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Four newly recorded species of Dryopteridaceae from Kashmir valley, India

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ABSTRACT

Mir SA, Mishra AK, Reshi ZA, Sharma MP. 2014. Four newly recorded species of Dryopteridaceae from Kashmir valley, India. Biodiversitas 15: 6-11. Habitat diversity, elevation, cloud cover, rainfall, seasonal and temperature variations have created many ideal sites for the luxuriant growth of pteridophytes in the Kashmir valley, yet all the regions of the valley have not been surveyed. In Kashmir valley the family Dryopteridaceae is represented by 31 species. During the recent extensive field surveys of Shopian district four more species viz., *Dryopteris caroli-hopei* Fraser-Jenkins, *Dryopteris blanfordii* subsp. *nigrosquamosa* (Ching) Fraser-Jenkins, *Dryopteris pulvinulifera* (Bedd.) Kuntze and *Polystichum nepalense* (Spreng) C. Chr. have been recorded for the first time from the valley. The taxonomic description, synonyms, distribution and photographs of each species are given in this article.

Key words: *Dryopteris*, Kashmir valley, Shopian, pteridophytes, new records

INTRODUCTION

The ferns originated in ancient tropical habitats and have been successful in many types of environments for thousands of millennia. According to Rothwell and Stockey (2008) ferns first appeared in the fossil record during the Middle Devonian 390 million years ago. Ferns have continued to evolve and diversify up to the recent ages. However according to Chapman (2006) about 15% of all fern and lycophyte species may not yet be known to science. The total number of known ferns is estimated at about 12000 species worldwide belonging to 225-230 genera (Kramer and Green 1990) and 37 families (Smith et al. 2006). Dryopteridaceae is a large and diverse family of leptosporangiate ferns that have a world-wide distribution, but it has the highest density of genera and species in the temperate regions of the Northern Hemisphere, especially in the hills and mountains of eastern Asia (Ching 1965; Tryon and Tryon 1982; Wu and Ching 1991; Wu 2000). Ching (1965) founded the family *Dryopteridaceae* based on the type genus *Dryopteris* Adans. The members of this family are usually terrestrial and medium-sized plant bearing creeping, ascending or erect rhizome clothed with non-clathrate scales at apices; petioles with numerous vascular bundles arranged in a ring; pinnate or forking veins; and rounded to reniform spores with winged perine. This family includes about 1700 species belonging to 40-45 genera, of which the two largest genera are *Dryopteris* with 225-300 species (Kramer 1990; Fraser-Jenkins 1986; Zhang et al. 2012), and *Polystichum* with 260-300 species (Barrington 1995; Mabberley 1997; Kung et al. 2001; Driscoll and Barrington 2007). The characteristic features of *Dryopteris* genus are the presence of ctenitoid hairs on fronds, absence of groove on costae and costules. The other genus, *Polystichum* is characterized by absence of ctenitoid hairs on fronds and presence of an adaxial groove on costae and costules.

The Kashmir valley or the Vale of Kashmir, a deep elliptical bowl-shaped valley beautifully enclosed in a magnificent amphitheater of mountain ranges- the Great Himalayas and the Pir Panjal, is the central division of Jammu and Kashmir State (Wadia 1975). Total area of the valley is about 15,948 km^2, virtually 64% of which being hilly. Altitude of the valley plain at its summer capital Srinagar is 1,675 m above mean sea level (Srivastava 1998) and the highest peak among its surrounding mountains is that of the 'Kolahoi or Gwashibror' with an altitude of 5,420 m. Owing to the vast variety of edapho-climatic and physiographic heterogeneity, the valley harbors diverse ecosystem types, including lakes, springs, rivers, cultivated fields, orchards, subalpine and alpine meadows, mountain slopes and terraces, permanent glaciers, etc., which equally support diverse floristic elements (Gupta 1982; Singh et al. 1998) and renders suitable habitat for supporting rich flora of cryptogams, especially pteridophytes. Therefore the study was taken to explore in-depth pteridophyte wealth of Shopian district, Kashmir Himalaya.

MATERIALS AND METHODS

Study area

The study was carried out in Shopian district of Kashmir valley. The region is located in the south and

south-west extremity of the valley in close proximity of Pir-Panjal range (Figure 1). Most of the area of this district is hilly with the altitudinal range from 1700 to 4500 meters. The district lies between latitude of $33^0 20'$ and $34^0 54'$ N and longitude of $73^0 35'$ and $75^0 35'$ E. Total area of Shopian district 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 temperature ranges from an average daily maximum of 32ºC and minimum of 15ºC during summer to an average daily maximum of 4ºC and minimum of -4ºC during winter (Bhat et al. 2012). It receives annual precipitation of about 1050 mm. The district also possesses rich soil diversity, namely hill soils, alluvial soils and Karewa soils (Raza et al. 1978). Great altitudinal variation and contours of hills shapes the district into a gradually heightening slope with a wavy appearance that adds magnificent variation in vegetation. Besides, edapho-climatic variations, mountain slopes and terraces, permanent glaciers, large number of stream and streamlets and significant precipitation in this district have built many ideal sites for the luxuriant growth of pteridophytes. Although, some earlier works on pteridophytes of the valley had been done by Clarke (1880), Beddome (1883, 1892), Stewart (1945, 1951, 1972 and 1984) and Kapur (1985), the collective contribution of these workers resulted in the discovery of only 90 species and 4 varieties (belonging to 29 genera) from Kashmir (Dar et al. 2002). In this connection, attempts have been made to explore in-depth the Perido-flora of this area.

Regular field trips were carried out in and around different areas of Shopian district for the collection of fern and fern allies from June to November during the years 2011 and 2012. During the survey we not only confirmed the presence of the various species of Dryopteridaceae reported earlier, but also discovered four more species viz., *Dryopteris blanfordii* subsp. *nigrosquamosa, Dryopteris caroli-hopei and Dryopteris pulvinulifera*, *Polystichum Nepalense* that constitute new records for Kashmir valley. The specimens were identified by the consultation of relevant literature and study of herbarium specimens deposited in the Herbarium, Botanical Survey of India (BSI), Dehradun. Help has also been taken from Dr. H. C. Panday (Scientist 'D') and Brijesh Kumar from BSI, Dehradun, India. The voucher specimens are deposited in Department of Botany, Jamia Hamdard and in the Herbarium of University of Kashmir (KASH), India.

RESULTS AND DISCUSSION

A detailed account comprising taxonomic descriptions, synonyms, distribution and figures of these newly recorded species is provided here under:

Dryopteris blanfordii

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

Dryopteris nigrosquamosa Ching, Bull. Fan Mem. Inst. Biol. 2: 194 (1931); *Dryopteris gushaingensis* Ching, Fl. Xizangica 1: 269 (1983).

Rhizome long, obliquely ascending, thick, clothed with scales. Stipes ca. 8 cm long, longitudinally grooved, densely fibrillose and scaly: scales broadly ovate, fuscous-brown, concolorous, crinkled, margins with filamentous projections, apex acuminate, gradually smaller upward, lanceolate to linear, sparse higher up, stipe base dark-brown; rachis scaly and fibrillose; fibrils dark-brown at base, higher up light-brown. Lamina 2-pinnate, ca. 40 cm long, 12 cm broad, lanceolate to oblong-lanceolate, slightly tapered below to a truncate base, thinner with herbaceous texture, adaxially glabrous, apex acuminate; pinnae ca. 18 pairs, ca. 7 cm long, 1.5-2 cm broad, slightly distant, alternate, horizontally spreading, shortly stalked, oblong-lanceolate, apex acuminate: pinnules ca. 14 pairs, separated, lanceolate to oblong-lanceolate, sessile, slightly oblique, lowest pair of pinnules slightly stalked and large than those above it, further up narrowly attached and becoming widely attached to the pinna costa, lobed; lobes narrow, rectangular with truncate apices, upper lobes becoming pointed and ending in a single acute tooth, segment apex rarely sharply serrate. Veins pinnate, forked; costae and costules sparsely scaly. Sori indusiate, round, in

Figure 1. Research site "Shopian" located at south-west of Kashmir, Jammu and Kashmir, India

1 row on each side close to the costa, usually only upper half of lamina fertile; indusia rounded to reniform, membranous, margin entire irregular. Spores dark-brown, perinate, perine folded.

Figure 2: A, B, C

Habitat: Steep Abies forests

Specimen examined: Shopian, Dubjan, 2750 m alt., 05.07.2011, Shakoor Ahmad, 847 (KASH).

Distribution: China (Fraser-Jenkins 1989).

Dryopteris caroli-hopei

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

Aspidium dilatatum var. *patuloides* H. Christ, Societe Botanique de France 1: 41, 1905; *Dryopteris pseudomarginata* Ching, Sporae Pterid. Sin. 327: 1976.

Rhizome, short stout, prostrate, scaly: scales adnate, brown, ovate-lanceolate. Stipe long, c 30-45 cm, thick, 0.4-0.5 cm, stramineous, base brownish, densely scaly; scales pale-brown, ovate-lanceolate, apex acuminate, stipe upward with sparsely adpressed scales and fibrils. Lamina large, 2-3 pinnate, ovate-lanceolate, c 65 cm long and 40 cm broad, pale-green, costa sparsely linear-lanceolate scaly, basal pinnae tripinnate, pinnate on the upper part, apex acuminate and pinnate; pinnae c 23 pairs, up to 20 cm long and 7 cm broad, obliquely spreading, alternate, stalked, triangular lanceolate, matted upper surface, costa sparsely fibrillose on lower surface; pinnules c 12-18 pairs, up to 4 cm long, 1.5 cm broad, short stalked, sessile upwards, alternate, narrowly triangular lanceolate, apex acute, pinnatisect; pinnulet or pinnule lobes, c 8-10 pairs per pinnule, adnate to costule, ovate-lanceolate, with rounded and obliquely pointed apices, margin serrate, pinnules on the basiscopic side of the pinnae in the lower half of the frond are longer than those on the acroscopic side. Veins simple or forked, conspicuous abaxially, slightly distinct adaxially, 8-10 pairs per pinnule. Sori indusiate, small, rounded, not crowded, one per segment, entire lamina fertile, indusia brown; round-reniform, entire, persistent. Spores pale-brown, perinate.

Figure 2: D, E, F

Habitat: Near stream banks under shade

Specimen examined: Shopian, Imamsahib, 1866 m alt., 15.07.2011, Shakoor Ahmad, 844 (KASH).

Distribution: India (Arunachal Pradesh, Manipur, Meghalaya, Nagaland, Uttar Pradesh, Jammu division.), Bhutan, China (Tibet, Yunnan), Nepal (Khullar 2000; Chandra 2000).

Dryopteris pulvinulifera

Dryopteris pulvinulifera (Bedd.) Kuntze, Revis. Gen. Pl. 2: 813 (1891).

Dryopteris harae H. Ito, Fl. E. Himalaya 1: 476 (1966); *Lastrea pulvinulifera* Bedd., Ferns Brit. India, (1870); *Nephrodium pulvinuliferum* (Bedd.) Baker, Syn. Fil. (1874); *Nephrodium sparsum* var. *squamulosum* C. B. Clarke, Trans. Linn. Soc. London, Bot. 1: 524 (1880); *Lastrea pulvinulifera* var. *zeylanica* Bedd., Suppl. Ferns S. India (1876).

Rhizome short-creeping, thin, densely clothed with bright golden, linear-lanceolate scales. Stipes long, 30-35 cm, almost the same length as the lamina, dia. 0.2 cm, pale, base curved just above the point of attachment, densely scaly; scales long, narrowly lanceolate, glossy, bright golden in color, stipe upward glabrous or containing scattered, narrowly lanceolate, dark scales; rachis glabrous, except for dense covering of small, dark-brown, hair-like scales, especially near the attachment of costa to the rachis. Lamina lower part 4-pinnate, upper part 3-pinnate, deltoid-lanceolate, apex acuminate, c 45 cm long, c 40 cm broad, dark-green adaxially, herbaceous; pinnae c 20 pairs, alternate, overlapping, deltoid-lanceolate; pinnules c 17 pairs in largest pinna, triangular lanceolate, shortly petiolate, pinnate, base cunate, apex acuminate, basal basiscopic ones longest; pinnulets c 11 pairs in the largest pinnule, obliquely spreading, deeply pinnatifidly lobed, acroscopic lobes more developed, wider and longer, apices acutely pointed and bearing a few insignificant, small, acute teeth; pinnulet segments or ultimate segments longer on the acroscopic side of the pinnulet, ending in a few small acute teeth; costa with sparse small, black-brown scales adaxially. Veins pinnate. Sori indusiate, rounded, small, regularly in one row on each side of costule; indusia rounded-reniform, thin, lifting deciduous. Spores regular.

Figure 2: G, H, I

Habitat: Growing on steep forest floor under shade

Specimen examined: Shopian, Heerpur, 2600 m alt., 08.07.2011, Shakoor Ahmad, 813 (KASH).

Distribution: India (Sikkim, Darjeeling, Meghalaya, Nagaland), Bhutan, China, Nepal, Sri Langka, Philippines (Khullar 2000; Chandra 2000).

Polystichum nepalense

Polystichum nepalense (Spreng.) C. Chr. Index Filic. fasc. 10: 84 (1906).

Aspidium nepalense Spreng, Syst. Veg. 4: 97 (1827); *Polystichum atroviridissimum* Hayata, Icon. Pl. Formosan. 4: 190 (1914).

Rhizomes erect to sub-erect, thick, scaly; scales light brown. Stipes c 5 cm long, straw colored, scaly and fibrillose, basal scales ovate to lanceolate, pale-brown, paler higher up on stipe, glossy, margin with short projections, apex acuminate; rachis fibrillose and sparsely clothed with small cuspidate scales intermixed with a number of large ovate, light-brown ones. Lamina pinnate, linear-deltoid or lanceolate, c 24 cm long and 4 cm broad, coriaceous; pinnae c 28 pairs, falcate, alternate, up to 2.5 cm long and 0.7 cm broad (largest), acute, shortly petiolate, adpressed scales on abaxial side, adaxially glabrous, base auriculate, auricle attached to the rest of the pinna, margin irregularly more or less entire or slightly serrate with pale colored teeth, lower pinnae slightly reduced in size compared to above. Veins and veinlets numerous in small groups. Sori indusiate, many, medial in one row on either side of mid-vein; indusia brown, membranous, large, margin undulate, persistent. Spores dark-brown, perinate.

Figure 2: J, K, L

Habitat: Rocky meadows near stream

Figure 2. A, B, C. *Dryopteris blanfordii* subsp. *nigrosquamosa*; D, E, F. *Dryopteris caroli-hopei*, G, H, I- *Dryopteris pulvinulifera*; J, K, L- *Polystichum Nepalense*

Specimen examined: Shopian, Secjan, 2400 m alt., 15.09.2011, Shakoor Ahmad, 928 (KASH).

Distribution: India (Arunachal Pradesh, Darjeeling hill, Himachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Uttarakhand) Afghanistan, Bhutan, China (Tibet, Yunnan), Japan, Myanmar, Nepal, Philippines, Sri Langka, Vietnam (Khullar 2000; Chandra 2000).

Discussion

Ferns inhabit a great variety of substrates, climates, and light regimes, both in habitats dominated by flowering plants and those where few angiosperms can survive. They also represent a critical evolutionary step, bridging the functional gap between nonvascular bryophytes and seed-bearing vascular plant. The earlier fern collectors in the Kashmir were R. McLeod and T. Thomson. Subsequently many European (mainly British) botanists gathered collections from Kashmir, notable among them being J. Winterbottom, J.E.T. Atchinson, V. Jacquemont, H. C. Levinge, E.W. Trotter, A. Meebold, W.N. Kolz, J. Marten, G.A. Grammie, C. Stokoe, J. C. Mcdonell etc. The classical work of Clarke (1880), Beddome (1883, 1892) and Hope (1903) also include several ferns from the Kashmir. Ralph Randles Stewart (1937, 1945, 1951, 1957 and 1972) is utmost fern collector of Kashmir. Recently Wani et al. (2012) presented an up-to-date account of fern and fern allies of Kashmir valley, Gurez and Ladakh. The authors also included ecological status, phytogeographical affinity and the distributional data of collected ferns. Of the total taxa reported, 30 taxa belong to family *Dryopteridaceae*, 20 to *Woodsiaceae* and 13 taxa to the family Aspleniaceae. 47 taxa (42%) were recorded to be rare or endangered.

The four species of pteridophytes mentioned above have been reported from other parts of the world and also from different states of our country, India. The three species *D. blanfordii* subsp. *nigrosquamosa*, *D. pulvinulifera* and *Polystichum nepalense* are new to the Jammu and Kashmir state, whereas the fourth *D. caroli-hopei* has earlier been reported from the Jammu division only. *D. caroli-hopei* differs from *D. Pulvinulifera* in having thick rhizome, broad-ovate stipe scales, 2-3-pinnate pale-green lamina and lobed pinnules with bluntly acuminate apex. *P. Nepalense* differs from its closest species *P. lonchitis* in bearing broad base and pinnae margin more or less entire or slightly serrate. Similarly *D. blanfordii* subsp. *nigrosquamosa* contrasts from *D. blanfordii* subsp. *blanfordii* by long-sub-erect rhizome, short stipe densely clothed with fuscous-brown ovate scales and shallowly lobed pinnules.

CONCLUSION

Since exploration, inventory and documentation of phytodiversity (including non-flowering plants), is a minuscule step in the larger goal of sustainable utilization of earth's resources, the present study was undertaken to document the Pteridophytic wealth of District Shopian, Kashmir valley, India. The present communication reports the four species of ferns, viz. *Dryopteris caroli-hopei* Fraser-Jenkins, *Dryopteris blanfordii* subsp. *Nigro-squamosa* (Ching) Fraser-Jenkins, *Dryopteris pulvinulifera* (Bedd.) Kuntze and *Polystichum nepalense* (Spreng) C. Chr that constitute new record for Kashmir valley.

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