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TAXONOMIC ASSESSMENT OF FAMILY BRYACEAE (BRYOPSIDA) OF PACHMARHI BIOSPHERE RESERVE (MADHYA PRADESH), INDIA

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ABSTRACT

Nine taxa belonging to Bryaceae: *Anomobryum auratum* (Mitt.) Jaeg., *Brachymenium acuminatum* Harv., *Brachymenium ptychothecium* (Besch.) Ochi, *Bryum argenteum* Hedw., *Bryum caespiticium* L. ex Hedw., *Bryum capillare* L. ex Hedw., *Bryum coronatum* Schwaegr., *Bryum paradoxum* var. *reflexifolium* (Ochi) Ochi and *Pohlia flexuosa* Hook., growing on various habitats in Pachmarhi Biosphere Reserve (PBR), between altitude 800-1060 meters have been assessed. These mosses are being reported from the Pachmarhi Biosphere Reserve for the first time.

Keywords : Bryaceae, Bryopsida, Pachmari.

INTRODUCTION

Bryaceae is one of the largest families of mosses (Bryopsida) with worldwide distribution of 13 genera and 850 species (Shaw 1985). It includes erect mosses with generally sparsely branched stems. There is extensive variation among the members of the family in leaf shape, shape of cells and capsules and development of capsule (from perfect to absent). The family was divided by Brotherus (1924) into 3 subfamilies *viz.* Orthodontioideae, Bryoideae and Melichhoferioideae. Andrews (1935) and Ochi (1959) have divided Bryaceae into two subfamilies: Bryoideae and Pohliodeae. Gangulee (1977) has followed the two subfamily classification and described 10 genera of the family from India. However, Lal (2005) has listed 11 genera under this family from India *viz*. *Anomobryum* Schimp.*, Bryum* Hedw.*, Brachymenium* Schwaegr. *Epipterygeum* Lindb.*, Leptobryum* (B.S.G) Wilson, *Mielichhobryum* Srivastava*, Mielichhoferia* Nees & Hornsch, *Mniobryum* Limpr.*, Plagiobryum* Lindb.*, Pohlia* Hedw.*, Rhodobryum* (Schimp.) Limpr.

Bryaceae is often considered a taxonomically difficult family. Some workers have extensively worked on it and revised several genera of the family. Traditional generic concepts in the family as exemplified by those of Brotherus (1924) are based sometimes on gametophytic and at other times on sporophytic characters. Later, several workers have worked on various genera. Ochi (1959, 1972, 1972a,) has revised *Bryum* and related genera. Crundwell and Nyholm (1964), Syed (1973) and Mohammed (1979) revised several groups of the family. Shaw and Fife (1984) discussed peristome variation and taxonomy in *Anomobryum*.

The central Indian zone is rich in terms of bryoflora. Mosses of the central Indian region have been studied and described by several authors, Nath & al. (2005, 2007, 2008), Chaudhary and Sharma (2002), Chaudhary and Deora (1996, 2001), Bapna (1975). But the mosses of the Pachmarhi Biosphere Reserve have not been explored to a satisfactory extent. Pachmarhi Biosphere Reserve is situated in Madhya Pradesh, covering three civil districts - Chhindwara, Betul and Hoshangabad, undertaking an area of 4987.38 square kms. This region is of great importance due to the fact that this area lies in what was known in the past as the Gondwanaland and its age can be calculated to the Triassic period. The flora and fauna of the region thus hold much importance phylogenetically. Further, the region also forms a link between the biodiversity of the southern Indian region and that of the Himalayan region, and this makes the Biosphere Reserve a connecting link between the two belts. Nearly 57 species of liverworts, 37 species of epiphytic mosses and 46 species of terrestrial mosses have been reported from there so far (Singh and Kaul 2002). Family Bryaceae shows considerable representation as evident from 9 taxa belonging to 4 genera being encountered from here. The genus *Bryum* is represented by 5 species namely *B. argenteum* Hedw., *B. caespiticium* L. ex Hedw., *B. capillare* L. ex Hedw., *B. coronatum* Schwaegr. and *B. paradoxum* var. *reflexifolium* (Ochi) Ochi. The genus *Brachymenium* is represented by only 2 species *viz*. *B. acuminatum* Harv. and *B. ptychothecium* (Besch.) Ochi whereas, genus *Anomobryum* and *Pohlia* are represented by one species each, *A. auratum*

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(Mitt.) Jaeg and *P. flexuosa* Hook. respectively. Previously, Singh and Kaul (2002) reported 4 genera *viz*. *Anomobryum, Brachymenium, Bryum* and *Pohlia* of this family from the Biosphere Reserve area.

MATERIALS AND METHODS

The specimens were collected in the successive years in 1992, 1993 and 2006 respectively from 10 localities situated at an altitudinal range between 800 to 1060 m, of the Biosphere Reserve. The specimens were collected from terrestrial habitats such as rocks, soil covered rocks and wet rocks etc. and have been deposited in the Bryophyte Herbarium, NBRI, Lucknow (LWG).

Key to the genera

1a.	Plants slender, unbranched , leaf cells in upper & middle region nearly four times as long as broad, basal leaf cells longer	1. ...*Pohlia*
1b.	Plants frequently branched , leaf cells in middle & upper region not in 4:1ratio, basal cells abruptly shortening at the base	...2
2a.	Plants slender, julaceous, long slender sub- floral innovations. leaves small, appressed to stem, costa ending much below leaf apex	2. ...*Anomobryum*
2b.	Plants moderately robust, non- julaceous, robust sub- floral innovations, leaves longer, erect to erectopatent, costa ex-current	...3
3a.	Plants with hyaline or shorter arista, leaf cells spindle shaped or rhomboidal, broader	3. ...*Brachymenium*
3b.	Plants with hyaline or shorter arista, leaf cells spindle shaped or rhomboidal, narrower	4. ...*Bryum*

1. Pohlia flexuosa Hook. in Icon. Pl. Rar., 1: 19 (1836). **(Fig. 1)**.

Plants terrestrial, in lax tufts, yellowish green. Stem erect, up to 8 mm long, with subfloral innovations. Leaves loosely arranged below, dense at apex; erectopatent, lanceolate up to 1.4 mm and 0.4 mm broad. Leaf margin flat, slight dentitions at apex. Costa strong, brownish, percurrent. Leaf cells in the upper region thick walled, rhomboid, ± 40 × 8 µm in size, basal cells rectangular to quadrate, ± 36 × 8 µm. Sporophyte not seen.

Specimen examined : India, Madhya Pradesh, Pachmarhi : Tamia Valley, growing on soil over rock, alt. c.1000 m, 10.10.1992, *V. Nath & A. K. Asthana* 205486.

2. Anomobryum auratum (Mitt.) Jaeg. in Ber. Tsitigk. St. Gallischen Naturwiss. Ges., 1873 – 74: 142 (1875). **(Fig. 2)**.

Plants terrestrial, julaceous, tufted, yellowish green, bounded by rhizoids at base. Stem upto 1.2 cm long, branched by 2 to 3 subfloral innovations, densely covered by leaves. Leaves closely appressed to the stem, ovate – elliptical with obtusely apiculate to rounded tip ± 1.2 × 0.6 mm in size. Costa pale, ending much below the leaf apex. Leaf cells thick walled, linear up to 48 × 6 µm at apex; basal cells rhomboidal to sub-rectangular up to 40 × 16 µm. Sporophyte not seen.

Specimens examined : India, Madhya Pradesh, Pachmarhi: on way to Dhoopgarh, growing on soil, alt. c.1056 m 16.12.1993, *V. Nath & A.K. Asthana* 205556; On Pandav Caves, growing on rock, alt. c.820 m, 1.12.2006, *V. Sahu & V. Awasthi* 227685C.

Key to the species of Genus Brachymenium

1a.	Plants smaller (up to 6 mm), pale- yellowish, leaves small, margin entire	... *B. acuminatum*
1b.	Plants longer (up to 10 mm), glossy green, branched, leaves larger, margin dentate	... *B. ptychothecium*

3. Brachymenium acuminatum Harv. in Hook. in Icon. Pl. Rar, 1:19 (1863). **(Fig. 3)**.

Plants terrestrial, pale to yellowish green plants in dense mats. Stem erect, up to 6 mm high, branched by several subfloral innovations, matted by tomenta. Leaves erect, ovate – lanceolate up to 1.2 mm long and

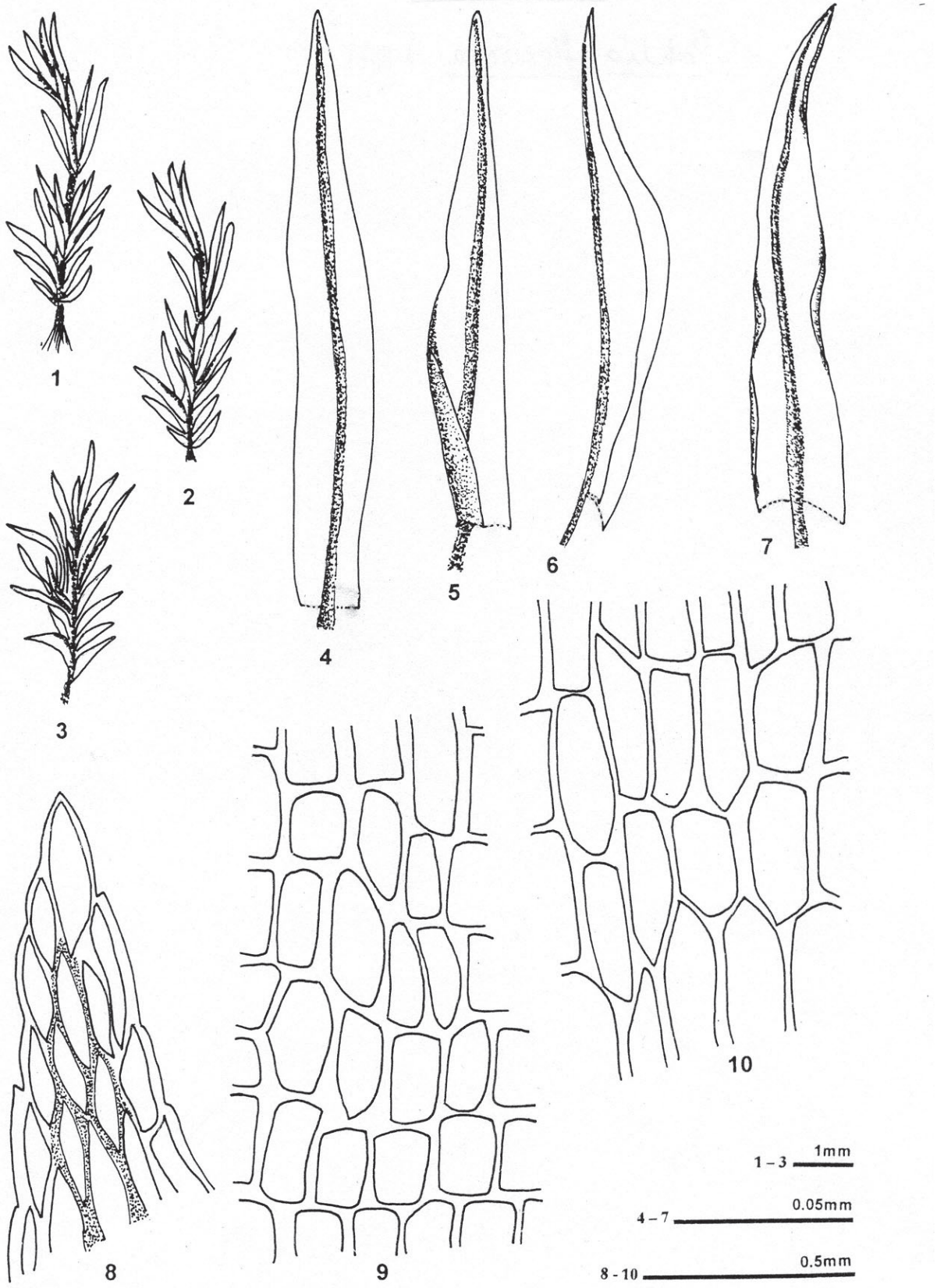


Fig. 1 (1-10) : *Pohlia flexuosa* Hook. 1-3. vegetative plants, 4-7. leaves, 8. apical leaf cells 9. middle leaf cells, 10. basal leaf cells.

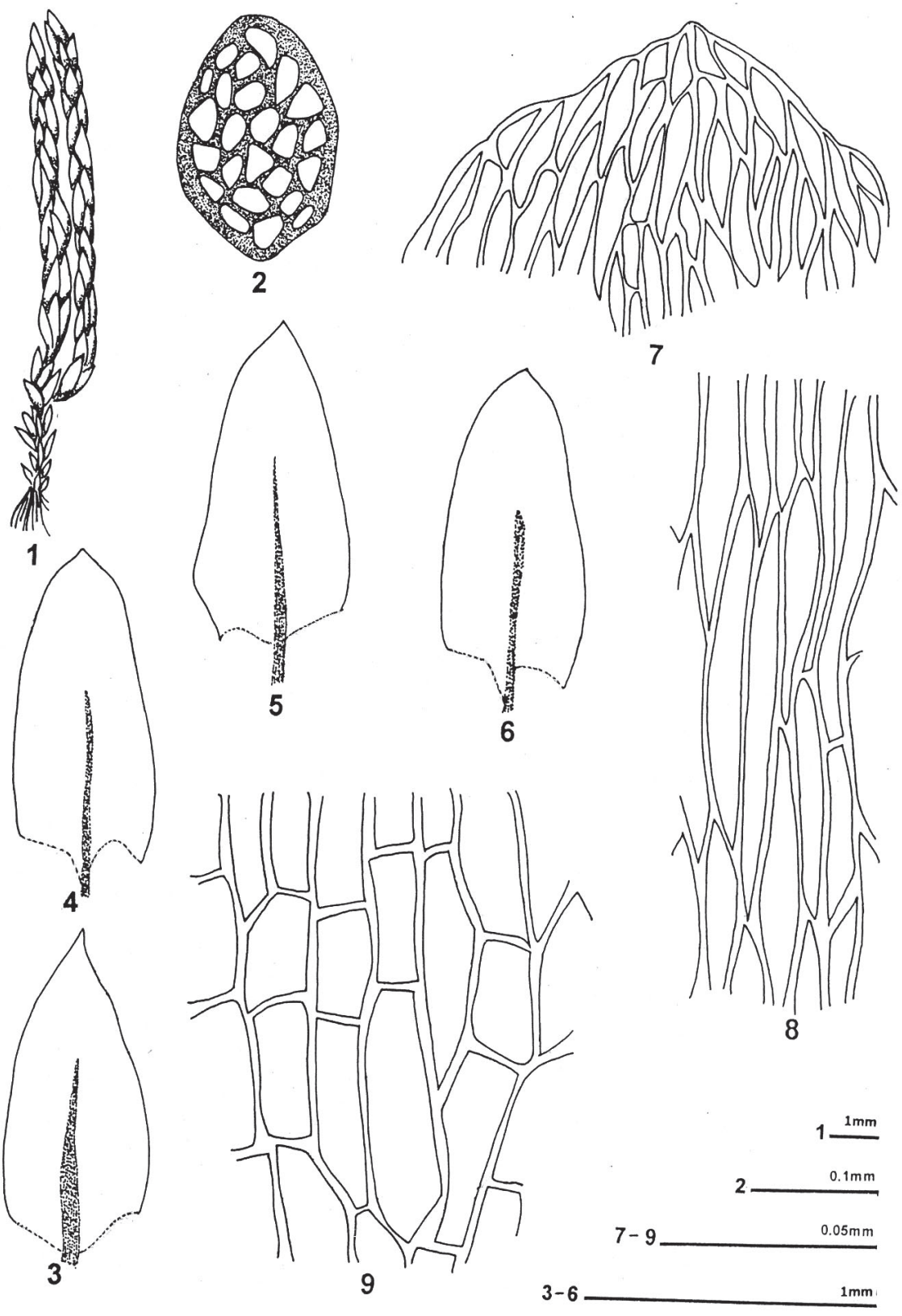


Fig. 2 (1-9) : *Anomobryum auratum* (Mitt.) Jaeg. 1. vegetative plant, 2. T.S. of stem, 3-6. leaves, 7. apical leaf cells, 8. middle leaf cells, 9. basal leaf cells.

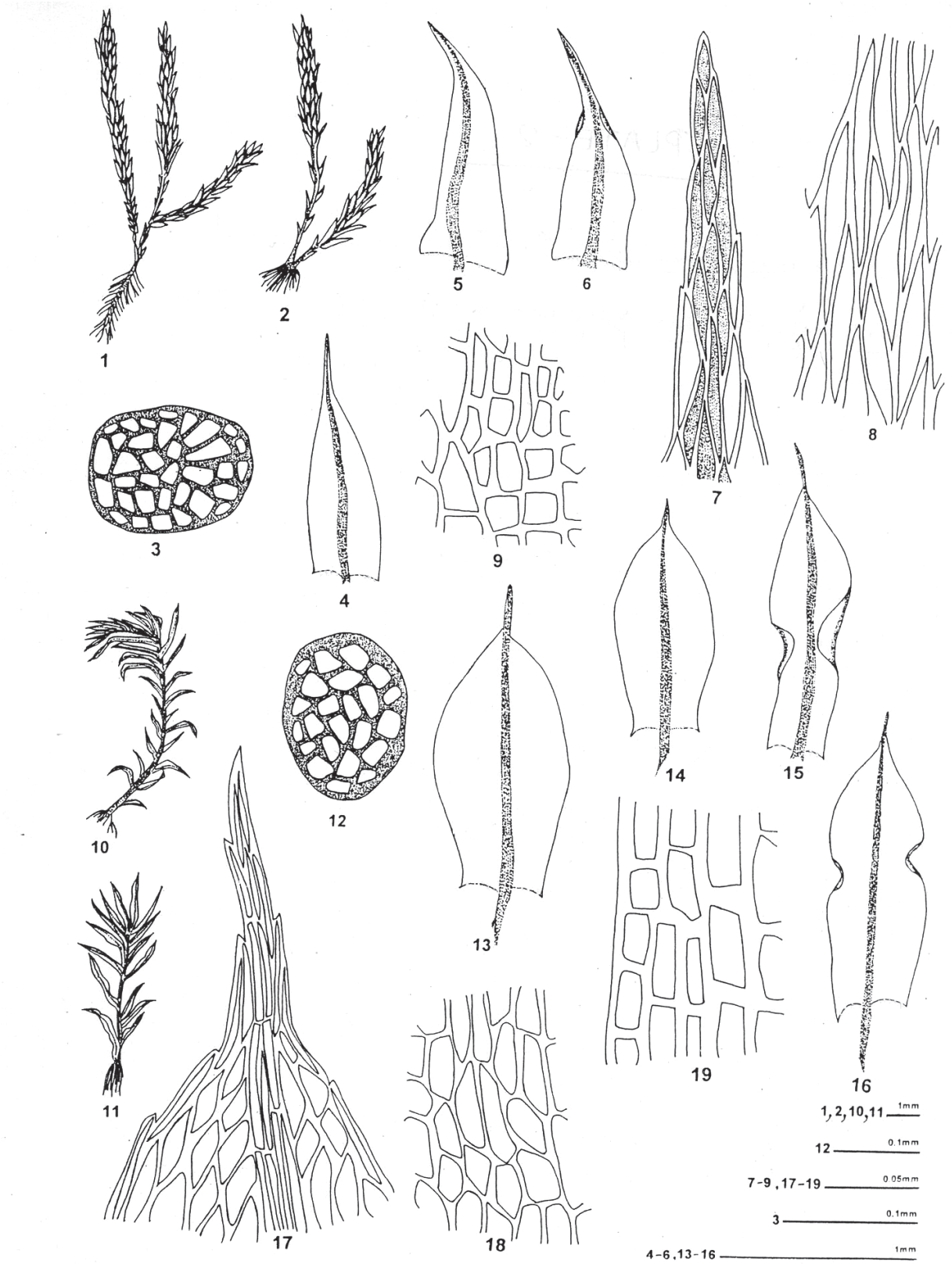


Fig. 3.(1-19): *Brachymenium acuminatum* Harv. 1,2. vegetative plant, 3. T.S. of axis, 4-6. leaves, 7. apical leaf cells 8. middle leaf cells, 9. basal leaf cells. Figures 10-19 *Brachymenium ptychothecium* (Besch.) Ochi. 10,11. vegetative plants, 12. T.S. of stem, 13-16. leaves, 17. apical leaf cells 18. middle leaf cells, 19. basal leaf cells.

0.42 mm wide, acuminate, margin entire. Costa strong, excurrent in an arista ± 0.11 mm long. Leaf cells rhomboid, up to 75 × 12 µm at apex, gradually getting rectangular at base, 50 × 16 µm in size; marginal cells narrower but no distinct margin seen. Sporophyte not seen.

Specimens examined : India, Madhya Pradesh, Pachmarhi : Jambu Dweep, growing on soil over rock, alt. c.900 m, 17.12.1993, *V. Nath & A.K. Asthana* 205598; 205599.

4. Brachymenium ptychothecium (Besch.) Ochi in Adv.Front. Pl. Sc., 4: 108 (1963).

Plants terrestrial, tufted, glossy, green, reddish at base. Shoot erect, up to 10 mm high, with subfloral innovations. Leaves erectopatent, curled when dry, oblong – spathulate, bordered and apiculate, ± 1.93 mm long and ± 65 mm broad at middle. Leaf margin entire below, slightly dentate at apex, usually revolute from base to mid leaf. Costa strong, deep brownish, excurrent in a slightly denticulate arista, ± 0.27 mm in size. Leaf cells rhomboid to hexagonal at apex, ± 37.5 µm long and ± 17.7 µm wide; basal cells subrectangular, ± 41.7 × 19.8 µm; marginal cells elongated, narrow, forming a border of 2 – 3 rows. Sporophyte not seen.

Specimen examined : India, Madhya Pradesh, Pachmarhi : Down Fall, growing on moist rock, alt. c.884 m, 28.11.2006, *V. Sahu & V. Awasthi* 227601.

Key to the species of Genus Bryum

1a.	Plants glossy green with silvery tinge, leaf apex hyaline, branches julaceous	… *Bryum argenteum*
1b.	Plants green without silvery appearance, leaf apex not hyaline, branches non- julaceous	...2
2a.	Smaller leaves (± 2 × 0.5 mm in size), appressed to stem, characteristic pendulous capsule	...*Bryum coronatum*
2b.	Larger leaves(± 4 × 2 mm in size), erectopatent, capsule non- pendulous	… 3
3a.	Leaf margin recurved at places, distinct border formed by normal or tinted cells	...*Bryum capillare*
3b.	Leaf margin revolute, marginal cells slender forming an indistinct border	...4
4a.	Plants larger (up to 10 mm), leaves distant below, densely arranged above but not in comal tufts, leaf tips show mild denticulations	...*Bryum paradoxum*
4b.	Plants smaller (up to 7 mm), leaves at apical region form comal tufts, margin entire with no denticulations	...*Bryum caespiticium*

5. Bryum argenteum Hedw. in Sp Musc. : 181 (1801). **(Fig. 4)**.

Plants terrestrial, small, tufted. Stems erect, short with subfloral julaceous branches which may be up to 15 mm in height; silvery white in colour. Leaves uniformly arranged on stem, ovate, concave, acuminate. Leaf size 0.8 to 1.1 × ± 0.4 mm, entire. Costa percurrent in some leaves, in others ending in a hyaline arista. Leaf cells rhomboidal above, ± 54 × 12 µm and rectangular up to 40 × 12 µm at base. Sporophyte not seen.

Specimen examined : India, Madhya Pradesh, Pachmarhi : Near Pandav Caves, growing on soil, alt. c. 820 m, 1.12.2006, *V. Sahu & V. Awasthi* 227688A.

6. Bryum caespiticium L. ex Hedw. in Sp. Musc. : 180 (1801).

Plants terrestrial, up to 7 mm long with subfloral innovations. Leaves small, forming comal tufts only on main shoots, erect to erectopatent, acuminate up to 1.5 mm long and 0.42 mm broad; margin revolute all along the length, entire. Costa excurrent in arista up to 0.18 mm long. Leaf cells rhomboidal, up to 52 ×12.5 µm at apex, becoming sub – rectangular at base, up to 75 µm long and 20.8 µm broad. Marginal cells narrower and longer but generally distinct border not seen. Sporophyte not seen.

Specimen examined : India, Madhya Pradesh, Pachmarhi : On way to Chota Mahadev, growing on soil covered rock, alt. c.854 m, 29.11.2006, *V. Sahu & V. Awasthi* 227628B.

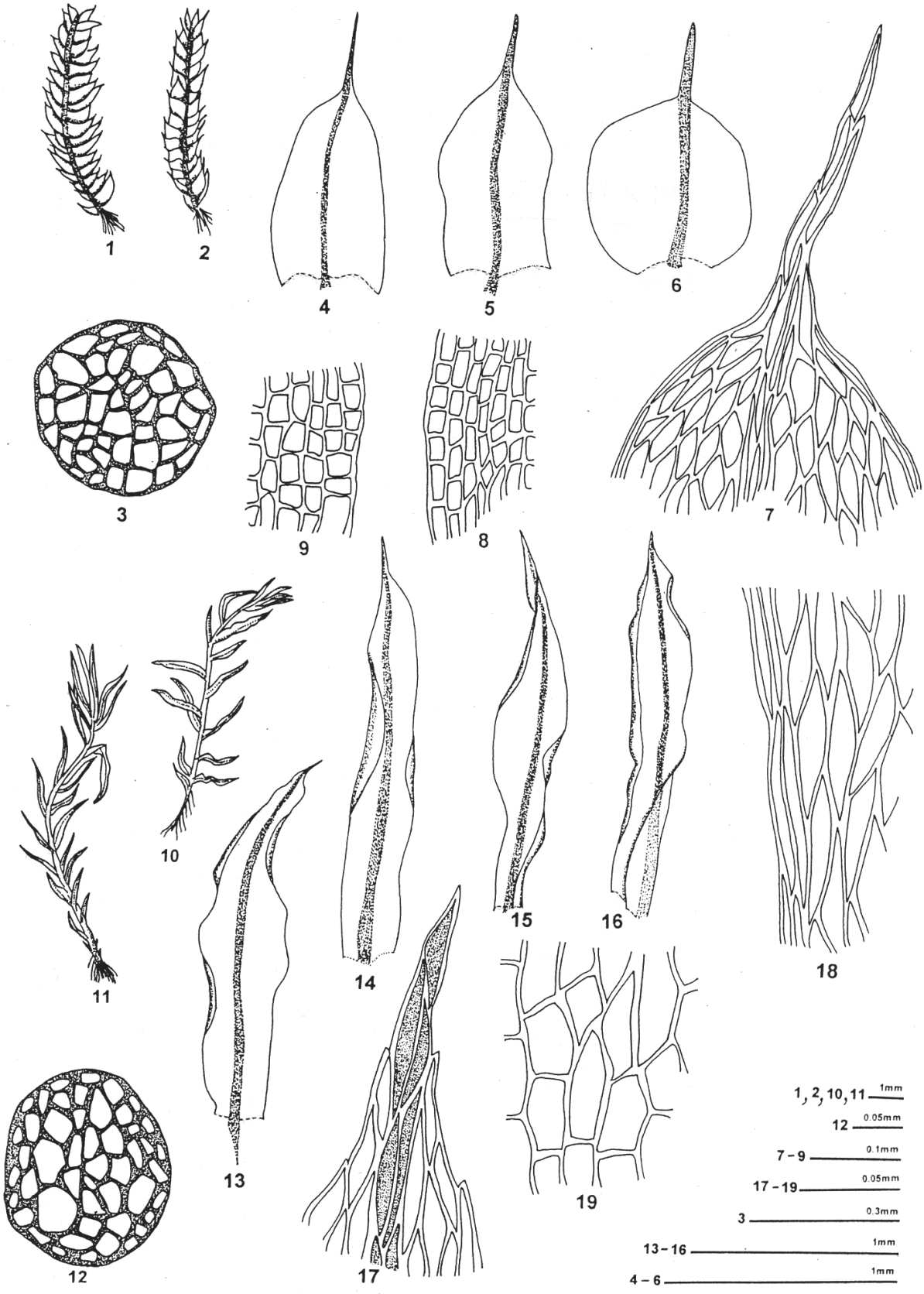


Fig. 4 (1-19): *Bryum argenteum* Hedw. 1,2. vegetative plants, 3. T. S. of axis, 4-6. leaves, 7. apical leaf cells 8. middle leaf cells, 9. basal leaf cells, Figures 10-19 *Bryum caespiticium* L. ex Hedw. 10,11. vegetative plant 12. T. S. of stem, 13-16. leaves, 17. apical leaf cells, 18. middle leaf cells, 19. basal leaf cells.

7. Bryum capillare L. ex Hedw. in Sp. Musc.; 182 (1801). **(Fig. 5)**.

Plants terrestrial, up to 12 long mm, densely tufted, deep green above, reddish below, generally branched. Leaves lax in lower region, dense in upper regions. Comal tufts seen. Leaves erectopatent, ovate, acuminate, up to 4.25 mm long and 1.8 mm wide; margin entire with fine dentitions at tip. Costa stout, excurrent in an arista up to 1.9 mm long. Leaf cells thin walled; rhomboid – hexagonal up to 60.5 × 11.5 µm at top, rectangular up to 67 × 21 µm at base. Marginal leaf cells narrow, elongated forming border. Seta apical, erect but curved at tip, up to 2.5 cm long, deep red in colour. Capsule horizontal, ovate, cylindrical, with a wide mouth, ± 3 mm long and 1 mm in diameter. Peristome normal; outer teeth reddish at base, paler at tips, endostome hyaline with segments as high as outer teeth. Spores not seen.

Specimens examined : India, Madhya Pradesh, Pachmarhi: Down Fall, growing on soil covered rock, alt. c.1056 m, 15.12.1993, *V. Nath & A.K. Asthana* 205546; Jalgali, growing on soil covered rock, alt. c.900 m, 16.12.1993, *V. Nath & A.K. Asthana* 205577; Little Fall, growing on wet rock; alt. c.884 m, 28.11.2006, *V. Sahu & V. Awasthi* 229392; Near Jambu Dweep, growing on rock, alt. c.790 m, 29.11.2006, *V. Sahu & V. Awasthi* 227646, 227655A.

8. Bryum coronatum Schwaegr. in Sp. Musc. Frond. Suppl. 1(2): 103 (1816). **(Fig. 6)**.

Plants terrestrial, tufted, slender, bright to dull green, tomentose at base. Stem usually branched, up to 15 mm high. Lower leaves smaller, upper ones larger, oblong – ovate, acuminate, ± 2 mm long and 0.5 mm wide. Margin entire, flat, costa reddish at base, excurrent in a arista which shows mild dentitions. Upper leaf cells thin walled, narrow, rhomboid, ± 48 × 6.5 µm; basal cells shorter, rectangular, ± 40×16 µm, border cells not differentiated. Perichaetial leaves shorter, triangular. Seta apical, erect, curved at tip, reddish brown, up to 28 mm long. Capsule pendulous, thick, ± 2.5 mm long and 1 mm in diameter; capsule mouth wide, peristome reddish, outer teeth broad with sharp, hyaline, papillose tips; endostome transparent – yellowish, as high as exostome, with 2 – 3 appendiculate cilia. Spores not seen.

Specimens examined : India, Madhya Pradesh, Pachmarhi : Near Pandav Caves, growing on soil alt. ca 820 m, 1.12.2006, *V. Sahu & V. Awasthi* 227688B; On Pandav Caves, growing on rock, alt. c.820 m, 1.12.2006, *V. Sahu & V. Awasthi* 227681C, 227684.

9. Bryum paradoxum var. **reflexifolium** (Ochi) Ochi in Hikobia, 5: 158 (1969). **(Fig. 7)**.

Plants terrestrial, tufted, matted with radicles below, green. Stems about 10 mm high, with subfloral innovations. Leaves smaller and distant below, larger and closer above, erectopatent, oblong – lanceolate, acuminate, ± 4.4 mm long and ± 1.5 mm wide; margin usually revolute all along, entire except showing mild denticulations at tip. Costa strong, excurrent in an arista, up to 0.16 mm long. Leaf cells thin walled; rhomboid to hexagonal at apex up to 69 × 17 µm in size, becoming narrower at margin, forming indistinct border; basal cells rectangular, 92 × 28 µm in size. Sporophyte not seen.

Specimen examined : India, Madhya Pradesh, Pachmarhi : On way to Bee Fall, growing on wet rocks, alt. c.820 m, 30.11.2006, *V. Sahu & V. Awasthi* 227666B.

DISCUSSION

The distribution of the mosses undertaken in the present study, among the major bryogeographical zones of India has been provided in *Table-I.* Bryaceae has emerged as one of the most dominant acrocarpous moss family at PBR, as indicated by the presence of 9 taxa in the region. Although, the mosses show abundant occurrence at the PBR, yet the frequency of occurrence of any single taxon is not much. The genus *Bryum* showed good representation with 5 species. Among these, *B. capillare* emerged to be the most widely distributed moss with presence at about 4 localities and seems to exhibit some variations in its characters such as habit which is characterized mostly by comal tufts at the apical region, but may be devoid of it in a few specimens. Further, the leaf size may range from 2.5 to 4.25 mm in length and 1.3 to 1.8 mm in width. Subsequently, the leaf cell size also varies with the cells at the apical region of leaf being up to 60.5 × 11.5 µm in size and those of the basal region being up to 67 × 21 µm in size. The basal leaf cells may have a reddish tint in some cases, but not always so. The other plants studied, exhibit slight variations in characters which are not significant. In PBR, the taxa of this family were found on diverse type of terricolous habitats *(Table – II)*. The distribution of

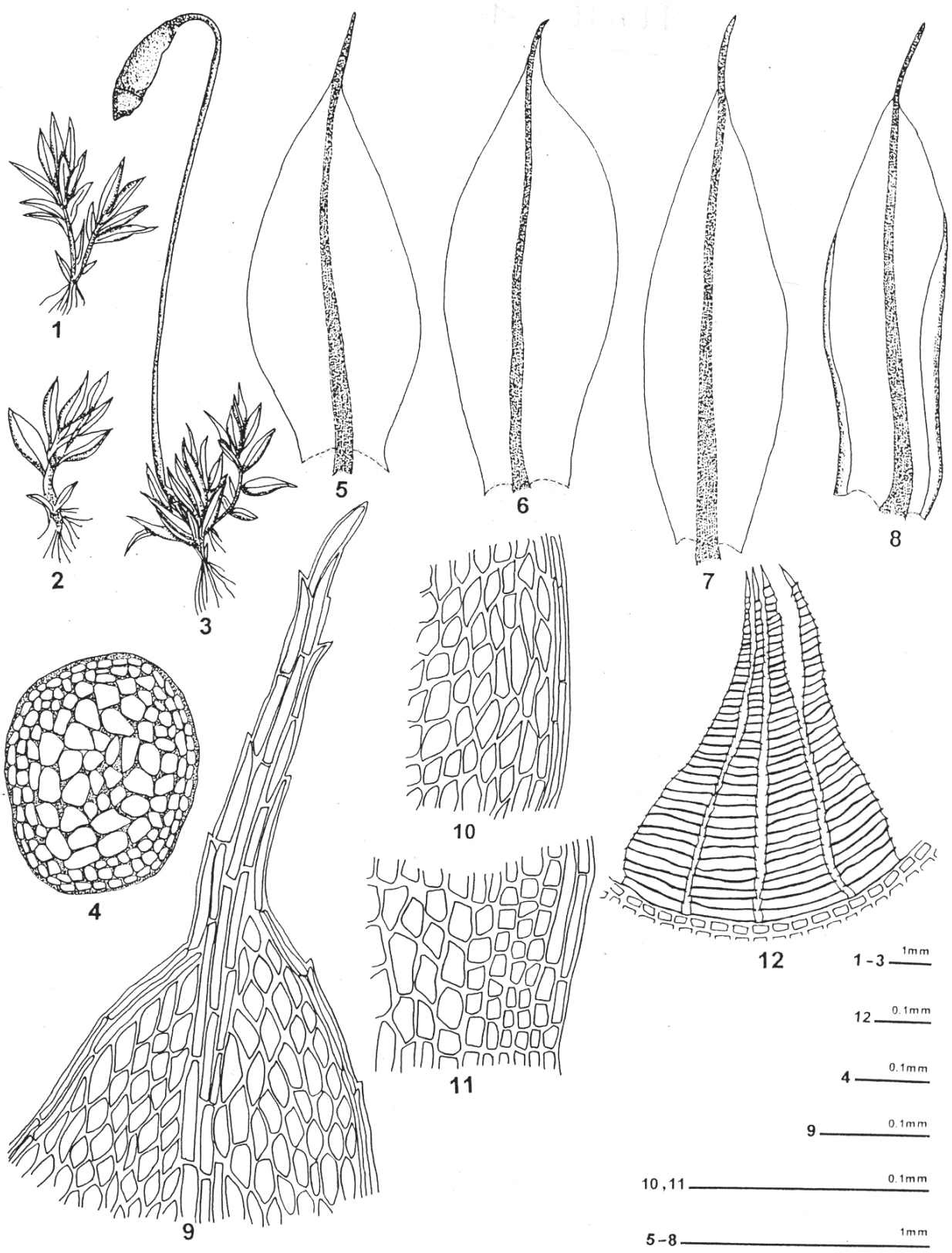


Fig.5 (1-12) : *Bryum capillare* L. ex Hedw. 1,2. vegetative plants, 3. plant with sporophyte, 4. T.S. of stem 5-8. leaves, 9. apical leaf cells, 10. middle leaf cells, 11. basal leaf cells, 12. Peristome teeth.

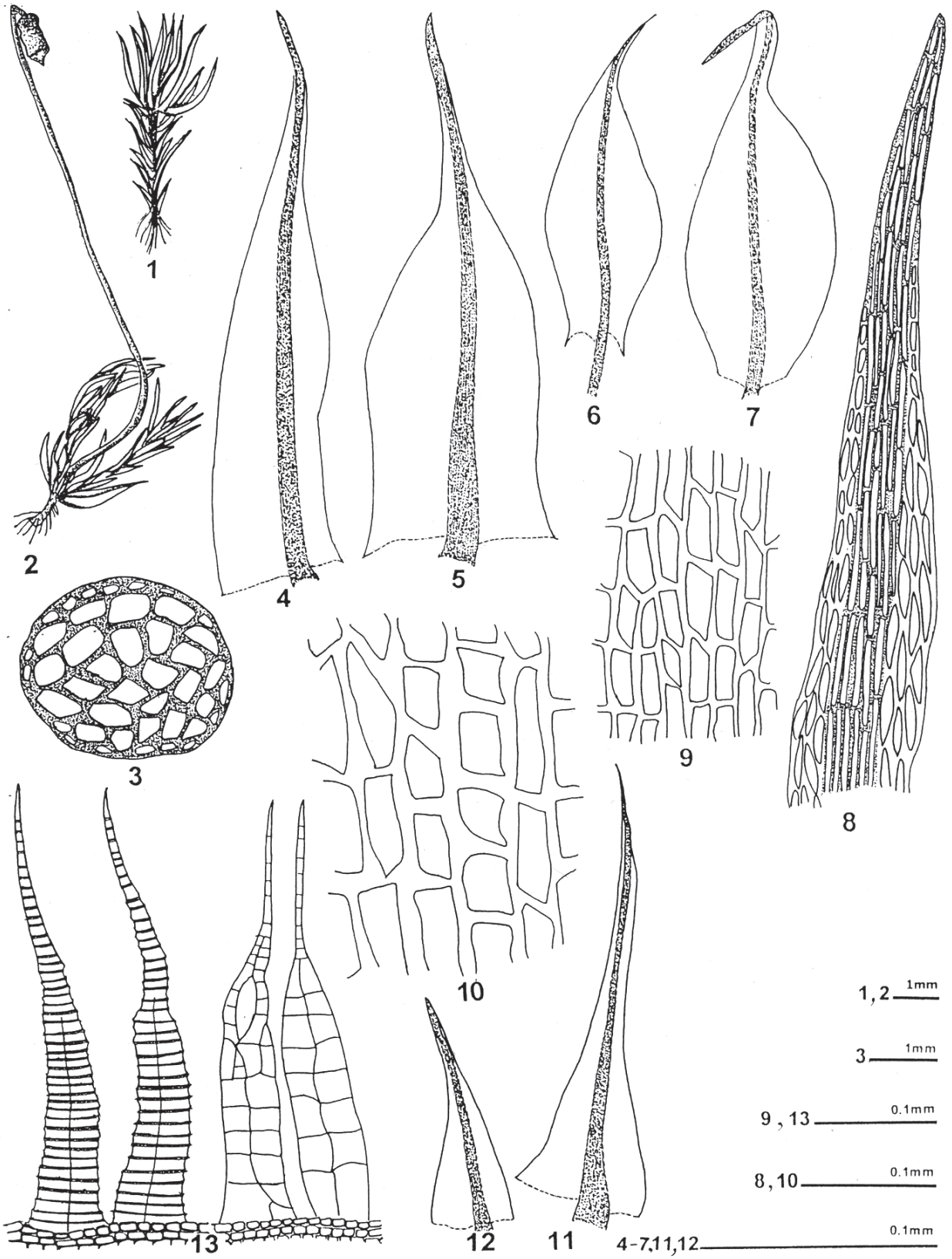


Fig. 6 (1-13) : *Bryum coronatum* Schwaegr. 1. vegetative plant, 2. plant with sporophyte, 3. T.S. of stem 4-7. leaves, 8. apical leaf cells, 9. middle leaf cells, 10. basal leaf cells, 11,12. perichaetial leaves 13. peristome showing exostome and endostome teeth.

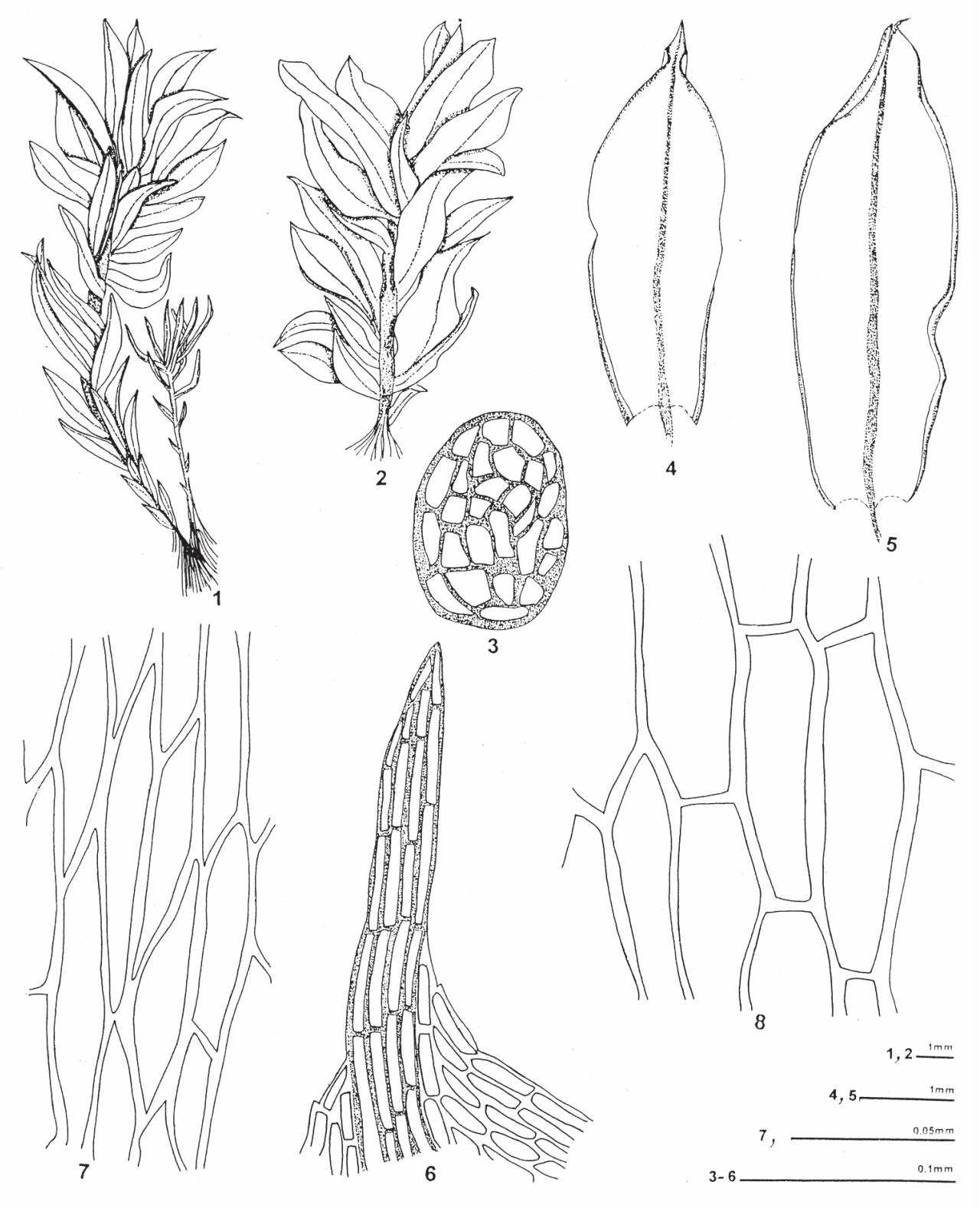


Fig. 7 (1-8) : *Bryum paradoxum* var. *reflexifolium* (Ochi) Ochi 1,2. vegetative plants, 3. T.S. of stem, 4,5. leaves 6. apical leaf cells, 7. middle leaf cells, 8. basal leaf cells.

Table – I : Distribution of mosses in bryogeographical regions of India

Names of Taxa	Bryogeographical Regions					
	Western Himalaya	Eastern Himalaya	Punjab and Rajasthan plains	Gangetic plains	Central India	Southern India
Anomobryum auratum	+	+	–	–	+	+
Brachymenium acuminatum	+	–	–	–	+	+
Brachymenium ptychothecium	–	+	–	–	+	–
Bryum argenteum	+	+	+	–	+	+
B. caespiticium	+	+	–	–	+	–
B. capillare	+	+	–	–	+	+
B. coronatum	+	+	–	–	+	+
B. paradoxum var. *reflexifolium*	+	+	–	–	+	+
Pohlia flexuosa	+	+	–	+	+	+

Table – II : Distribution of the taxa on different habitats at Pachmarhi Biosphere Reserve

Names of Taxa	Habitats		
	On Soil	On Soil covered rocks	On Rocks
Anomobryum auratum	+	–	+
Brachymenium acuminatum	+	+	–
Brachymenium ptychothecium	–	–	+
Bryum argenteum	+	–	–
Bryum caespiticium	–	+	–
Bryum capillare	+	+	+
Bryum coronatum	+	–	+
Bryum paradoxum var.*reflexifolium*	–	–	+
Pohlia flexuosa	+	–	+

Table – III : Distribution of the taxa in various localities of Pachmarhi Biosphere Reserve

Names of Tamia Taxa	Localities										
	Dhoopgarh	Down Fall	Jalgali Dweep	Jambu Fall	Little Jambu Dweep	Near Pandav Caves	Near to Bee Fall	On way to Chota Mahadev	On Way Pandav Caves	On Valley	
Anomobryum auratum	+	–	–	–	–	–	–	–	–	+	–
Brachymenium acuminatum	–	–	–	+	–	–	–	–	–	–	–
Brachymenium ptychothecium	–	+	–	–	–	–	–	–	–	–	+
Bryum argenteum	–	–	–	–	–	–	+	–	–	–	–
Bryum caespiticium	–	–	–	–	–	–	–	–	+	–	–
Bryum capillare	–	+	+	–	–	+	+	–	–	–	–
Bryum coronatum	–	–	–	–	–		+	–	–	+	–
Bryum paradoxum var. *reflexifolium*	–	–	–	–	–	–	–	+	–	–	–
Pohlia flexuosa	–	–	–	–	–	–	–	–	–	–	+

these taxa collected from various localities is listed in *Table – III*. An account of distinctly recognized taxa of mosses has been provided from the Pachmarhi Biosphere Reserve for the first time.

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पचमढी जीवमंडल रिजर्व (मध्य प्रदेश), भारत के कुल ब्राएसी (ब्रायोप्सिडा) का टैक्सोनो. मिक मूल्यांकण

वीरेन्द्र नाथ एवं रीसा गुप्ता

सार संक्षेप

800–1060 मीटर तुंगता के मध्य पचमढी जीवमंडल रिजर्व (पी.बी.आर.) के विभिन्न प्राकृतवास में उगने वाले ब्राएसी के नौ टैक्सा : *एनोमोब्रियम ऑरेटम, ब्रेकिमेनियम एक्युमिनेटम, ब्रेकिमेनियम टाइकोथेसियम, ब्रायम अर्जेण्शियम, ब्रायम सेस्पिटिसिअम, ब्रायम केपिलेयर, ब्रायम कोरोनेटम, ब्रायम पेरेडोक्सम प्रभेद रिफ्लोक्सिफोलियम* एवं *पोहलिया फ्लेक्जुओसा* के मूल्यांकण किए गए। इन काई का पचमढ़ी जीवमंडल रिजर्व से पहली बार रिपोर्ट हो रहा है।