darjeeling hills).

Specimen examined: Aharbal (SAM 873), 23/07/2011, 2250 m; Kund (SAM 912), 16/09/2012, 2120 m.

Botanical study of flora of particular area is an important aspect as it forms baseline information for the distribution of plant species or communities and their relation with physical environment. This paper gives a broad outlook about the pteridophytes of Shopian. About 81 species of ferns and fern allies have been collected in the course of the study for three consecutive years, 2010-2012; indicating that agro-climatic conditions of the study area are favorable for the growth and development of pteridophytes. The pteridophytes form a vital element of the ecosystem and most of them being forest dwellers that can be taken as good indicators of the extent of problems like deforestation and habitat destruction. Botanical explorations should increase in the under-explored botanically rich areas for documenting the diversity and ecological characteristics of pteridophytes. Taxonomic reinvestigations in such areas should take place to avoid the confusions with new species and existing species.

ACKNOWLEDGEMENTS

The first author is thankful to University Grants Commission (UGC), New Delhi, India for providing financial assistance to carry out the research work. Authors are also thankful to Late Dr. H. C. Pande (Sci.-D) and Brijesh Kumar, Botanical Survey of India, Dehradun; Dr. Shweta Singh, Guru Gobind Singh Indraprastha University, New Delhi; and Prof. S. P. Khullar, Chandigarh for their help in the identification of plants and rendering me necessary literature facilities.



Figure 2. *Asplenium punjabense* Bir, Fraser-Jenk. & Lovis.



Figure 3. *Pseudophegopteris pyrhorachis* (Kunze) Ching, subsp. *distans* (Mett.) Fraser-Jenk.

REFERENCES

- Beddome RH. 1883. Handbook to the ferns of British India Ceylon & Malay Peninsula. Thacker Spink & Co., Calcutta
- Beddome RH. 1892. Supplement to the ferns of British India Ceylon & Malay Peninsula. Thacker Spink & Co., Calcutta.
- Bhat TA, Nigam G, Majaz M. 2012. Study of some medicinal plants of the Shopian District, Kashmir India with emphasis on their traditional use by Gujjar and Bakerwal Tribes. *Asian J Pharm Clin Res* 5: 94–98.
- Chandra S. 2000. The Ferns of India Enumeration, Synonym & Distribution. Dehra Dun, India: International Book Distributors.
- Clarke CB. 1880. A Review of ferns of Northern India. *Trans Linn Soc Bot London* 1: 425–611.
- Dixit RD. 1984. A Census of Indian Pteridophytes, Flora of India IV. Bot. Surv. India, Howrah., Calcutta, India.
- Fraser-Jenkins CR, Benniamin A. 2010. Fifty rarities and additions to the pteridophytic flora of Arunachal Pradesh, NE India. *Panjab Univ Res J Sci* 59: 1–38.
- Fraser-Jenkins CR. 1989. A monograph of Dryopteris Pteridophyta: Dryopteridaceae in the Indian Subcontinent. *Bull Brit Mus Nat Hist Bot* 18: 323–477.
- Fraser-Jenkins CR. 1991. An outline monographic study of the genus *Polystichum* in the Indian Subcontinent. In: Bhardwaj, T.N., Gena, C.B. (Eds.), *Aspects Plant Science* 13: 249–287.
- Fraser-Jenkins CR. 1992. The ferns and allies of the far west Himalaya. *Pakistan Syst* 5: 85–120
- Fraser-Jenkins CR. 1993. The ferns and allies of the far west Himalaya– Some additions and corrections. *Bot Helvetica* 102: 143–157.
- Fraser-Jenkins CR. 1997. New species syndrome in Indian pteridology and the ferns of Nepal, International Book Distributors, Booksellers and Publishers, Dehra Dun.
- Fraser-Jenkins CR. 2008. Endemics and pseudo-endemics in relation to the distribution patterns of Indian pteridophytes. *Taiwania* 53: 264–292; Reprinted, *Indian Fern J* 25: 1–45 with new combinations.
- Ghosh SR, Ghosh B, Biswas A, Ghosh RK. 2004. The pteridophytic flora of eastern India. *Flora of India, Series 4, Botanical Survey of India.*
- Hope CW. 1899–1904. The ferns of North–Western India including Afghanistan, the Trans–Indus Protectedstates and Kashmir. *J Bombay Nat Hist Soc* 122: 315–325 (1899); 124: 621–633 (1899); 131: 25–36 (1900); 132: 236–251 (1900); 133: 443–461 (1901); 141: 118–127 (1902); 142: 252–266 (1902); 143: 458–480 (1902); 144: 720–749 (1903).
- Jacobsen WBG, Jacobsen NHG. 1989. Comparison of the pteridophyte floras of Southern and Eastern Africa, with special reference to high-elevation species. *Bulletin du Jardin Botanique de Belgique* 59: 261–317.
- Javeid GN. 1965. Some fern and fern–allies of Srinagar. *Kashmir sci* 2: 90–100.
- Kapur SK, Sarin YK. 1977. Useful medicinal ferns of Jammu and Kashmir. *Indian Drugs* 14: 136–140.
- Kapur SK. 1985. Contribution to the Pteridophytic flora of Jammu and Kashmir. *J Econ Tax Bot* 6: 503–514.
- Kaul V, Zutshi DP. 1966. Vegetation of Kashmir University Campus, Srinagar. *J Ind Bot Soc* 45: 354–364.
- Kaul V, Zutshi DP. 1967. A study of aquatic and marshland vegetation in Srinagar. *Proc Nat Inst Sci India* 33: 111–127.
- Khullar SP, Sharma SS. 1987. The ferns of Western Himalaya excluding Uttarakhand. In: Pangtey YPS, Joshi SC (eds). *Western Himalaya, Environmental Problems and Development*. Gyanodaya Prakashan, Nanital, India. pp 310–346.
- Khullar SP. 1984. The ferns of Western Himalaya– a few additions, corrections and annotations. *Indian Fern J* 1: 89–95.
- Khullar SP. 1994. An Illustrated Fern Flora of West Himalaya Vol. I Botrychiaceae to Aspleniaceae. International Book Distributors, Dehra Dun, India.
- Khullar SP. 2000. An Illustrated Fern Flora of West Himalaya Vol II Onocleaceae to Salviniaceae. International Book Distributors, Dehra Dun, India.
- Kornas J. 1993. The significance of historical factors and ecological preference in the distribution of African pteridophytes. *J Biogeogr* 20: 281–286.
- Kumari A, Lal B, Fraser-Jenkins CR. 2010. *Microlepia setosa* Sm. Alston - a new generic record in the pteridophyte flora of Himachal Pradesh, India. *Indian Fern J* 27: 376–382.
- Lawrence WR. 1895. *The Valley of Kashmir* (Reprinted). Srinagar: Chinar Publishing House.
- Linder HP. 2001. Plant diversity and endemism in sub-Saharan Tropical Africa. *J Biogeogr* 28: 169–182.
- Mir SA, Mishra AK, Reshi ZA, Sharma MP. 2014a. Four newly recorded species of Dryopteridaceae from Kashmir valley, India. *Biodiversitas* 15: 6–11.
- Mir SA, Mishra AK, Reshi ZA, Sharma MP. 2014b. New records of Pteridophytes for Kashmir Valley, India. *Biodiversitas* 15: 131–136.
- Navchoo IA, Kachroo P. 1995. *Flora of Pulwama Kashmir*. Bishen Singh Mahendra Pal Singh, Dehradun, India.
- Pryer KM, Schneider H, Smith AR, Cranfill R, Wolf PG, Hunt JS, Sipes, SD. 2001. Horsetails and ferns are a monophyletic group and the closest living relatives to seed plants. *Nature* 409: 618–622.
- Pryer KM, Schuettpelz E, Wolf PG, Schneider H, Smith AR, Cranfill R. 2004. Phylogeny and evolution of ferns monilophytes with a focus on the early Leptosporangiate divergences. *Am J Bot* 91: 1582–1598.
- Raza M, Ahmad A, Mohammad A. 1978. *The Valley of Kashmir, a geographical interpretation*. Vikas Publication, New Delhi, India.
- Razdan B, Kachroo P, Bir SS. 1986. Cytomorphology of the ferns of Kashmir–I. Aspleniaceae. *Indian Fern J* 3: 111–120.
- Rodgers WA, Panwar HS. 1988. *Planning a Wildlife Protected Area Network in India Vol. I & II*. Field Document No. 7. Wildlife Institute of India, Dehra Dun.
- Smith AR, Pryer KM, Schuettpelz E, Korall P, Schneider H, Wolf PG. 2008. Fern classification. In: Ranker TA, Haufler CH (eds). *Biology and Evolution of Ferns and Lycophytes*. Cambridge University Press, Cambridge. pp. 417–467.
- Smith AR, Pryer KM, Schuettpelz E, Korall P, Schneider H, Wolf PG. 2006. A classification for extant ferns. *Taxon* 55: 705–731.
- Stewart RR. 1945. Ferns of Kashmir Himalaya. *Bull Torrey Bot Club* 72: 399–426.
- Stewart RR. 1951. The Ferns of Pehlgam Kashmir. *J Indian Bot Soc* 30: 137–142.
- Stewart RR. 1957. The Fern & Fern Allies of West Pakistan Kashmir. *Biologia* 3: 133–164.
- Stewart RR. 1972. An annotated catalogue of vascular plants of West Pakistan & Kashmir In: Nasir E, Ali SI (eds). *Flora of West Pakistan*. Fakhri Press, Pakistan.
- Stewart RR. 1984. Remarks on North–West Himalayan Ferns. *Indian Fern J* 1: 41–46.
- Wani MH, Shah, MY, Naqshi AR. 2012. The ferns of Kashmir-an update account. *Indian fern J* 29: 100–136.