

Morphological and Ethnobotanical Aspects of Ten Common Species of Ferns and Fern Allies Belonging to Families Dennstaedtiaceae, Dryopteridaceae, Equisetaceae & Blechnaceae from District Kinnaur of Himachal Pradesh

Research Article

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Abstract

Extensive documentation of ethnobotanically important pteridophytes remains lacking though vascular cryptogams are used by indigenous people to a great extent. Therefore, this paper gives an account of the useful pteridophytes of the Kinnaur district of H.P. The present study focuses on the morphological and ethnobotanical study of 10 common species of ferns and fern allies viz *Cyrtomium caryotideum*, *Dennstaedtia scabra*, *Dryopteris barbigera*, *Dryopteris chrysocoma*, *Dryopteris cochleata*, *Dryopteris nigropaleacea*, *Dryopteris panda*, *Equisetum arvense*, *Equisetum ramosissimum* & *Woodwardia unigemmata*. The documentation of these pteridophytes may be helpful in preserving them by local people. This may also help to popularize their uses leading to the bioprospection of these resources.

Keywords: Kinnaur; Himachal Pradesh; Pteridophytes; Fern and fern allies; Ethnobotanical uses

Introduction

India ranks sixth among the 12 mega biodiversity centers of the world [1,2] and is acknowledged as the Botanical Garden of the World and has 3 biodiversity hotspots namely Andaman and Nicobar Islands, Eastern Himalayas and Western Ghats. India is renowned for having many medical systems worldwide, with ayurveda having about 250,000 registered medical practitioners [3]. Traditional medicines were used by many native communities in

cultural, ecological, and historical aspects India has a pteridophytic flora as it has diverse topography, varying climatic conditions distinct geographical positions with numerous migration-flows of species of different phytogeographical elements meeting in various parts of the country [4].

Pteridophytes, are seedless tracheophytes that first appeared during the Carboniferous period and are second to angiosperms in the world with 13,600 species around the world [2,5,6]. They are shade

and moisture-loving and thrive in moist temperatures and exist in areas with high altitudes. Asia represents about 4,500 pteridophytes, one-third of the total number existing in the world Indian flora consists of 67 pteridophytic families with 191 genera comprising more than 1000 species with 47 endemic ferns [6].

Theophrastus (327–287 BCE) and Dioscorides (50 CE) mentioned pteridophytes possess medicinal properties for the treatment of different health problems [7]. Pteridophytes have been used by indigenous people for a long time but their ethnobotanical uses have yet not been documented to a large extent. Inhabitants of tribal communities in India, China, and the Philippines use these ferns for ethnobotanical purposes. Ferns belonging to the *Microsorium* genus are used to make medicines by people in the Pacific islands [8,9].

Indian subcontinent exhibits high biodiversity richness and many traditional healthcare systems. Several forest products are used by indigenous people. Thus, the conservation of indigenous knowledge is necessary in national and international perspectives which will lead to the acknowledgement of progressive trends in indigenous knowledge [10]. [11] mentioned 160 species of medicinal pteridophytes of our country having pharmacological properties [12].

Materials and Methods

Himachal Pradesh is a mountainous state situated in northern region bordered by Jammu and Kashmir and Ladakh in the north, in west by Punjab, Haryana in southwest, in the southeast by Uttarakhand and shares a narrow border in south to Uttar Pradesh.

Kinnaur District is located in the north-easternmost part of Himachal Pradesh with an area of 6520 sq. meter. Satluj river divides the district equally and enters the district from north-west and leaves on the western boundary. Kinnaur is situated on the banks of river Satluj from Northern latitude 31-05'-50" to 32-05'-15" and eastern longitudes 77-45' to 79-00'-35" East longitudes. Ngari region of western Tibet forms eastern boundary of Kinnaur; Zaskar Mountains separate it from Tibet. The district is separated from Uttarkashi district of Uttarakhand on south by Dhauladhar Range and Rohru tehsil of district Shimla. Kullu and Rampur regions are separated on western side by Srikhand Dhar. Rivers Spiti and Parachu separate Kinnaur from Lahaul and Spiti in north. near international boundary with Tibet. *Cedrus deodara*, *Juglans regia*, *Pinus gerardiana*, *Pinus roxburghii*, *Rhododendron arboreum* are common tree species found locally. July to October are the best months for the collection. Collection of ferns and fern allies was done during this period as monsoon rains occur and these plants reach maturity or become fertile. During winter period either only wintergreen species survive or they remain dormant to resume active growth in the next monsoon season.

Standard methods were adopted for collection, preservation & identification of the plants. The plants were photographed & their characteristic features were noted in the field. Five herbarium mounts of each of these plants were also prepared for record & identification. The collected plants were identified & described according to latest International Rules of Botanical Nomenclature [13,14]. Metric system has been adopted throughout the work.

Classification given by [15] & followed by [16] for identification of pteridophytes; with revisions according to updated rules and regulations have been applied. The collected and identified plants are illustrated by following the latest International Rules of Botanical Nomenclature. For each plant common and vernacular names available in the literature, etymology, citations, morphological features, flowering and fruiting season, specimens examined, habitat, economic and ethnobotanical value of some ferns and coloured photographs are also presented. Metric system has been adopted throughout the work. In addition to several other references [13] and latest International Code of Botanical Nomenclature have been followed for plant nomenclature. Classification given by [13, 15] and followed by [14] for pteridophytes have been adopted.

Observations

Extensive field visits were made to the study sites of district Kinnaur of Himachal Pradesh for sample collection. 10 species belonging to 5 genera of 4 families have been documented in this paper. 1 species is used as a fuel wood, 2 species are used as fodder for livestock and 4 species are used as medicines. All of these pteridophytic species have been reported for the first time in this area. Dryopteridaceae is the dominant family with 2 genera (6 species) and Dennstaedtiaceae (1 species), Equisetaceae (2 species) and Blechnaceae (1 species).

Results and Discussion

Cyrtomium caryotideum (Wallich ex Hook. & Grev.) Presl. syn. *Aspidium caryotideum* Wall., *Cyrtomium falcatum* Swartz var. *caryotideum* (Wallich ex Hooker & Greville) Beddome Family: Dryopteridaceae *Cyrtomium caryotideum* (Wallich ex Hooker & Greville) Presl. Tent. Pterid. 86. Pl. 2. f. 26. 1836; Dhur, Ferns of North-West. Himal. 78. 1980; Khullar, Illust. Fern Fl. W. Himal. II: 256. f. 91. 2000; Pande & Pande, Illust. Fern Fl. Kumaon Himal. II: 196. f. 66. 2002; Pande & Pande, Illust. Fern Fl. Kumaon Himal. I: 249 2003; Chandra, Ferns Ind. 166. 2007. *Aspidium caryotideum* Wall., Numer. List No. 376. 1828. *Aspidium falcatum* sensu Clarke, Trans. Linn. Soc. Lond. 2 Bot 1: 512. 1880, *pro parte*; non-Hooker & Greville 1828.



Morphological aspect: Size 45-95 cm long. Rhizome is short and thick, robust, wrapped by tenacious leaf bases, crowded scales, scales dark-brown, concolorous, longer than its width /ovate. Stipes 15-30 cm long, diam. 0.1-0.2 cm, pale-brown with dark-brown base, densely scaly at the base, with dispersed scales and fibrils, scales longer than its width to ovate or lance-shaped, dark brown. Rachis fibrillose, broad scales absent, fibrils more prominent at pinna-junction. Lamina pinnate, 30-60 x 10-20 cm, imparipinnate, base truncate, texture sub-coriaceous to leathery, smooth, petiole decreasing in length in the upper pinnae, leathery, ovate-lance shaped, falcate, caudate, acute or obtuse at base, strongly auriculate on the upper or both sides, acroscopic base extended into a long sharp auricle, terminal pinna generally the largest. Veins reticulate, darkened and prominent, primary veins arising from the costa of the pinna almost parallel to each other extending near to the margin, dividing pinnately 1-3 times; veinlets inwardly directed, anastomosing, areolae hexagonal. Sori indusiate, round, numerous larger, scattered. Indusium pale-brown, large, round, flat, thin, peltate, more or less caducous, smooth, margin fimbriate. Sporangia spherical to elliptical, with 15-17 vertical annular cells and having considerably long stalk. Spores round, brown 42-45.5 x 49-56 µm, perinate, perine faintly reticulate. **Fertile season:** September-February.

Specimens examined: Chaura forest (Kinnaur, 2200 m), 1.1.2019, H.C.Negi 320.

Habitat: A beautiful terrestrial fern which rarely grows on humus rich soils in damp shaded nallahs and hilly slopes under the shades of *angiospermic* bushes. Distribution: Bhutan, China, Japan, Nepal, Pakistan, Philippines, Tibet, Vietnam, W. Himalaya, India: Jammu & Kashmir, Uttarakhand, Himachal Pradesh: Chamba (Dalhousie), Kulu (Manali), Shimla hills (Chachpur, Glen, Theog), Solan (Kandaghat, Mt. Karol). Altitude: 2000-2400 m.

Notes: 1) Chromosome number: triploid apomict, $n = 30$ [17].

2) *Cyrtomium caryotideum* has been collected and described for the first time from district Kinnaur of Himachal Pradesh.

Dennstaedtia scabra Wall. ex Moore syn. *Dicksoniascabra* Wall. Family: Dennstaedtiaceae

Dennstaedtia scabra Wall. ex Moore, Index Fil., 307. 1861; Beddome, Hbk Ferns Brit. Ind. 24. t. 124. 1883; Baishya & Rao, Ferns & Fern-allies of Meghalaya State, Ind. 88. 1982; Dixit, Cens. Ind. Pterid. 94. 1984; Khullar, Illust. Fern Fl. W. Himal. I: 360. f. 128. 1994; Borthakur et al., Illust. Man. Ferns Assam 251. f. 116. 2001; Pande & Pande, Pteridology in W. Himal. (Kumaun). 74. 2002; Pande



& Pande, Illust. Fern Fl. Kumaon Himal. II: 98. f. 28(i). t. 25. 2002; Chandra, Ferns Ind. 97. 2007. *Dicksonia scabra* Wall., Numer. List no. 2173. 1829. nom. nud. (Wall. ex Moore) Clarke, Trans. Linn. Soc. Lond. 2 Bot. 1: 436. 1880; Hope, J. Bomb. nat. Hist. Soc. 13: 28. 1900.

Morphological aspect: Size medium, 18-22 cm. Rhizome long crawling type, slender, diam. 0.3-0.4 cm, densely hairy, brown, 5-10 celled long, acicular, scaly, scales dull-brown in color, 0.4-0.6 x 0.1-0.2 cm. Stalks 6-18 cm in length, diam. 0.1-0.3 cm, reddish-brown, ± thick, rough, densely hairy at base, becoming sparsely hairy higher up, hairs brown, 9-13 cell long. Rachis often wavy, brown, hairs as on stipe. Lamina 2-3 pinnate, 15-50 x 9-25 cm, deltate or broad lance-shaped, with a surface which is herbaceous, dark olive-green, both surfaces sparsely hairy, hairs white, glistening. Pinnae 6-10 pairs, up to 5-7.5 x 2-3.5 cm, close together, alternate, with stalk (in well developed plants) or sessile, deltate. Pinnules 1.5-2 x 0.4-0.6 cm, lower pinnules lobed extensively to the costa. Pinnules many, longer than its width-deltate. Veins free, hairy, costa and costules hairy. Sori indusiate, subglobose, 2-6 per lobe, terminal on the margin of the lobes. Sporangia 11-12 celled annulus, black coloured. Indusium cup-shaped, smooth. Spores yellow-brown, 34.5-28.5 x 28-38.5 µm, tetrahedral trilete, non-perinate, exine smooth. **Fertile season:** May-November.

Specimens examined: Rispa (Kinnaur, 2500 m), 17.6.2017, Ruchi Negi 208.

Habitat: Well flourished in small cliffs or steep slopes in deep sheltered stream gulleys and humus rich forest floor of *Pinus wallichiana*. Distribution: Burma, China, Japan, Malaysia, Nepal, Thailand, Taiwan, Vietnam, W. Himalayas. India: Darjeeling hills, Meghalaya, Sikkim, Uttarakhand (Chamoli-Garhwal Dehradun, Mussoorie, Tehri-Garhwal) [18]. Himachal Pradesh: Shimla (Chadwick fall, Tutikandi). Altitude: 1600-2700 m.

Notes: 1) Chromosome number: $n = 33, 34$ (17).

2) *Dennstaedtia scabra* has been collected and described for first time from district Kinnaur of Himachal Pradesh

Dryopteris barbigera (T. Moore ex Hooker) O. Ktze. syn. *Nephrodium barbigerum* T. Moore ex Hooker Family: Dryopteridaceae

Dryopteris barbigera (T. Moore ex Hooker) O. Ktze., Revis. Gen. Pl. 2: 812. 1891; Dhir, Ferns NW. Himal. 66. 1980; Dixit, Cens. Ind. Pterid. 149. 1984 [19]; Khullar, Illust. Fern Fl. W. Himal. II: 275. f. 96. 2000; Pande & Pande, Pteridology in W. Himal. (Kumaun) 117. 2002; Clarke, Trans. Linn. Soc. Lond. 2 Bot. 1: 522. 1888; Hope, J. Bomb. nat. Hist. Soc. 14: 731. 1905. *Lastrea barbigera* (T. Moore ex Hooker) Beddome, Ferns Brit. Ind. 246. 1883. *Nephrodium falconeri* Hooker, Sp. Fil. 4: 123 pl. 254. 1862. *Lastrea falconeri* (Hooker) Beddome, Ferns Brit. Ind. 1: 41 pl. 41. 1865. *Dryopteris falconeri* (Hooker) Kuntze, Revis. Gen. pl. 2: 812. 1891.

Morphological aspect: Size medium, 42-47 cm. Rhizome woody, massive, horizontal, thick, scaly. Stipes 12-14 cm long, diam. 0.2-0.25 cm, thick, base brown, stramineous higher up, with glands, with dense scales and fibrils, scales dull to reddish-brown, generally ovate-lance-shaped or lance shaped, large, one Lamina bi pinnate, large, 25-55 x 15-25 cm, ovate-lance shaped to oblong-lance shaped,



broadest above the reduced base, texture densely herbaceous, ventral and dorsal surfaces scaly with narrow scales, upper surface sparsely scaly. Pinnae 15-20 pairs, close, 9-12 x 1.5-2.5 cm, sub-opposite (lower part), alternate (higher up on lamina), short with stalk, lance shaped, lower 2-3 pairs of pinnae gradually reduced in size, lowest pair of pinnae the shortest. Pinnules many, 10-15 pairs, 1.5-2 x 0.4-1.2 cm, sessile, symmetrical, lance shaped the lower lobes being longer, serrated with prominent slightly mucronate teeth. Veins 6-9 pairs per pinnule (depending upon the length of the pinnule), in groups of 3-4, corresponding to the pinnule lobes, costae and costules have dense scales and fibrils, scales dull-brown, concolorous, narrow lance shaped, margin smooth or slightly hairy bordered, apices long-caudate. Sori with indusium, tiny, spherical, sub medial, close to costa, 4-6 pairs both ways to the costule. Indusia dull-brown, reniform, tiny, thin, caduceus. Sporangia with 16-18 annulus cells. Spores dark- brown, yellow, globose, 35-38.5 x 45.5 μ m, perinate, perine folded. **Fertile season:** July-October.

Specimens examined: Kinner Kailash (Kinnaur, 6500 m), 13.8.2016, H.C. Negi 211; Lipa (Kinnaur, 2750 m), 14.7.2017, H.C. Negi 253;

Habitat: A high altitude fern prefers to grow in open exposed meadows, along the sides of riverlets and in the crevices of rocks. Distribution: Afghanistan, Bhutan, China, Nepal, Pakistan, Taiwan, Tibet, Yunnan, W. Himalayas. India: Kashmir (Anantnag, Baramula, Pir Panjal, Poonch), Sikkim, Uttarakhand (Almora, Badrinath, Kedarnath, Kidarkanta, Mastura, Nag Tibba, Pithoragarh,). Himachal Pradesh: Chamba, Kangra (Dharmasala, near Triund), Kullu (Dibibokri Nal), Lahaul (Khoksar), Shimla Hills (Ghor Jubbal, Matiana). Altitude: 3000-6500 m.

Notes: 1) Chromosome number: diploid sexual $n = 41$ [20]

2) *Dryopteris barbigera* has been collected and described for the first time from district Kinnaur of Himachal Pradesh.

Dryopteris chrysocoma (Christ) C. Chr. subsp. *Chrysocoma* syn. *Aspidium chrysocomum* (Christ.) Christ. Family: Dryopteridaceae



Dryopteris chrysocoma (Christ) C. Chr., Index Fil 257. 1905. subsp. *chrysocoma*; Dhir, Ferns NW. Himal. 67. 1980; Baishya & Rao, Ferns & Fern-allies of Meghalaya State, Ind. 126. 1982; Dixit, Cens. Ind. Pterid. 149. 1984; Khullar, Illust. Fern Fl. W. Himal. II: 284 f.100. 2000; Pande & Pande, Illust. Fern Fl. Kumaon Himal. 1: 255. f.61. 2003; Chandra, Ferns Ind. 173. 2007. *Aspidium filixmas* Swvar. *chrysocomum* Christ, Bull. Herb. Boiss. 6: 966. 1898. *Nephrodium chrysocoma* (Christ) Hand.-Mazz, Symb. Sin. 6: 24. 1929. *Dryopteris chrysocoma* (Christ) C. Chr. var. *major* Ching, Bull. Fan Mem. Inst. Biol. (Bot.) 8: 438. 1937. *Dryopteris chrysocoma* (Christ) C. Chr. var. *alpina* Ching, Bull. Fan Mem. Inst. Biol. (Bot.) 8: 438. 1938. *Dryopteris chrysocoma* (Christ) C. Chr. var. *squamosa* (C. Chr.) Ching, Bull Fan Mem. Inst. Biol. (Bot.) 8: 438. 1938.

Morphological aspect: Size 37-47 cm in length. Rhizome erect or short creeping decumbent, thick, branching to form several crowded apices, scaly, scales 1.1-1.3 x 0.1-0.2 cm. Stipes 10-15 cm in length and 0.3 cm in diam., one third of the laminar length, stramineous. stipe base has a bunch of dense scales, which has sparse scales and with fibrils near the apex of stalk, scales at stipe base are pale to dull brown, concolorous transparent, large up to 3.5 cm long, stipe becoming muricated due to persistent bases of fallen scales. Rachis stramineous, bearing scattered fibrillae with some light brown scattered narrow scales and bearing only scattered fibrillae further up. Lamina 2-pinnate, size variable, 15-55 x 2.5-18 cm, lance shaped or slightly ovate-lanceolate, but base slightly truncate, texture somewhat densely herbaceous turning yellowish on approaching the end of the growing season, upper surface is smooth. Pinnae numerous, up to 25-28 pairs, 2.5-12 x 1.5-2.8 cm, alternate, with a short stalk or almost sessile, basal 1 or 2 pairs short and distant, lance-shaped. Pinnules 8-14 pairs, 0.8-2.5 x 0.5-0.8 cm, opposite to alternate, sessile; very small and narrow. Sori indusiate, markedly large and round, close to the costule, 4-5 dyads in one row on both side of the costule, crowded, whole frond fertile. Sporangia with 16-18 celled annulus, light yellow colored. Indusia light brown which becomes grey on maturing, reniform, large, thick, diam. up to 0.25 cm persistent and not or hardly shriveling, smooth, margin entire, sinus broad. Spores generally circular in shape, dark brown, perine folded granulose. broad. Fertile season: June-November.

Specimens examined: Nichar (Kinnaur, 2200 m), 12.8.2015, H.C. Negi 113, Katgaon (Kinnaur, 2200 m), 14.9.2016, H.C. Negi 114; and Rup-Shorang way (Kinnaur, 2400 m), 25.9.2016, H.C. Negi 210.

Habitat: Rock crevices and on the floor of pine forest. Distribution: Bhutan, Burma, China, Nepal, Pakistan, Philippines, W. Himalayas. India: Arunachal Pradesh, Darjeeling hills, Kashmir Madhya Pradesh, Meghalaya, Sikkim, Uttarakhand, Himachal Pradesh: Chamba (Dalhousie), Kangra (Dharmasala), Kullu (Hadimba temple, Jalori pass, Manali, Marhi, Solang nallah), Shimla hills (Baghi, Chachpur, Chail, Craignano, Matiana, Narkanda, Naldera, Retreat).

Notes: 1) Chromosome number, diploid sexual, $n = 41$ [20]

2) *Dryopteris chrysocoma* has been collected and described for the first time from district Kinnaur of Himachal Pradesh.

Dryopteris cochleata (Buch.-Ham. ex D. Don) C. Chr. syn. *Nephrodium cochleatum* Buch.-Ham. ex D. Don. [21] Family: Dryopteridaceae



Dryopteris cochleata (Buch.-Ham. ex D. Don) C. Chr., Index Fil.: 258. 1905; Dhir, Ferns NW. Himal. 68. 1980; Baishya & Rao, Ferns & Fern-allies of Meghalaya State, Ind. 126. 1982; Dixit, Cens. Ind. Pterid. 150. 1984; Khullar, Illust. Fern Fl. W. Himal. II: 288. f.101. 2000; Borthakur et al., Illust. Man. of Ferns Assam. 401. f.196. 2001; Pande & Pande, Pteridology in W. Himal. (Kumaun). 118. 2002; Pande & Pande, Illust. Fern Fl. Kumaon Himal. II: 201. f.67(v). 248. t.17. 2002; Pande & Pande, Illust. Fern Fl. Kumaon Himal. I: 256. 2003; Chandra, Ferns Ind. 173. 2007. *Nephrodium cochleatum* Buch.-Ham. ex D. Don, Prodr. Fl. Nepal.; 6. 1925; Clarke, Trans. Linn. Soc. Lond. 2 Bot. 1: 521. 1880; Hope, J. Bomb. nat. Hist. Soc. 14: 734. 1903. *Nephrodium filix-mas* Pr. var. *cochleata* (Buch.-Ham. ex D. Don. Beddome, Ferns S. Ind.. Suppl. 33. 1876; Hbk. Ferns Brit. Ind.: 250. 1883. *Aspedium filix-mas* Sw. var. *cochleatum* (Buch.-Ham. ex D. Don) Christ. Farnkr. Erde. 257. 1897.

Morphological aspect: Size large, 50-95 cm. Rhizome sub erect or short creeping, decumbent, horizontal or ascending at the apex, thick and scaly. Fronds dimorphic, with distinct sterile and fertile ones. Infertile fronds numerous, spread out, with one or more fruitful fronds standing unbendingly in the central region. Stipes 20-40 cm long, stramineous, lance-shaped, apices caudate, higher up on stipe scales very scattered and narrow, or stipe nearly smooth. Rachis very sparsely scaly and fibrillose, fibrils dull mostly at the junction between the pinna costae and rachis. **STERILE FRONDS:** Lamina pinnate and bipinnatifid or bipinnate, 25-75 x 45-55 cm, lance-shaped or almost triangular base widely truncate, texture like herb to subcoriaceous, upper surface somewhat glossy, smooth, diamorphic. Pinnae 12-16 pairs, margin deeply lobed to the costa, lowest pair of pinnae equally long or shorter than the pair present above, distant. Pinnules 10-12 pairs, 1.5-2.5 cm broad, lance-shaped, cuneate, at their acroscopic bases and cuneate to decurrent to a narrowly winged costa, apices obtuse or acute, margins shallowly lobed, each lobe bearing an acute tooth. **FERTILE FRONDS:** Lamina 22-75 x 6-14 cm, erect, lance-shaped. Pinnae 10-14 pairs, 5.5-10.5 x 1.5-2.5 cm broad, ascendant, subopposite to alternate, with a short stalk, triangular-lance-shaped. Veins are paired, 20 in each pinnule, forked, costae sparsely fibrillose. Sori indusiate, very large, markedly crowded, wrapping the whole lower surface of the fertile lobe fully, round, medial, 4-7 pairs in one row on both side of the costule. Indusia dull brown, reniform, large, prominent, thick, shriveling, persistent, smooth, margin entire, sinus broad. Sporangia dull brown, large, with 12-16 celled annulus. Spores brown, 31.5-38.5 x 42-52.5 µm, perinate, perine folded. Fertile season:

Almost throughout year.

Specimens examined: Chaura forest (Kinnaur, 1800 m), 10.2)2018, H.C. Negi 234.

Habitat: Moist and damp shades of bushes, along road sides and corners of crop fields. Distribution: Bali, Bangladesh, Bhutan, Burma, W. Himalayas. India: Bihar, Darjeeling hills, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Meghalaya, Nagpur, Orissa, Pachmari, Sikkim, South India, Uttarakhand, Himachal Pradesh: Chamba (Dalhousie), Kangra (Dharmshala), Mandi, Kullu, Shimla (Chail, Shogi, Taradevi). Altitude: 900-1800 m.

Notes: 1) Chromosome number, diploid sexual, $n = 41$ [20]

2) *Dryopteris cochleata* has been collected and described for the first time from district Kinnaur of Himachal Pradesh.

Dryopteris nigropaleacea (Fraser-Jenkins) Fraser-Jenkins syn. *Dryopteris pallida* (Bony) C.Chr. apud. Maire & Petitm. Family: Dryopteridaceae



Dryopteris nigropaleacea (Fraser-Jenkins) Fraser-Jenkins, Bolm. Soc. Brot. II, 55: 238. 1982. Khullar, Illust. Fern Fl. W. Himal. II: 314. f.111, 112. 2000; Pande & Pande, Pteridology in W. Himal. (Kumaun). 120. 2002; Pande & Pande, Illust. Fern Fl. Kumaon Himal. II: 204. f.67 (viii). 2002; Pande & Pande, Illust. Fern Fl. Kumaon Himal. I: 347. 2003; *Nephrodium filix-mas* Rich. var. *narmalis* Clarke, Trans. Linn. Soc. Lond. 2 Bot. 1: 519. 1880, *pro parte*.

Morphological aspect: Size large, 55-70 cm in length. Rhizome long, erect, thick, scaly, scales 0.7-0.9 x 0.2-0.3 cm. Stipes 20-40 cm long, diam. 0.2-0.5 cm, stramineous to light-brown, stipe base has dense scales and fibrils, scales being dark-brown or blackish, of the same colour, broadly ovate-lance shaped, margin sometimes have small tooth-like protrusions, apex caudate, scales disperse, narrower, light colored, small sized as higher up on the stipe. Rachis stramineous, almost smooth or with some discreet pale coloured fibrils and imperfect ephemeral scales, scales dull-brown, concolorous, linear-lanceolate, margin with short projections, apex long- caudate. Lamina 2-pinnate, 25-55 cm long, diam. 15-22 cm broad, narrowly triangular-lance-shaped. Pinnae 12-20 pairs, 7-18 x 2-3.5 cm, contiguous, alternate, with a short stalk, becoming subsessile or without a stalk higher up on lamina, elongated triangular-lance-shaped, apex caudate, and pair at lower end or few pairs following it may be the largest. Pinnules 10-15 pairs, the lowest few with short stalk, rest becoming winged, elliptical longer than its width, partly curved, with acute or rounded apex, margin with lobes of 4-6 pairs of circular,

or circularly shortened lobes with sharp tooth. Veins in a pinnule 4-8 pairs, pinnate, veinlets curved, most forked, running into the teeth of the lobes but stopping short of the margin. Sori indusiate, tiny and round, medial, present 5-7 pairs per pinnule, in one row on both side of ridge. Indusia brown, reniform, tiny, thin, shrivelling up at maturity, persistent, smooth, margin entire, sinus narrow. Sporangia with 16-18 celled annulus. Spores dark-brown, globose, 30-35 x 31-39 μm , perinate, perine dull-brown, thin. Fertile season: May-October.

Specimens examined: Powari (Kinnaur, 2050 m), 10.6.2017, *Ruchi Negi*, 16; Asrang (Kinnaur, 2500 m), 11.7.2018, *H.C. Negi* 225.

Habitat: Prefers to grow in the dense forest floor of *Alnus* and *Pinus* sp. and even in the Apple orchard fields. Distribution: Pakistan, West Nepal, W. Himalayas. India: Jammu & Kashmir (Gilgit, Kishtwar, Pahlgam, Rajori-Uri, Sanasar, S), Uttarakhand (Brahmkhal, Chamoli- Gaurikund, Hemkund, Mussoorie,). Himachal Pradesh: Chamba (Dalhousie), Kangra (Dharamsala), Kullu (Manali), Shimla hills (Anandale, Baldwin, Chachpur, Chail, Glen, Kufri, Mashobra, Mt. Jakho, Naldera), Solan (Barog, Mt. Karol). Altitude: 1900-2500 m.

Notes: 1) Chromosome number, diploid sexual, $n = 41$ [20]

2) *Dryopteris nigropaleacea* has been collected and described for first time from district Kinnaur of Himachal Pradesh.

Dryopteris panda (Clarke) Christ. syn. *Lastrea filix-mas* Pr. var. *panda* (Clarke) Beddome. Family: Dryopteridaceae



Dryopteris panda (Clarke) Christ. Bull. Acad. Int. Geogr. Bot. Mans. 19: 175. 1909; Dhir, Ferns of NW. Himal. 63. 1980; Khullar, Illust. Fern Fl. W. Himal. II: 313. f.113. 2000; Pande & Pande, Pteridology in W. Himal. (Kumaun) 121. 2002; Pande & Pande, Illust. Fern Fl. Kumaon Himal. II: 205. f.67(ix). 2002; Pande & Pande, Illust. Fern Fl. Kumaon Himal. I: 259. 2003; Chandra, Ferns Ind. 182. 2007. *Nephrodium filix-mas* Rich var. *panda* Clarke, Trans. Linn. Soc. Lond. 2 Bot 1: 519. 1880. *Lastrea filix-mas* Pr. var. *panda* (Clarke) Beddome, Hbk. Ferns Brit. Ind. 251. 1883. *Nephrodium pandum* (Clarke) Hope. J. Bomb. nat. Hist. Soc. 12: 623. 1899; 14: 623. 1901. *Dryopteris filix-mas* (L) Schott. subsp. *panda* (Clarke) C. Chr. ex Ching, Bull. Fan. Mem. Inst. Biol. Bot. 8: 419. 1938.

Morphological aspect: Size medium, 25-55 cm long. Rhizome long, erect, woody, massive, thick, scaly, scales dark colored, 1.5-2 cm in length, diam. 0.1-0.5 cm [22]. Stipes 10-25 cm in length, diam. 0.1-0.2 cm, equal to lamina or longer, with dark-brown base, with straw, thick, stipe base scaly, higher up stipe becoming has sparse scales, few in number, dull concolorous, lance shaped or ovate-lance

shaped, margin entire, apex caudate. Rachis stramineous, sparsely scaly, with small scales, dull in colour, apex is caudate, higher up on rachis scales fewer and smaller. Lamina pinnate, 15-30 x 12-14 cm, sometimes narrowly lance shaped with a truncate base, texture densely herbaceous, upper surface hairless and smooth. Pinnae 10-15 pairs, 6-9 x 1-5-2 cm wide, close, alternate, nearly sessile, lance shaped, falcate, base much broadened, apex caudate, margin lobed 1/3 to 1/2 or slightly more to the costa. Pinnules 5-8 pairs, 0.4-0.7 x 0.2-0.3 cm, rounded-shortened, apex sharply toothed, margin sub-spinulose, serrulate, never pinnate. Veins 4-6 pairs per pinna lobe, pinnate, costae and costules dispersely scaly, scales light-brown, concolorous, long, linear. Sori with indusium, big, circular, almost on the principal costa, 1 or 2 sets per lobe near to base. Indusia light brown, kidney-shaped, large, diam. 0.2 cm, thin like a membrane, smooth, margin entire, sinus broad. Sporangia with 12-16 celled annulus. Spores dark-brown, 35-38.5 x 42-49 μm , perinate, perine folded. Fertile season: June-October.

Specimens examined: Barang Kanda (Kinnaur, 4600 m), 10.7.2000, *H.C. Negi* 302

Habitat: This high altitude fern prefers to grow in xeric condition in the open meadows above the tree line and in between the huge stone pieces. Distribution: China, Nepal, Tibet, W. Himalayas. India: Darjeeling hills, Kashmir (Muzaffarabad, Suden Gali), Sikkim, Uttarakhand (Almora, Badrinath, Chamoli-Garhwal, Gangotri, Gori valley, Tehri-Garhwal, Trijugarayan, Uttar-Kashi, Yamunotri). Himachal Pradesh: Chamba (Shaol forest), Kangra (Dharamsala, near Triund), Kullu (Manali, Rohtang Pass), Shimla (Jakhu), Sirmaur. Altitude: 2500-3400 m.

Notes: 1) Chromosome number, diploid sexual, $n = 41$ [20]

2) *Dryopteris panda* has been collected and described for the first time from the district Kinnaur of Himachal Pradesh.

Equisetum arvense Linn. Family: Equisetaceae

The common or field horse tail, scouring rushes¹.



Equisetum arvense Linn. Sp. Pl. 2: 1050. 1753; Milde, Mon. t.1-3; Hook., Brit. Ferns, t.60; Engl. Bot. ed. iii. t. 1809; Baker, Hbk. Fern-Allies, 2. 1887. Dixit, Cens. Ind. Pterid. 19. 1984; Pande & Pande, Pteridology in W. Himal. (Kumaun). 12. 2002.

Morphological aspect: Size 30-45 cm long. Rhizome deep seated. Stems dimorphic, erect or decumbent, 0.3-1.5 cm in diameter. Tall or long, hollow and jointed. Sterile stems green, persistent with much

small joints, the lateral branches in whorls along the main stem, green, solitary or in clusters, normally 10-12 ridged, internodes 1.3-5.5 cm. long, 1.3-5 mm. in diam., branches solid, numerous, regularly whorled, 3 or 4 angled [23]. Leaves on infertile stems are green, forming concave cover at the joints. Sheaths having 3-4 teeth, the basal one being dull-brown, 5-10 mm in length gradually widening upwards, the teeth (face tips) dark-brown or dull-tan, tenacious, free or slightly united, 1.2-2 mm in length, thin, dry, membranous and margin. Fertile stems stout, producing a terminal cone, the covers 14-20 mm in length, with large teeth, partly unified, 5-9 mm in length, branchless, skin colored, yellowish or brownish. Fruiting heads or Cones 2.5-2.7 cm long and 0.5-0.7 cm in diam., terminal, usually cones born on the fertile stems only. Spores large, dull-greenish to yellowish, longer than its width to globular, with a pair of elaters for dissemination.

Fertile season: February-May.

Notes: Reproductive shoots appear in early springtime and disappear soon while infertile shoots come up in end of spring and remain until frost. This fern ally reproduces by means of spores and the tubers attached to underground stem i.e. rhizome.

Specimens examined: Sangla (Kinnaur, 2680 m), 11.5.2019, *Ruchi Negi*, 19.

Habitat: A perennial fern ally prefers to grow mostly on wet sandy or gravelly soils with high water table and barren eroded slopes along the crop fields and road sides. Distribution: America, Canada, China, Iran, Korea, Nepal, Turkey, W. Himalayas. India: Quite common in alpine region of Kumaun Himalaya. Altitude: 1600-2700 m.

Note: *Equisetum arvense* has been collected and described for the first time from Himachal Pradesh and district Kinnaur.

Equisetum ramosissimum Desf. syn. *Equisetum ramosissimum* Desf. var. *altissimum* A. Br. Family: Equisetaceae



Equisetum ramosissimum Desf. Fl. Atlant. 2: 398. 1800; Milde, Mon. t.24. 1867; Verh. zod. Bot. Ges. Wien 13: 243. 1863 *et* in Mono. 440. 1867; Baker Hbk. Fern Allies 4. 1887; Hauke, Amer. Fern Jour. 52 (1): 32. 1962 *et* in Nova Hedg. 8: 54. 1963; Mehra *et* Bir, Res. Bull. PU. (n.s) 15: 99. 1964. Baishya & Rao, Ferns & Fern-allies of Meghalaya State. Ind. 29. 1982; Pande & Pande, Pteridology in W. Himal. (Kumaun). 13. 2002; *Equisetum ramosissimum* Desf. var. *altissimum* A. Br. in Nova Act. Acad. Nat. Car. 32. 11. t.24, 1865. [24] 20. 1984.

Tallest and largest of all the local species of *Equisetum*.

Morphological aspect: Size 55-65 cm. long. Rhizome deep, long creeping, rough, dark brown to black. Stems 45-90 cm tall, 1-6 mm in diam., rough or smooth, usually having 2-3 branches per node, remain throughout the year or in winter climate drying, ridges with cross bands, grooves or silica rosettes of silica. Stomata in 1-3 lines in the groove. Sheaths campanulate to funnel shaped, longer than the width, 5.5-21 mm long; lower sheath light-brown having dark girdle; upper rim of the sheath is whitish, segments rounded or somewhat flattened with lateral ridges, 2-8 mm long teeth, narrow with brown centre and with white margin. Branches 6-8 angled, rough, with sheath like those of the stem, fertile and sterile branches are alike, irregularly branched. Strobili or cones terminal, longer than its width, 1.4-1.7 x 1.4-2 cm, apiculate, shortly stalked or sessile. Sporangiophore orbicular or longer than its width. Sporangia longer than its width, yellowish. Spores large, dark yellowish, globose and hyaline. Fertile season: May-July.

Specimens examined: Powari (Kinnaur, 2050 m), 25.5.2015, H.C. Negi 20; Re/Peo (Kinnaur, 2290 m), Speelo (Kinnaur, 2246 m), 31.5.2016, H.C. Negi 50; and Shongthong (Kinnaur, 1981 m), 19.5.2017, *Ruchi Negi* 187.

Habitat: A terrestrial plant grows well in shady or open, moist, water lodged places, often scrambling along the bushy plants. Distribution: Africa, America, China, Europe, E. & W. Himalayas, Fiji, Japan, Korea. India: Arunachal Pradesh, Sikkim, West Bengal. Altitude: 1000-3000 m.

Note: *Equisetum ramosissimum* has been collected and described for the first time from Himachal Pradesh and District Kinnaur.

Woodwardia unigemmata (Makino) Nakai syn. *Woodwardia radicans* (L.) Smith var. *unigemmata* Makino. Family: Blechnaceae

Woodwardia unigemmata (Makino) Nakai, Bot. Mag. Tokyo 39: 103. 1925; Dixit, Cens. Ind. Pterid. 173. 1984; Khullar, Illust. Fern Fl. W. Himal. II: 477. f.171. 2000; Pande & Pande, Pteridology in W. Himal. (Kumaun). 139. 2002; Pande & Pande, Illust. Fern Fl. Kumaon Himal. II: 240. f.79. 264. t.82. 2002; Pande & Pande, Illust. Fern Fl. Kumaon Himal. 1: 298. f.87. 2003. *Woodwardia radicans* auct. W. Himalaya, *non* (L.) Smith. *Woodwardia himalaica* Ching & S.K. Wu, in C.Y. Wu, Flora Xizangica 1: 192) 1983.

Morphological aspect: Size large, 40-85 cm long. Rhizome stout, ascending, with dense scales, scales golden-brown, concolorous, up to 1.5-2 cm long, lance-shaped, apex caudate, attached to the base. Stipes 14-17 cm in length, 0.8-1 cm in diam., brown, thick, base of the stipe is brown, upper surface grooved, scaly at base, stipe is smooth. Rachis



Table 1: Ethnobotanical uses of pteridophytes described.

S. No.	Species	Ethnobotanical uses
1.	<i>Cyrtomium caryotideum</i>	The cytomorphological and dermatological studies on <i>Cyrtomium caryotideum</i> showed that the compounds present in the sori and frond petroleum ether extract and the rhizome methanol extract elicited a mild irritant reaction from rabbits.
2.	<i>Dennstaedtia scabra</i>	Fronds are analgesic, used in malaria and stomachaches.
3.	<i>Dryopteris barbigera</i>	In Kinnaur due to the scarcity of fuel wood in higher alpine zone, the pilgrims and shepherds use the dried parts of this plant as fuel along with <i>Juniperus</i> twigs.
4.	<i>Dryopteris chrysocoma</i>	Rhizomes of most of the species of <i>Dryopteris</i> possess anthelmintic properties. Fronds are edible and are good source of Filcin [22].
5.	<i>Dryopteris cochleata</i>	Rhizome is used medicinally in cholera .
6.	<i>Dryopteris nigropaleacea</i>	Generally growing in crop fields, harvested along grasses and give to cattle as fodder.
7.	<i>Dryopteris panda</i>	As it is a high altitude fern, the dried plant parts are used as the roofing materials along with bark of <i>Betula utilis</i> for making the huts by local inhabitants of district Kinnaur.
8.	<i>Equisetum arvense</i>	This fern ally is so called "Scouring rushes" because stems are impregnated with abrasive silica. It is an unpalatable forage, hence poisonous to animal stock , mostly to horses and cattles causing a disease Equisetosis. It is also a Source of HerbaEquiseti which is used as a diuretic. It has haemostatic properties and clinical trial showed that oral administration is considered useful in edema and renal affections. In Kinnaur, the local inhabitants use the infertile stems and branches to wash the utensils and used as beds for animals.
9.	<i>Equisetum ramosissimum</i>	The stem and branches of this plant are used to wash the utensils and used as cattle beds by the local inhabitants of district Kinnaur.
10.	<i>Woodwardia unigemmata</i>	The beautiful, subcoriaceous fronds are used as decorative materials in various functions by local people.

similar to stipe, scaly, scales brown, bicolorous, apex subulate, margin entire, vegetative bud present at end of frond. Lamina pinnate, large, up to 90-110 cm long, texture sub-coriaceous, smooth. Pinnae many, 15-17 cm or more long, 5-7 cm broad, distant, alternate, upper pinnae sessile, lance-shaped, slightly curved, apex caudate, margin curved backwards, with small spiny teeth, cartilaginous, apex acute. Veins connected to form one costal and 1-3 costular areolae, free towards the margin, costae scaly, scales limited to pinnae base, costule hairless. Sori with indusium, rectangular or longer than its width, deeply set in a cavity with elevated margin, in a single row on either side, near to costae. Indusia are wing-like, opening towards inside on the costal side, texture leathery. Sporangia with 22-24 yellow margined, dark coloured annulus cells. Spores light-brown, usually reniform, rarely globose, perinate, perine hyaline, faintly loose, highly and irregularly wrinkled into some large blunt folds possessing smooth crescents, faintly granulose. Fertile season: June-October.

Specimens examined: Chaura (Kinnaur, 1800 m), 10.10.2014, H.C. Negi 40; and Nichar-Ponda road (Kinnaur, 2200 m), 14.8.2020, Ruchi Negi 138.

Habitat: A wintergreen fern prefers to grow in sloppy places or dripping rocks along with the ravine beds or on the shady, moist forest floor of *Alnus* sp. near small streamlets. Distribution: China, Pakistan (Hazara, Kagan, Swat, West Punjab), Philippines, Taiwan, Tibet, W. Himalaya. India: Darjeeling hills, Jammu & Kashmir (Jammu, Kishtwar, Muzaffarabad, Poonch, Udhampur), Manipur, Meghalaya, Sikkim, Uttarakhand (Almora, Chamoli-Garhwal, Dehradun, Mussoorie, Nainital, Patnitop,). Himachal Pradesh: Chamba (Banikhet, Dalhousie), Kangra (Dharmasala), Kullu (Manali), Mandi, Shimla (Chachpur, Chadwick falls, Chail, Glen, Jubbal), Solan (Mt. Karol).

Altitude: 1200-2400 m.

Notes: 1) Chromosome number: diploid sexual, $n = 34$ [20]

2) *Woodwardia unigemmata* has been collected and described for the first time from district Kinnaur of Himachal Pradesh.

Ethnobotanical uses of pteridophytic species:

Conclusion

In this paper 10 pteridophytic species have been described morphologically and ethnobotanically. All of these species have been listed for the first time in Kinnaur district of Himachal Pradesh. These pteridophytes are used by the tribals of this area for different purposes. All of the plants have utility as asthetic items and also used medicinally.

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