

***Microlepia speluncae* (Pteridophytes): A new record and additional taxonomic circumscription from Terai region (marshlands) of Uttar Pradesh, India**

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ABSTRACT

Microlepia speluncae (L.) Moore, a fern taxa belonging to family Dennstaedtiaceae has been encountered in the forest of Dudhwa National Park in Uttar Pradesh. The sighting of *M. speluncae* certainly adds to the record of pteridophytic flora from the northern province of India. In the present article, we provide additional taxonomic attributes and discussions on variable morphological characteristics of rachis, pinnae, pinnules, pinnulets, costa, costules, costulets, winged margins and blunt or obtuse ultimate lobes within the population of species for convenience of taxonomic treatment.

Key-words: Pteridophytes, *Microlepia speluncae*, taxonomy, Dudhwa National Park, Uttar Pradesh.

INTRODUCTION

Dudhwa National Park (DNP) in the terai (marshlands) region of Lakhimpur Kheri district, Uttar Pradesh, India occupies an area of about 490.3 km² with a buffer zone of 190 km². DNP is situated within 28°21.591'–28°33.130' N latitudes and the 80°26.513'–80°52.322' E longitudes, with an altitudinal range of 500–600 ft. DNP is connected with Bardia National Park of Nepal in north, Katarniaghat Wildlife Sanctuary (KTWLS) in east, upper Gangetic plain region in south, Kishanpur Wildlife Sanctuary (KPWLS) and forests of Pilibhit District (Uttar Pradesh) in the west. Terai regions are the adjoining areas of the foothills of Himalayas and are unique for seasonal torrential rainwater during the month of July-September and in having consistent moist habitat throughout the year. It acts as a species corridor from western Himalayas up to the foothills of north east regions of Indian Himalayas,

across the Indo-Nepal border. Forests of DNP and KTWLS in Bahraich are known for their unique habitat of flora and fauna including *Shorea robusta*, *Terminalia tomentosa*, *Eugenia jambolana*, *Terminalia bellarica*, *Dalbergia sissoo* as dominant tree and tiger, leopard, rhinoceros, elephant, deer as animals. Geographical boundaries of terai region exhibit diverse habitat, microclimate, temperature, humidity and rainfall which favor growth and development of pteridophytes. For these reasons there are tremendous possibilities of species invasion and migration. These variable factors have led the terai region to be richest territory for pteridophytes in this northern province of Uttar Pradesh. Scattered contributions on the pteridophytes in this region were made earlier (Anderson 1859, Chandra 2000, Chowdhury and Raizada 1954, Chowdhury 1973, Clarke 1879, 1880, Dixit and Tripathi 1966, Rajkumar et al. 2012, 2013, Edgeworth 1852, 1867,

Ganguli and Roy 1960, Kapoor 1962, Khare et al. 2005, Raizada and Chowdhury 1961, Roy and Kumar 1959, Sharma et al. 1969, Singh 1997, Singh 2002, Tewari 1973, Varshney 1971). In view of the above, subsequent exploration and survey of pteridophytes from different localities (Text Figure 1) in the forest area of DNP, Kishanpur Wildlife Sanctuary and Katarniaghat Wildlife Sanctuary were made. During the survey few populations of *Microlepia speluncae* were encountered at several localities namely Dudhwa to Sathiyana track (28°29.887'N, 80°38.059'E), Near Dudhwa Guest House, (28° 29.473 N, 80° 38.680'E), Salukapur (28°25.705'N, 80°42.179'E), Belrayan (28°23.324'N, 80°54.695'E) of DNP (Text Figure 1) and Bicchia (28°20.215'N, 81°07.943'E) in the forests of Katarniaghat Wildlife Sanctuary (Text Figure 1). Discovery of *M. speluncae* from DNP and KTWLS certainly adds to the record of pteridophytic flora from the northern province of India (Singh et al. 2014). In addition, morphological variation discussed in the article surely increases our knowledge on the taxonomy of *M. speluncae* and may act as an additional identification key for deciphering other *Microlepia* species occurring in India.

Throughout the world, the genus *Microlepia* is known by 50 species (Copeland 1947, Guo and Li 2006, Nayar and Kaur 1963, Yan et al. 2013). Out of these, 23 species (about 46%) are known from the Eastern Himalaya and Western Ghat region of India (Chandra 2000). Also, most of the species of *Microlepia* are Asiatic (Nayar and Kaur 1963). Known records of *M. speluncae* come from Nepal, China, Bangladesh, Hong Kong, Japan, Australia, Africa, West Indies, Brazil and Polynesia (Mirza 2006, Yan et al. 2014). In India, *M. speluncae* has been previously reported from southern India (Manickam and Irudayaraj 1992) and from northern India (Arunachal Pradesh) with three varieties namely *M. speluncae* var. *pubera*, *M. speluncae* var. *pubescens* and *M. speluncae* var. *speluncae* (Singh and Panigrahi 2005).

A detailed literature survey was carried out by the authors and we believe that there are no known reports on species belonging to genus *Microlepia* prior to this report from the forest territories and boundaries of terai regions of Uttar Pradesh. Based on the detailed

taxonomic observation, line-drawing illustration, photographic plate, citations on the specimens examined, distribution pattern and a brief discussions on variable morphological attributes (rachis, pinnae, pinnules, pinnulets, costa, costules, costulets, winged margins and blunt or obtuse ultimate lobe) within populations of the species we provide the first record on *M. speluncae* from the terai region of Uttar Pradesh, India.

MATERIAL AND METHODS

Plant specimens were collected during the month of May 2013, November 2013 and October 2014 from Dudhwa National Park and Katarniaghat Wildlife Sanctuary (which is terai regions and mixed moist deciduous forests) of Uttar Pradesh. The specimens were critically observed with the help of field lens (MG 21008, 30x21 mm) and stereomicroscope (Nikon SMZ 800) in the laboratory (CSIR-NBRI, Lucknow). Identification of the specimens was made with the help of recent literatures and comparison with other specimens (paratypes, isotypes) already deposited in herbarium. The line-drawing illustration was made with the help of camera lucida attached with microscope (Nikon SMZ 10 and Olympus Tokyo 203690). Voucher specimens were properly processed, procured and deposited in the Pteridophyte Herbarium, CSIR-National Botanical Research Institute, Lucknow (LWG).

TAXONOMIC OBSERVATIONS AND RESULTS

Microlepia speluncae (L.) Moore, Index Fil. 93. 1857. Sledge in Kew Bull. 3: 524. 1956. Comp. Beddome Handb. 19. 1974. Iwatuski in Fl. East. Himal. 3 Rep. 175. 1975.

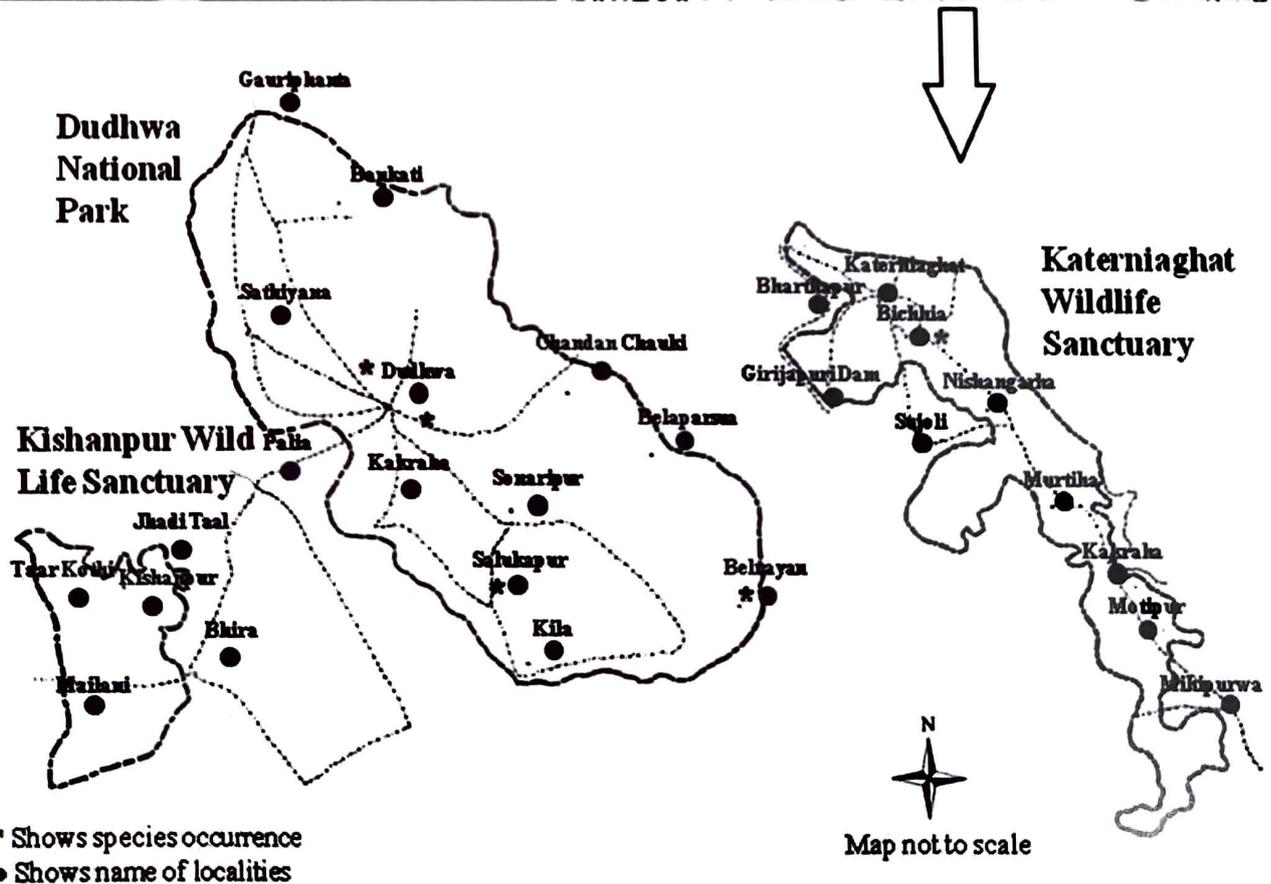
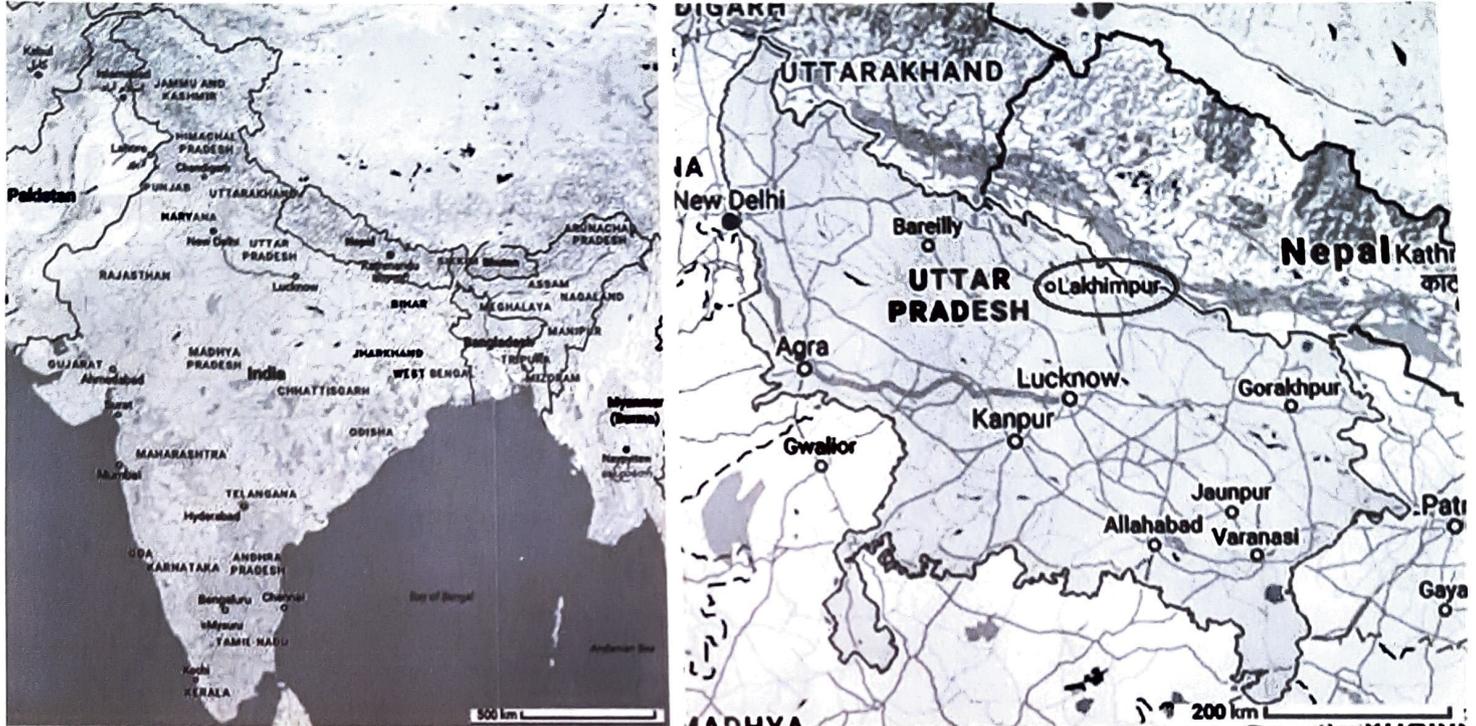
Basionym: *Polypodium speluncae* L. Sp. Pl. 2: 1093. 1753.

Synonym: *Microlepia flaccida* var. *pilosula* sensu Clarke, Trans. Linn. Soc. London II. Bot. 1: 449. 1880. *Davallia speluncae* (L.) Hook. & Bak., Syn. Fil. 2ed. 100. 1867. *Microlepia polypodioides* (Sw.) Pr., Tent. Pterid. 125. 1836. *Davallia flaccida* R. Br. in Don, Prodr. Fl. Nepal. 157. 1810.

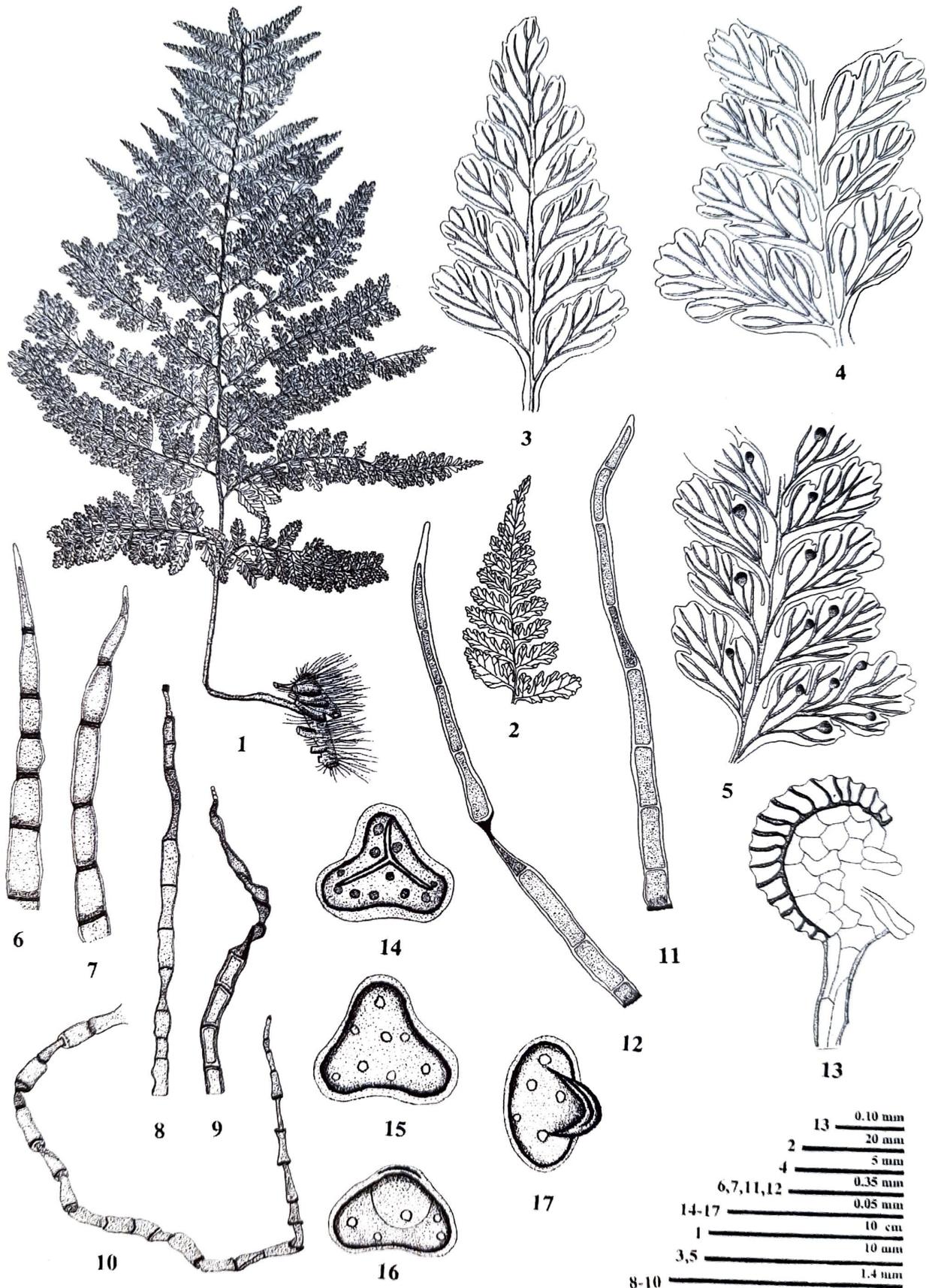
[Text Figure 2 (1-17), Plate 1 (1-2), Plate 2 (1-6)]

Description: Rhizome rather stout-short creeping, woody, light brown-dark brown, 5-8 cm long, 0.5 cm thick, 3.7 cm in diameter, hairy, paraphyses present [Text Figure 2 (1), Plate 2 (2)]; paraphyses 11-25 celled

long (multicellular), sometimes twisted, curved, tip obtuse [Text Figure 2 (8-10)]; roots numerous, dark brown-black brown, 8-10 cm long arising the below of rhizome. Fronds 30-35 (up to 250) cm long, 23 (up to 50) cm wide, broadly deltoid, ovate-lanceolate,



Text Figure 1: Distribution pattern of *M. speluncae* in Dudhwa National Park and Katerniaghat Wildlife Sanctuary of Uttar Pradesh.



Text Figure 2: *Microlepis speluncae* (L.) Moore. 1. Plant (LWG 253150), 2. Pinnae, 3. Venation pattern in apical portion of pinnae, 4. Venation pattern in basal portion of pinnae, 5. Sori pattern in basal portion of pinnae (figures 2-5 from LWG 253664), 6-7. Lamina hairs, 8-10. Rhizome paraphyses, 11-12. Rachis hairs (figures 6-12 from LWG 253150), 13. Sporangia, 14-17. Spores (figures 13-17 from LWG 253149).

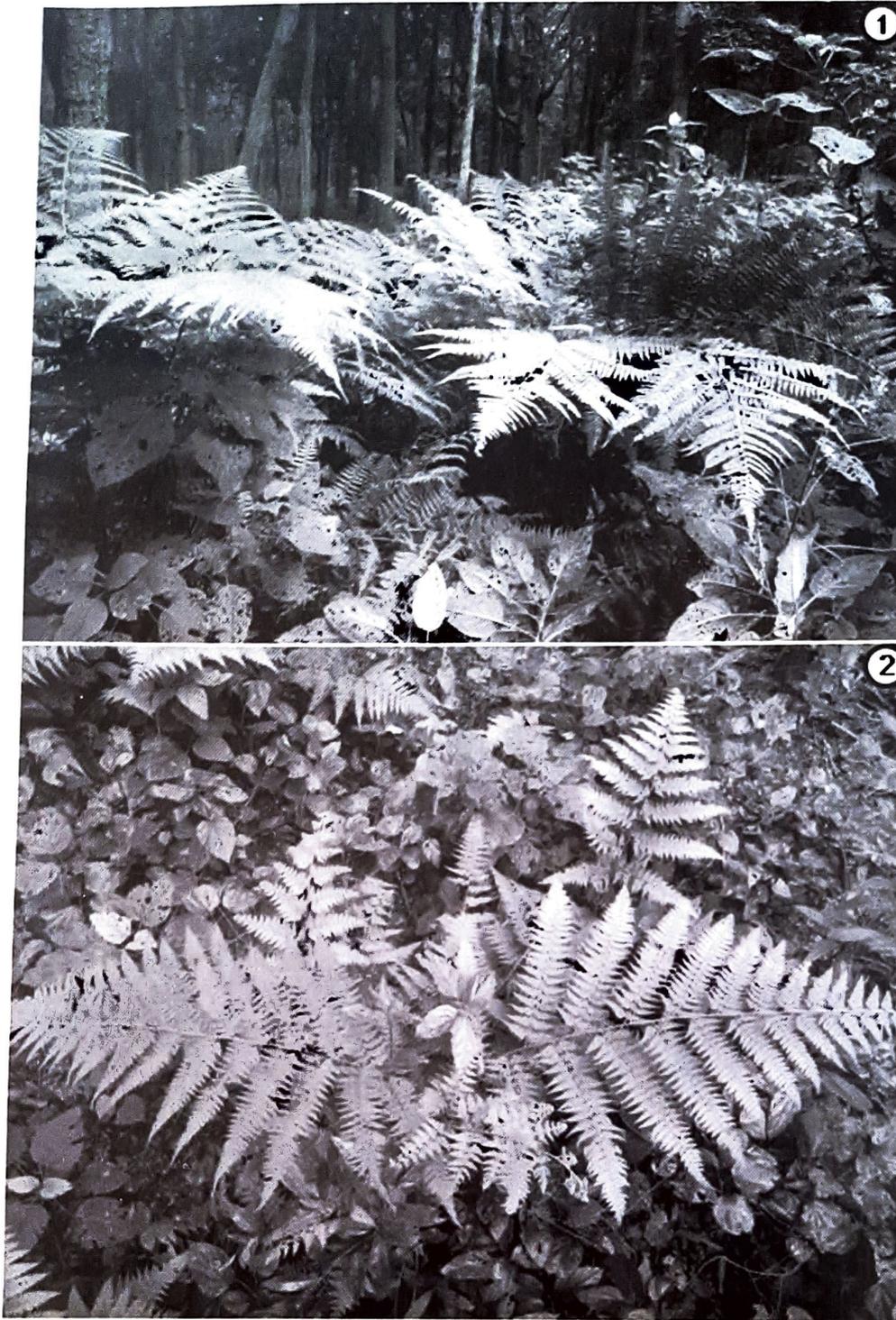


Plate 1

Microlepia speluncae. 1. Population of larger plants growing in Dudhwa National Park (Dudhwa to satiyana track, 28°29.887' N, 80°38.059' E), 2. Short heighted plant growing in the forest (Near Dudhwa guest house, 28°29.473' N, 80°38.680' E).

usually obtuse-blunt apex with 1.5-3.0 cm long ultimate pinnae [Text Figure 2(1), Plate 2(1,3)] or caudate, acuminate (*M. speluncae* var. *speluncae*). Stipe 12 (up to 45) cm long, 4-8 mm broad, grooved dorsally, dorso-laterally, glabrous, stramineous, light brown-dark

brown in color. Rachis similar to the stipe, entire upto 1/2 distance, minutely winged above, grooved dorsally (up to middle), flattened or tapered up to apex [Plate 2(3)], hairy, hairs very long, present on both surfaces, 6-8 celled long, broad at base but sometimes dispersed in the middle, tip obtuse or caudate to acuminate [Text Figure 2(6-7)]. Lamina tripinnatisect, widest (24-28 cm) in middle, narrower towards apex, hairy on both surfaces, hairs short-long, 5-7 celled long, reddish brown in color, tip capitate, lower surface broad, upper surface antrorse. Pinnae 12-20 (up to 35) pairs, oblong-lanceolate to deltoid-lanceolate, 4-17 (up to 23) cm long, 1.5-6.0 (up to 8) cm broad, without or with ultimate lobe on apex [Plate 2(4)], alternate, petiolate, petiole 0.5-0.6 cm long (in the lower 3-4 pinnae), slightly winged; basal pinnae 9-10 cm long, 4-5 cm wide; median pinnae 11-17 cm long, 4-5 cm wide; apical pinnae 4-5 cm long, 1.5-2.0 cm wide; basal acroscopic auricle the largest (2nd and 3rd pinnae), 2-4 cm long, 0.5-1 cm broad, hairy, hairs present on the margin of pinnae; costa tapered, indistinct, hidden or faint to the pinnae and pinnules with winged margins and blunt or obtuse ultimate lobes [Plate 2(4-5)]; pinnules 16-20 pairs, deltoid-

lanceolate, alternate, short petiolated-sessile, obtuse (\pm acuminate), 2-2.5 cm long, 1-1.5 cm wide; costules tapered, indistinct, hidden and ending with 1-2 double veinlets [Plate 2(5)]; pinnulets smaller, 4-5 mm long, 2.5-3.0 mm wide, quadrangular, margin entire, apex

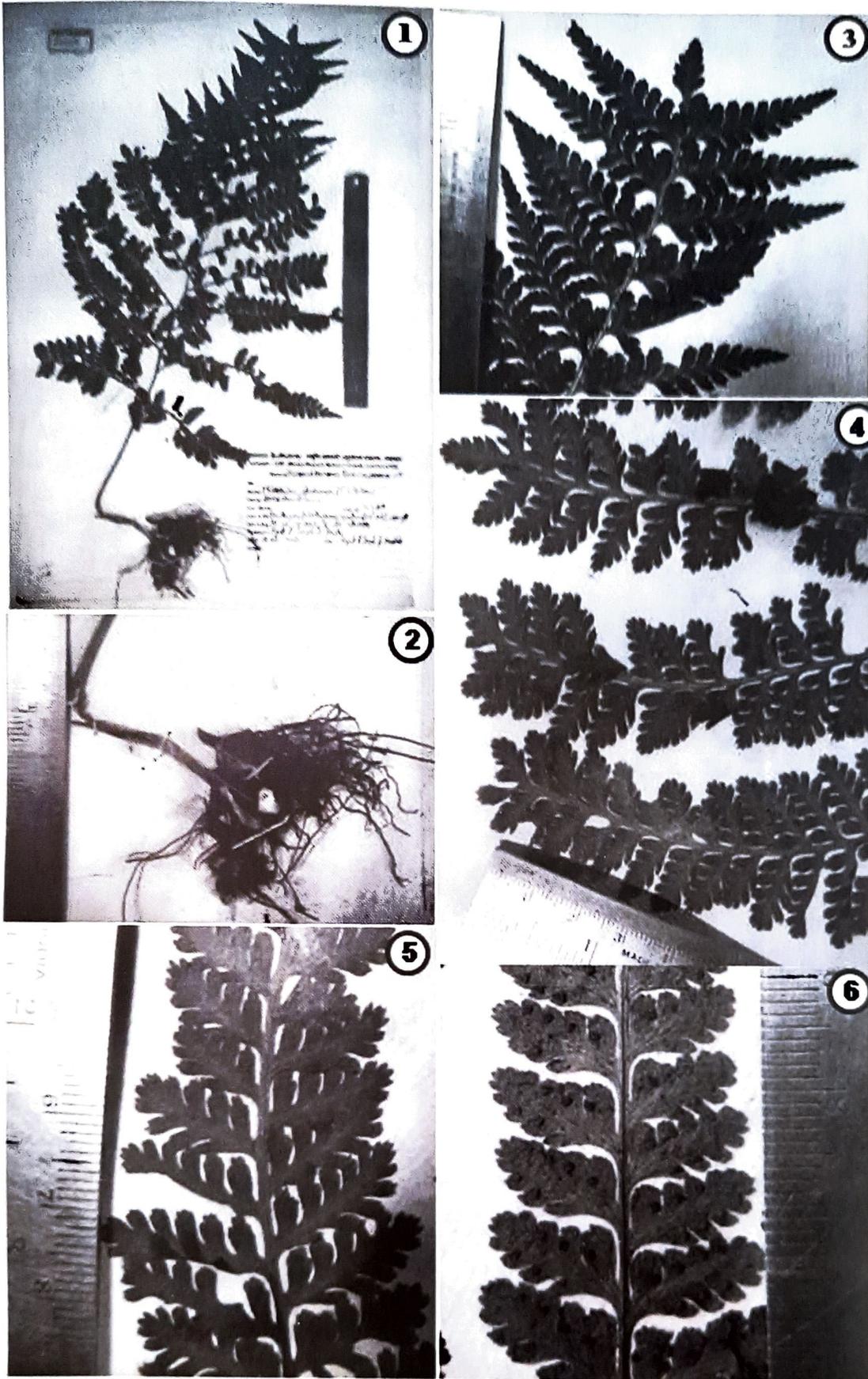


Plate 2

Microlepidia speluncae with morpho-variants. 1. Plant, 2. Rhizome, 3. Apex and ultimate lobe of frond, 4. Pinnae with blunt or rarely reduced ultimate lobes, 5. Pinnules and pinnulets with chlorophyllous laminar costa and costules (figures 1-5 from LWG 253150), 6. Sori on non-dissected pinnules and pinnulets (LWG 256558).

crenate ($\pm 2-5$ crenation); costulets hidden, faint, single and ending with 2-5 veinlets to each crenate apex [Plate 2(5)], veins simple, forked, ending before margin [Text Figure 2 (3-5)], hairy on both surfaces, hairs short-long, sparse, but lower surface more dense; lamina tissue continue with the costa, hairy [Plate 2 (5)]; costa, costules and costulets hairy on both surfaces, hairs unicellular, acicular [Text Figure 2(11,12)]. Sori on tip of vein, intramarginal, round-oblong, cup shaped, indusiate, hairy, hairs transparent [Text Figure 2(5), Plate 2(6)]; sporangia stalk 2-3 celled long, 148 μm in length, 2.52 μm broad, annulus with regular thickening bands, 15-18 annulus cells, middle portion of annulus broader, narrowing towards base [Text Figure 2(13)]. Spores yellowish-light brown, 32-34 x 20-23 μm , exine smooth, minutely pitted, tetrahedral, trilete on proximal end [Text Figure 2(14-17)].

Distribution and Ecology:

Uttar Pradesh: Lakhimpur Kheri: Dudhwa National Park, on the way to Sathiyana (2 km from Dudhwa), Salukapur, Lodaria compartment

Belrayan range; Bahraich: Katarniaghat Wildlife Sanctuary, Bicchia beat. Plants scarcely grow on soil in moist habitat under shade of large trees or rarely in association of *Diplazium esculentum*.

Specimens Examined: India. Uttar Pradesh, Lakhimpur Kheri, Dudhwa National Park, on the way to Sathiyana (2 km from Dudhwa), 28°29.887' N, 80°38.059' E, 560.2 ft, 16.05.2013, A. P. Singh & party, LWG 253150. On the way to Sathiyana, 28°29.718' N, 80°38.297' E, 490.3 ft, 18.11.2013, A. P. Singh & party, LWG 253664.

Other specimens examined: India. Uttar Pradesh, Lakhimpur Kheri, Dudhwa National Park, on the way to Sathiyana (2 km from Dudhwa), 28°29.887' N, 80°38.059' E, 560.2 ft, 16.05.2013, A. P. Singh & party, LWG 253149; Near Dudhwa Guest House, 28°29.473' N, 80°38.680' E, 469.8 ft, 17.11.2013, A. P. Singh & party, LWG 253630. On the way to Sathiyana, 28°29.718' N, 80°38.297' E, 490.3 ft, 18.11.2013, A. P. Singh & party, LWG 253663, 253665; 28°29.571' N, 80°38.616' E, 491.7 ft, 01.11.2014, A. P. Singh & party, LWG 256631, 256632. Salukapur, 28°25.705' N, 80°42.179' E, 462 ft, 19.11.2013, A. P. Singh & party, LWG 256411. Lodaria compartment 11, Belrayan range, 28°23.324' N, 80°54.695' E, 575.5 ft, 29.10.2014, A. P. Singh & party, LWG 256558, 256559. Dudhwa (near railway crossing), 28°29.319' N, 80°39.048' E, 447.1 ft, 30.10.2014, A. P. Singh & party, LWG 256597, 256598. Bahraich: Katarniaghat Wildlife Sanctuary, Bicchia beat, 28°20.215' N, 81°07.943' E, 440.2 ft, 03.11.2014, A. P. Singh & party, LWG 256735, 256734.

DISCUSSION

Microlepia speluncae is distinct in having stout creeping rhizome cover with short palae hairs, larger plants (up to 250 cm), deltoid, ovate, tripinnatisect or tripinnate-quadrupinnate fronds; stipes 35–100 cm long, 4–8 mm broad, purplish green, hairy throughout; lamina 50–150 cm long, 30–50 cm broad; pinnae 30–35 pairs, 25–30 cm long, 8–10 cm wide, pinnules 25–30 pairs, 3–4 cm long, 1.5–2.0 cm wide; pinnulets sub-quadrangular, hairy, margins entire-crenulate, large basal

lobe, crenate tip; sori small, sub-marginal on free veinlets (Singh and Panigrahi 2005). Two varieties *M. speluncae* var. *speluncae* Moore and *M. speluncae* var. *hancei* C. Chir et Tard-Blot were recorded from the forests of Nagaland in eastern Himalayas (Jamir and Rao 1988). *M. speluncae* var. *hancei* differs from *M. speluncae* var. *speluncae* in having very few hair confined to veins, whereas the hairs are more or less prevalent throughout the surface in *M. speluncae* var. *speluncae*. Three varieties *M. speluncae* var. *speluncae*, *M. speluncae* var. *pubera*, *M. speluncae* var. *pubescens* were described from the Palni Hills in South India (Manickam and Irudayaraj 1992) considering the continuous range between sub-glabrous to pubescent all over the lamina as proposed earlier (Sledge 1957). In *M. speluncae* var. *speluncae* hair on pinnules are confined to veins, however it is distributed all over the surfaces in *M. speluncae* var. *pubera* and *M. speluncae* var. *pubescens* (Manickam and Irudayaraj 1992). Remarkably the lobe is distinctly crenate, pinnules sparsely puberulous on both the surface in *M. speluncae* var. *pubera*, whereas, in *M. speluncae* var. *pubescens* the lobes are entire and pinnules are hairy all over. The above three varieties were also reported from Arunachal Pradesh in eastern Himalayas (Singh and Panigrahi 2005). During the recent survey of pteridophytes in DNP and terai region of Uttar Pradesh the authors came across few populations of *M. speluncae*, which are rather different compared to *M. speluncae* var. *hancei*, *M. speluncae* var. *speluncae*, *M. speluncae* var. *pubera* and *M. speluncae* var. *pubescens*. Present population of *M. speluncae* is distinguished in having broad deltoid, ovate, tripinnatisect, without or with 1.5–2.0 cm ultimate lobes; rachis slightly winged above 1/2 portion; primary pinnae about 14–15 pairs, ascending, largest pinnae 12–13 cm long, sub-quadrangular, without or with ultimate lobes; costa flattened to tapering, winged with chlorophyllous laminar margins; primary pinnules 16–19 pairs, largest basal acroscopic pinnules 3.0–3.5 cm long, 1.5–2.0 cm wide, with 5–7 pair of lobes; costules flattened, tapered, indistinct, hidden or faint to the cells of pinnules with winged margins and blunt or obtuse ultimate lobes; costules tapered, indistinct, hidden and ending with single-double

vein lets [Text Figure 2 (3–5)]; pinnulets smaller, 4–5 mm long, 2.5–3.0 mm wide, quadrangular, margin entire, apex crenate (± 2 –5 crenation); costulets hidden, faint, single and ending with 2–5 veinlets to each crenate apex. Interestingly, the hairs (remarkable variety traits) profusely present throughout the surface and on veins brings the taxa near to *M. speluncae* var. *speluncae*. Nevertheless, the flattened-tapered costae, costules and costulets with chlorophyllous winged margins and absence or presence of ultimate pinnae of the frond show a remarkable variation in the population of *M. speluncae* var. *speluncae* growing in the forests of DNP and terai regions. Such variation confirms taxonomic plasticity within variety level of *M. speluncae* var. *speluncae* which have been observed for the first time and provided for convenience of taxonomic treatment. Majority of the population growing in different localities (Text Figure 1) within the geographical boundaries of DNP and terai regions exhibit variations, except few populations which more or less approach to *M. speluncae* var. *speluncae* in all taxonomic parameters. Such variation within *M. speluncae* var. *speluncae* could occur for the reason of their trans-geographical distribution from Himalayas and mountainous regions of India or altered genotype, which is a matter of future investigation.

CONCLUSION

Discovery of present species from DNP within the terai region is a new record for the north Indian province, which however was previously reported from Himalayas and mountainous regions of south India (Chandra 2000, Manickam and Irudayaraj 1992, Singh and Panigrahi 2005). Occurrence of this species from the DNP shows its possible trans-geographical migration from the Himalayas, because the study areas are at the foothills and in proximity of the Himalayas. Migration from such amicably favorable climatic conditions and adaptation to terai region in DNP might have brought some morphological variations (observed in present study). This morphological variation can be considered as an additional identification key and range of variation within the population.

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