

Studies on the bryoflora of Achanakmar Wildlife Sanctuary, Chhattisgarh, India

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ABSTRACT

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Bryophytes of the Achanakmar Wildlife Sanctuary, the core zone of Achanakmar-Amarkantak Biosphere Reserve, have been enumerated for the first time. The study has revealed occurrence of 34 species belonging to 24 genera and 15 families. Of these, 9 species belong to 8 genera and 5 families of liverworts, 2 species belong to 1 genus and 1 family of hornworts and 23 species belong to 15 genera and 9 families of mosses. Hypnaceae being the largest family is represented by 5 genera followed by Pottiaceae and Aytoniaceae with 3 genera each.

Key-words: Bryophytes, Achanakmar Wildlife Sanctuary, central India.

INTRODUCTION

Achanakmar Wildlife Sanctuary, established in 1975, forms the core zone of Achanakmar-Amarkantak Biosphere Reserve. The Sanctuary lies between 22°23' and 22°35'N latitudes and 81°34' and 81°55'E longitudes, in the lap of Maikal ranges in the north-west block of Bilaspur forest division in Chhattisgarh State. It occupies a southern position to that of Amarkantak plateau which is a natural heritage area of national and international importance, between altitudes of 274.3 to 1048m above mean sea level and covers an area of 551.55 km². The vegetation of the area ranges from tropical moist deciduous to tropical dry deciduous forest. The area is mainly covered by Sal forest along with *Terminalia tomentosa* (Roxb.) Wight & Arn., *Pterocarpus marsupium* Roxb., *Dendrocalamus strictus* (Roxb.) Nees, etc. The Sanctuary is drained by Maniyari River, which is a part of Mahanadi. The area is 70% hilly and 30% plain, with about 90% of total population as tribals. The Sanctuary is also proud home to large mammals, like bison, tiger, leopard, langoor, gaur, chital, panther, striped hyena, sloth bear, sambar deer, nilgai, 4-horned antelope, chinkara and dhole (wild dog).

As far as the knowledge about bryoflora of central India is concerned, some valuable contributions are available on Pachmarhi region (Pande & Srivastava 1952, Udar & Srivastava 1973, Jain & Kaul 1985, Patidar et al. 1985, Kaul et al. 1995a, 1995b, Kaul 2001, Srivastava & Sharma 2001, Singh & Kaul 2002). Lal and Parihar (1979) and Nath et al. (2007a) have worked out the diversity of Bryophytes in Amarkantak area. In earlier communications, Nath et al. (2005, 2007b) described the genera *Fissidens* Hedw. and *Entodontopsis* Broth., respectively from the study area. The present study provides the overall bryophyte diversity within the sanctuary with an account of 34 species belonging to 24 genera and 15 families.

The families of liverworts and hornworts have been arranged after Schuster (1984) and those of mosses after Vitt (1984) classification, followed by alphabetical arrangement of genera and species.

CLASS: HEPATICAE (LIVERWORTS)

Order: Jungermanniales

I. Family—Jungermanniaceae Reichenb., Bot. Damen 256. 1828.

1. *Jungermannia humilis* Kashyap, Liverw. W.

Himalaya and Punjab Pl. 2: 88. Tab. 25; f. 5-7, 1932.

Habitat and distribution: Plants growing on soil, as well as on tree bark, at 5 km before Chaparwa on Amarkantak road, altitude ca 473 m.

Range of distribution: India: central India–Madhya Pradesh (Amarkantak–Shambhoodhara, Kapildhara, Pachmarhi), Punjab (Amritsar), West Rajasthan plain, western Himalaya. Pakistan.

Specimens examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226101, 226112 (LWG).

II. Family–Lejeuneaceae Casares-G. I, Fl. iber. briof. 1: 703.1919

2. *Cololejeunea latilobula* (Herzog) Tixier, Bryophyt. Biblioth. 27:156. 1985.

Habitat and distribution: Plants grow on tree bark, at 13 km before Kewanchi towards Amarkantak, altitude ca 485 m.

Range of distribution: India: central India–Madhya Pradesh (Pachmarhi), eastern Himalaya–Manipur, Meghalaya, South India–Karnataka, Kerala, Tamil Nadu (Kodaikanal), western Himalaya–Uttarakhand (Nainital). China, Malawi (Nyasaland), Myanmar, Nigeria, Reunion, Tanzania, Uganda, Vietnam.

Specimen examined: India, central India: 13 km before Kewanchi towards Amarkantak, 22.3.2004, leg. A. K. Asthana and party, 226197 (LWG).

3. *Lopholejeunea sikkimensis* Steph., Sp. Hepat. 5: 87. 1912.

Habitat and distribution: Plants were found growing on tree bark as well as on rocks, at Jalda, 13 km before Kewanchi towards Amarkantak, altitude ca 458-485 m.

Range of distribution: India: central India–Madhya Pradesh (Amarkantak–Sonmuda, Mai ki Bagia, Pachmarhi), eastern Himalaya–Assam, Manipur, Meghalaya (Cherrapunji, Shillong), Sikkim, West Bengal (Darjeeling, Ghum, Manebhanjang, Tiger hill), South India - Karnataka, Kerala, Tamil Nadu, western Himalaya–Uttarakhand (Almora). Bhutan and Nepal.

Specimens examined: India, central India: Jalda,

20.3.2004, leg. A. K. Asthana and party, 226160, 226163, 226164 (LWG); 13 km before Kewanchi towards Amarkantak, 22.3.2004, 226198, 226206 (LWG).

Order: Marchantiales

III. Family–Aytoniaceae Cavers, New Phytol. 10: 42. 1911.

4. *Asterella wallichiana* (Lehm. et Lindenb.) Pande et al. ex Grolle, Ergebnisse der Forschungs-Unternehmen, Nepal Himalaya 1(4): 262. 1966.

Habitat and distribution: Plants growing on soil, rocks, at 5 km before Chaparwa on Amarkantak road, Gabhighat, altitude ca 473-488 m.

Range of distribution: India: central India–Madhya Pradesh (Amarkantak–Sonmuda, Jaleshwar, Pachmarhi), Rajasthan–Mt. Abu, Gangetic plain–Uttar Pradesh (Pratapgarh), eastern Himalaya–Meghalaya (Cherrapunji), West Bengal (Darjeeling), western Himalaya–Himachal Pradesh (Dalhousie, Shimla), Uttarakhand (Mussoorie, Pithoragarh, Ranikhet), South India–Maharashtra (Bhor Ghat, Khandala, Lonavala, Panchgani), Tamil Nadu (Kotagiri), western Ghats, Bhutan, Myanmar and Nepal.

Specimens examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226138, 226139 (LWG); Gabhighat, 20.3.2004, 226154 (LWG).

5. *Plagiochasma appendiculatum* Lehm. et Lindenb. Nov. stirp. pug. 4:14. 1832.

Habitat and distribution: Plants were found growing on rocks as well as on soil, at 5 km before Chaparwa on Amarkantak road, 5 km away from Chaparwa on Kota road, 13 km before Kewanchi towards Amarkantak, altitude ca 436-485 m.

Range of distribution: India: central India–Madhya Pradesh (Amarkantak–Doodhdhara, Pachmarhi, Shambhoodhara), Rajasthan (Mt. Abu), eastern Himalaya–Assam, Sikkim, West Bengal (Darjeeling), Punjab (Pathankot), Gangetic plains–Uttar Pradesh (Saharanpur), Maharashtra (Nagpur), South India–Tamil Nadu (Nilgiris), western Himalaya–Uttarakhand (Dehradun, Garhwal, Haridwar, Kumaon, Mussoorie, Nainital), Himachal Pradesh (Kangra, Kulu,

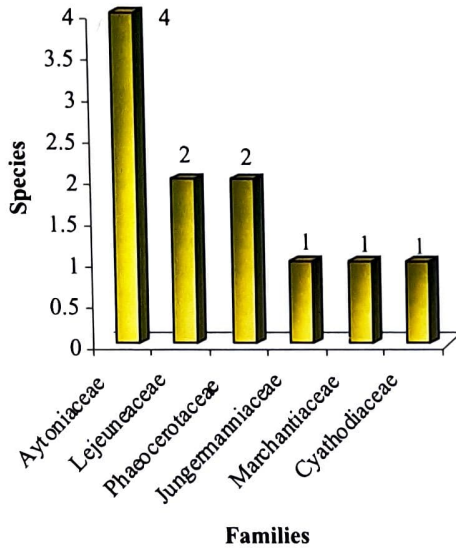
Patni pass, Shimla). Afghanistan, Africa, Celebes, China, Europe, Kenya, Myanmar, Nepal, Pakistan, Philippines, Rhodesia, Socotra, Taiwan, Vietnam, Yemen.

Specimens examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226115, 226144 (LWG); 5 km away from Chaparwa on Kota road, 21.3.2004, 226182 (LWG); 13 km before Kewanchi towards Amarkantak, 22.3.2004, 226201, 226204, 226208, 226211 (LWG).

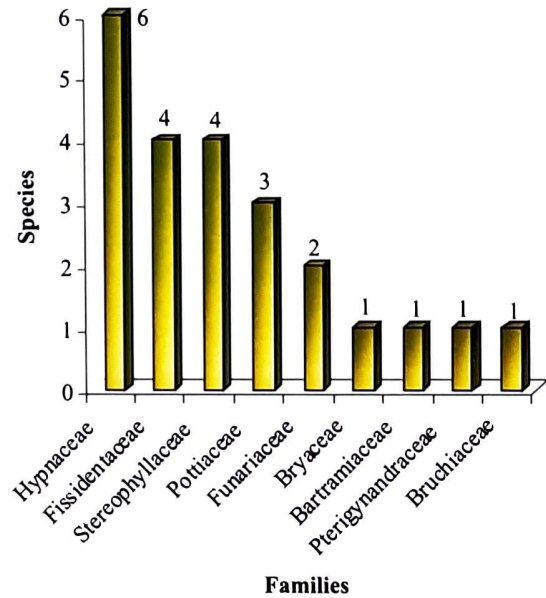
6. *Plagiochasma pterospermum* C. Massal., Mem. Acad. Agric Verona 73: 46. 1847; *Plagiochasma articulatum* Kashyap, New Phytol. 13: 320. 1914.

Habitat and distribution: Plants growing on soil, 5 km before Chaparwa on Amarkantak road, altitude ca 473 m.

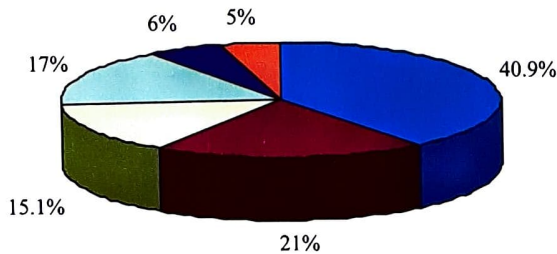
Range of distribution: India: central India-Rajasthan (Mt. Abu), eastern Himalaya, Punjab & West



Text-figure 1. Showing distribution of liverwort and hornwort families in Achanakmar Sanctuary

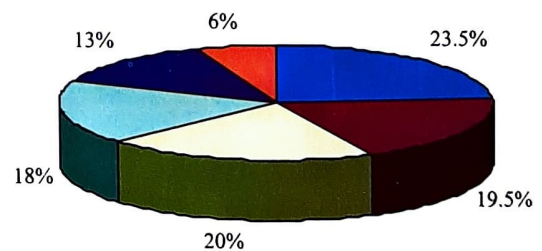


Text-figure 2. Showing distribution of moss families in Achanakmar Sanctuary



- Terricolous
- Saxicolous
- Corticolous
- Terricolous+Saxicolous
- Corticolous+Terricolous
- Corticolous+Saxicolous

Text-figure 3. Showing habitat dominance in Achanakmar Sanctuary



- Eastern Himalaya
- Central India
- Western Himalaya
- South India
- Gangetic plain
- Punjab & Rajasthan plain

Text-figure 4. Showing similarity of taxa of Achanakmar Sanctuary with other Indian biogeographical regions

Rajasthan plain-Rajasthan, South India-Tamil Nadu (Ootacamund, Nilgiris), Maharashtra (Bombay, Panchgani), western Himalaya-Kumaon Himalaya, Jammu & Kashmir (Leh). Nepal and Pakistan.

Specimens examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226126, 226141 (LWG).

7. *Reboulia hemisphaerica* (L.) Raddi., Opusc. Sci. 2: 357. 1818.

Habitat and distribution: Plants growing on soil, rocks as well as on wall of temple, at 5 km before Chaparwa on Amarkantak road, altitude ca 473 m.

Range of distribution: India: central India-Madhya Pradesh (Amarkantak- Kapildhara, Doodhdhara, Pachmarhi, Shambhoodhara), Rajasthan (Mt. Abu), eastern Himalaya-West Bengal (Darjeeling, Kurseong), Meghalaya (Khasi hills), Gangetic plains-Uttar Pradesh (Sidpur, Modinagar), South India-Karnataka (N. Kanara), Tamil Nadu (Iyenagar, Palni hills, Nagapatam, Nilgiri hills), western Himalaya-Himachal Pradesh (Shimla, Dalhousie, Pangi, Kulu, Spiti, Lahul, Kyelong), Jammu & Kashmir (Kashmir, Poonch), Uttarakhand (Mussoorie). Afghanistan, Australia, Borneo, Caucasus, China, Europe, Japan, Java, Korea, Mexico, Nepal, New Zealand, Pakistan (Kaghan valley), S. America, Sumatra, Tahiti, Taiwan, and W. Indies.

Specimens examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226110, 226111, 226113 (LWG).

IV. Family-Marchantiaceae (Bisch.) Lindl., Nat. Syst. Bot. ed 2: 24, 412. 1836.

8. *Marchantia linearis* Lehm. et Lindenb., Lehm., Pug. 4: 8. Nov. stirp. pug. 1832.

Habitat and distribution: Plants were found growing on rocks as well as on soil, at Jalda, altitude ca 458 m.

Range of distribution: India: eastern Himalaya-Assam, Meghalaya (Khasi hills), Sikkim, West Bengal (Darjeeling, Bengal), Nepal, Malacca and Sri Lanka.

Specimens examined: India, central India: Jalda, 20.3.2004, leg. A. K. Asthana and party, 226161,

226167, 226168, 226170 (LWG).

V. Family-Cyathodiaceae Grolle, J. Bryol. 7: 208. 1972.

9. *Cyathodium cavernarum* Kunze in Lehm., Pugillus 6: 17. 1844.

Habitat and distribution: Plants growing on rocks as well as on soil, Gabhighat, altitude ca 488 m.

Range of distribution: India: central India - Gujarat (Baroda), Madhya Pradesh (Pachmarhi, Amarkantak), eastern Himalaya - Assam, Meghalaya (Shillong, Khasi & Jaintia hills), West Bengal (Darjeeling), Gangetic plains-Uttar Pradesh (Pratapgarh, Varanasi, Lucknow, Bareilly), Punjab & West Rajasthan plain-Rajasthan, South India-Maharashtra (Bombay, Khandala, Mahabaleshwar, Malabar hills, Panchgani), western Himalaya-Uttarakhand (Dehradun, Gumkhal, Karn Prayag, Mussoorie, Satkuli). Java, Myanmar, Africa, Mexico, America and Cuba.

Specimen examined: India, central India: Gabhighat, 19.3.2004, leg. A. K. Asthana and party, 226157 (LWG).

CLASS: ANTHOCEROTAE (HORNWORTS)

Order: Anthocerotales

I. Family-Phaeocerotaceae Bharadwaj in Recent Advances in Cryptogamic Botany: 149. 1981.

10. *Phaeoceros laevis* (L.) Prosk. in Bull. Torrey Bot. Club 78: 347. 1951.

Basionym: *Anthoceros laevis* L., Sp. pl. 1139. 1753.

Habitat and distribution: Plants grow on soil, at 5 km before Chaparwa on Amarkantak road, 5 km away from Chaparwa on Kota road, 13 km before Kewanchi towards Amarkantak, altitude ca 436-485 m.

Range of distribution: India: Eastern Himalaya-Arunachal Pradesh (Shergaon), Assam (Guwahati, Dibrugarh), Manipur (Ukhrul), Sikkim (Gangtok, Nathula road), Meghalaya (Cherrapunji), West Bengal (Darjeeling, Mongpo), Maharashtra (Mahabaleshwar), south India-Karnataka (Mysore), Kerala (Devicolum, Mukurty, Vagavurrai), Tamil Nadu (Ooty, Kodaikanal,

Shembaganur), western Himalaya-Himachal Pradesh (Shimla), Uttarakhand (Pauri, Mussoorie, Company garden). Britain, Bonin, China, Coimbra, Europe, Nepal, Pakistan, Pompeii, Taiwan, Japan, Liukiu, N. America.

Specimens examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226104 (LWG); 5 km away from Chaparwa on Kota road, 21.3.2004, 226185, 226186 (LWG); 13 km before Kewanchi towards Amarkantak, 22.3.2004, 226201 (LWG).

11. *P. laevis* (L.) Prosk. subsp. *carolinianus* (Michx.) Prosk., Rapp. et Comm. VIII. Congr. Intern. Bot., Paris 14–16: 69, 1954.

Habitat and distribution: Plants were found growing on soil as well as on rocks, at 5 km before Chaparwa on Amarkantak road, 13 km before Kewanchi towards Amarkantak, altitude ca 473–485 m.

Range of distribution: India: central India-Madhya Pradesh (Pachmarhi), Rajasthan (Mt. Abu), eastern Himalaya–Sikkim (Gangtok), Manipur, West Bengal (Darjeeling, Teesta valley), Maharashtra (Nagar road), South India–Tamil Nadu (Kodaikanal), western Himalaya-Uttarakhand (Mussoorie, Kausani, Baijnath, Putlikuhl). Japan, N. America, Bhutan, Nepal, Sri Lanka, Africa and Europe.

Specimens examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226102, 226117, 226118, 226120, 226134 (LWG); 13 km before Kewanchi towards Amarkantak, 21.3.2004, 226210 (LWG).

CLASS: MUSCI (MOSESSES)

Order: Bryales

I. Family– Funariaceae Schwaegr. in Willd., Sp. Pl. ed.4.5(2): 43, 1830.

12. *Physcomitrium japonicum* (Hedw.) Mitt. in Trans. Linn. Soc. Bot. Lond. Ser. 2, 3: 164, 1891.

Habitat and distribution: Plants grow on soil covered rocks as well as on soil near river bank in association with *Phaeoceros laevis* (L.) subsp. *laevis* Prosk., at 5 km before Chaparwa on Amarkantak

road, altitude ca 473 m.

Range of distribution: India: central India-Rajasthan (Mt. Abu), eastern Himalaya- Assam, Sikkim, West Bengal (Darjeeling), Gangetic plains-Uttar Pradesh (Gorakhpur), western Himalaya-Uttarakhand (Mussoorie). Bhutan, China (Yunnan, Taiwan), Japan, Korea and Sri Lanka.

Specimens examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226122 (LWG), 226134 (LWG).

13. *Physcomitrium pulchellum* (Griff.) Mitt. in J. Proc. Linn. Soc. Bot. Suppl. 1: 54. 1859.

Basionym: *Gymnostomum pulchellum* Griff. in Cal. J. Nat. Hist., 2: 478, 1842.

Habitat and distribution: Plants grow on soil, at 5 km before Chaparwa on Amarkantak road, altitude ca 473 m.

Range of distribution: Eastern Himalaya-Arunachal Pradesh, Assam, Sikkim, Gangetic plains.

Specimen examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226116 (LWG).

II. Family– Bryaceae Schwaegr. in Willd., Sp. Pl. ed.4.5(2): 47, 1830.

14. *Brachymenium exile* (Doz. et Molk.) Bosch et Sande Lac. in Bryol. Jav., 1: 139, 1860.

Basionym: *Bryum exile* Doz. et Molk. in Ann. Sci. Nat. Bot., Ser. 3, 2:300, 1844.

Habitat and distribution: Plants grow on rocks as well as on soil, at Ataria, altitude ca 515 m.

Range of distribution: India: central India-Madhya Pradesh (Pachmarhi), Orissa, Rajasthan (Mt. Abu), eastern Himalaya - Arunachal Pradesh, Assam, Manipur, Nagaland (Naga Hills), Sikkim, West Bengal (Darjeeling), Gangetic plains - Delhi, Maharashtra (Khandala), south India-Tamil Nadu (Perumalmalai hills, Ootacamund), Andaman Islands, western Himalaya-Uttarakhand (Mussoorie, Almora, Ranikhet). China, East Nepal, Hawaii, Indonesia, Japan, Java, Korea, Mangolia, Malaya, Pacific Ocean Islands, Philippines, Rjukiui, Sri Lanka, Sumatra, Taiwan, Tonkin.

Specimen examined: India, central India: Ataria, 22.3.2004, leg. A. K. Asthana and party, 226216 (LWG).

III. Family-Bartramiaceae Schwaegr. in Willd., Sp. Pl. ed.4.5(2): 90, 1830.

15. *Philonotis turneriana* (Schwaegr.) Mitt. in Musci. Ind. Or.: 62, 1859.

Habitat and distribution: Plants grow on soil or on soil covered rocks, in pure populations but sometimes in association with *Asterella wallichiana*, *Fissidens taxifolius*, *F. subpulchellus* Norkett, at 5 km before Chaparwa on Amarkantak road, 5 km away from Chaparwa on Kota road, altitude ca 436-473 m.

Range of distribution: India: Eastern Himalaya-Meghalaya (Khasi hills), Sikkim, West Bengal (Darjeeling), western Himalaya-Kashmir, Himachal Pradesh (Shimla), Uttarakhand (Mussoorie, Garhwal, Kumaon, Jaunsar). Bhutan, China (Yunnan, Szetschwan, Taiwan, Kiangshu), Hawaii, Hong Kong; Indonesia, Japan, Java, Myanmar, Philippines, Sandwich Island, Sri Lanka and Sumatra.

Specimens examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226129, 226131, 226139, 226142 (LWG); 5 km away from Chaparwa on Kota road, 21.3.2004, 226177, 226180 (LWG).

Other specimen examined: E. Nepal, Tamrang Khola, 21.11.1961, leg. A. H. Norkett, 000844318 (BM), det. H. Ochi.

IV. Family-Pterigynandraceae Schimp., Syn. Musc. Eur. ed. 2, c XIII, 618, 1876.

16. *Trachyphyllum inflexum* (Harv. in W. J. Hooker) Gepp. in Hiern.: Cat. Welw. Afr. Pl., 2 (2): 299, 1901.

Basionym: *Hypnum inflexum* Harv. Icones Plantarum 1: 24f, 6. 1836.

Habitat and distribution: Plants grow on tree bark rarely on rocks, at 5 km before Chaparwa on Amarkantak road, Gabhighat, Jalda, 5 km away from Chaparwa on Kota road, 13 kms before Kewanchi towards Amarkantak, Ataria, altitude ca 436-515 m.

Range of distribution: India: central India--Madhya Pradesh (Pachmarhi), Orissa, eastern

Himalaya- Meghalaya (Khasi hills), Sikkim, West Bengal (Darjeeling), south India- Karnataka (Kanara), Tamil Nadu (Palni hills-Palamalai, Mundathurai). Australia, Bangladesh, Cambodia, China, E. Nepal, Java, Madagascar, Malacca, Moluccas, Myanmar, New Caledonia, Philippines, Sri Lanka and Thailand.

Specimens examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226107, 226143 (LWG); Gabhighat, 20.3.2004, 226159 (LWG); Jalda, 226162 (LWG); 5 km away from Chaparwa on Kota road, 21.3.2004, 226173, 226174, 226175, 226184 (LWG); 13 km before Kewanchi towards Amarkantak, 22.3.2004, 226206 (LWG); Ataria, 226213 (LWG).

Other specimen examined: Thailand, Udawn sandstonemassive Phu (Mt.) Krading, 17. 1. 1966, leg. A. Touw, 000844300 (BM), det. W. R. Buck.

V. Family-Stereophyllaceae (Fleisch.) Buck & Ireland, Nova Hedwigia 41: 95, 1985.

17. *Entodontopsis anceps* (Bosch. & Sande Lac.) Buck & Ireland, Nova Hedwigia 41: 103. 1985.

Basionym: *Stereophyllum anceps* (Bosch & Sande Lac.) Broth. in Nat. Pfl., 1 (3): 898, 1907; Gangulee, in Moss. E. Ind. and adjacent regions, 8: 1821, 1978.

Habitat and distribution: Plants grow on tree bark, at Gabhighat, Chaparwa Tiger Resort Campus, altitude ca 460-488 m.

Range of distribution: India: central India-Gujarat (Girnar hills), eastern Himalaya-Assam. Gangetic plains - Jharkhand (Chhotanagpur), South India-Karnataka (Kanara), Kerala (Cochin). Maharashtra (Mahabaleshwar). Bangladesh, China, Indonesia, Java, Mismari, Philippines, Sri Lanka, Thailand, Vietnam.

Specimens examined: India, central India: Gabhighat, 20.3.2004, leg. A. K. Asthana and party, 226150 (LWG); Chaparwa Tiger Resort Campus, 22.3.2004, 226192 (LWG).

Other specimen examined: Thailand, Payap (limestone massive Doi (Mt.) Chieng Dao hill), 6.12.1965, leg. A. Touw, 000844298 (BM).

18. *Entodontopsis leucostega* (Brid.) Buck &

Ireland, *Nova Hedwigia* 41: 103-104. 1985.

Habitat and distribution: Plants grow on tree bark and soil, at Gabhighat, 13 km before Kewanchi towards Amarkantak, altitude 485-488 m.

Range of distribution: India: central India – Gujarat (Girnar hills), Madhya Pradesh (Pachmarhi), western Himalaya-Uttarakhand (Kumaon). E. Nepal.

Specimens examined: India, central India: Gabhighat, 20.3.2004, leg. A. K. Asthana and party, 226146 (LWG); 13 km before Kewanchi towards Amarkantak, 22.3.2004, 226212 (LWG).

19. *Entodontopsis nitens* (Mitt.) Buck & Ireland, *Nova Hedwigia* 41: 104, 1985.

Habitat and distribution: Plants grow on tree bark, at Gabhighat, Jalda, Chaparwa Tiger Resort Campus, altitude ca 458-460 m.

Range of distribution: India: central India–Gujarat (Girnar hills), Madhya Pradesh (Pachmarhi), Gangetic plain-Jharkhand (Chhotanagpur), South India–Maharashtra (Pune), Kerala (Kanan Deva hills), Tamil Nadu (Botampalli, Palni hills), western Ghats, Punjab and West Rajasthan plains.

Specimens examined: India: central India: Gabhighat, 20.3.2004, leg. A. K. Asthana and party, 226152, 226153, 226155 (LWG); Jalda, 226165 (LWG); Chaparwa Tiger Resort Campus, 22.3.2004, 226193, 226194 (LWG).

20. *Entodontopsis tavoyensis* (Hook.) Buck & Ireland, *Nova Hedwigia* 41: 104, 1985.

Synonym: *Stereophyllum tavoyense* (Hook.) Jaeg. in Ber. S. Gall. Naturw. Ges. 1877–78: 279, 1880.

Habitat and distribution: Plants grow on tree bark, at Gabhighat, altitude ca 488 m.

Range of distribution: India : Gangetic plains–Bihar, Maharashtra (Khandala, Mahabaleshwar), South India-Tamil Nadu (Botampalli, Palni hills), western Himalaya-Uttarakhand (Dehradun). Bangladesh, E. Nepal, Moulmein, Penang, Tavoy.

Specimen examined: India, central India: Gabhighat, 20.3.2004, leg. A. K. Asthana and party, 226145 (LWG).

VI. Family-Hypnaceae Schimp., Coroll. Bryol. Eur. 113, 1855 (1856).

21. *Ectropothecium dealbatum* (Reinwardt & Hornschuch) Jaeg. in Ber. S. Gall. Naturw. Ges., 1977–78: 264, 1880.

Basionym: *Hypnum dealbatum* Reinwardt & Hornschuch in Nov. Act. Ac. Car. Leop. Caes., 14 (2): 729, 1829.

Habitat and distribution: Plants grow on soil and rocks near water stream; 5 km away from Chaparwa on kota road, 13 km before Kewanchi towards Amarkantak, altitude ca 436-485m.

Range of distribution: India: eastern Himalaya - Arunachal Pradesh. Borneo, Java, Philippines, Sumatra.

Specimens examined: India, central India: 5 km away from Chaparwa on Kota road, 21.3.2004, leg. A. K. Asthana and party, 226181, 226183 (LWG); 13 km before Kewanchi towards Amarkantak, 22.3.2004, 226211 (LWG).

Other specimen examined: Borneo Is., Tasik Laman City Park, Bandar Seri Bagawan, 6.12.1995, leg. B. C. Tan, 000844307 (BM), det. B. C. Tan.

22. *Hypnum aduncooides* (Brid.) C. Muell., Syn., 2: 295, 1851.

Habitat and distribution: On soil, 13 km before Kewanchi towards Amarkantak, altitude ca 485 m.

Range of distribution: India: central India–Amarkantak, eastern Himalaya - Assam, Darjeeling. China (Yunnan), Madagascar, Myanmar, S. Africa.

Specimen examined: India, central India: 13 km before Kewanchi towards Amarkantak, 22.3.2004, leg. A. K. Asthana & party, 226203 (LWG).

23. *Isopterygium lignicola* (Mitt.) Jaeg. in Ber. S. Gall. Naturw. Ges., 1876–77: 432.1878; Gangulee, in Moss. E. Ind. and adjacent regions, 8: 1964. 1978.

Basionym: *Hypnum lignicola* Mitt. in Kew J. Bot., 8: 355, 1856.

Habitat and distribution: Plants grow on soil, at Jalda, 5 km away from Chaparwa on kota road, altitude ca 436-458m.

Range of distribution: India: eastern Himalaya - Assam, Sikkim, South India-Karnataka (Coorg).

Myanmar and Sri Lanka.

Specimens examined: India, central India: Jalda, 20.3.2004, leg. A. K. Asthana and party, 226166 (LWG); 5 km away from Chaparwa on Kota road, 21.3.2004, 226182 (LWG).

24. *Pseudotaxiphyllum elegans* (Brid.) Iwats., Journ. Hattori Bot. Lab. 63: 449. 1987.

Basionym: *Isopterygium elegans* (Brid.) Lindb. in Not. Saellsk. F. Fl. Fenn. Foerh. 13: 416. 1874; Gangulee, in Moss. E. Ind. and adjacent regions, 8: 1957. 1978.

Habitat and distribution: Plants grow on tree bark, rocks, soil and on soil covered rocks, at 5 km before Chaparwa on Amarkantak road, Jalda, 5 km away from Chaparwa on Kota road, altitude ca 436-458 m.

Range of distribution: India: eastern Himalaya, western Himalaya–Shimla. Europe, Japan, Nepal, N. America and United Kingdom.

Specimens examined: India, central India, 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226114, 226133 (LWG); Jalda, 20.3.2004, 226169 (LWG), 5 km away from Chaparwa on Kota road, 21.3.2004, 226171, 226176 (LWG).

Other specimen examined: Poland, Silesian Upland, Rybruk Plateau 'Glebokie Doly', 25.4.1998, leg. A. Stebel, 000844311 (BM).

25. *Taxiphyllum maniae* (Ren. & Par.) Fleisch. in Musci. Fl. Buitnz., 4: 1436. 1923; Gangulee, in Moss. E. Ind. and adjacent regions, 8: 1947-1948, 1978.

Basionym: *Isopterygium maniae* Ren. & Par. in Rev. Bryol., 29: 84, 1902.

Habitat and distribution: Plants grow on soil, at 13 km before Kewanchi towards Amarkantak, altitude ca 485 m.

Range of distribution: India: south India-Nicobar Island, western Himalaya-Uttarakhand (Mussoorie). Java, Madagascar, Nepal and New Guinea.

Specimen examined: India, central India: 13 km before Kewanchi towards Amarkantak, 22.3.2004, leg.

A. K. Asthana and party, 226202 (LWG).

26. *Taxiphyllum taxirameum* (Mitt.) Fleisch. in Musci Fl. Buitenz., 4: 1435. 1923; Gangulee, in Moss. E. Ind. and adjacent regions, 8: 1945, 1978.

Habitat and distribution: Plants grow on soil, at 5 km away from Chaparwa on Kota road, altitude ca 436 m.

Range of distribution: India: central India–Orissa, eastern Himalaya–Arunachal Pradesh, Assam, Meghalaya (Khasi hills), Sikkim, West Bengal (Darjeeling), south India–Tamil Nadu (Palni hills, Kodaikanal, Periyar), Karnataka (Coorg), western Himalaya–Himachal Pradesh (Shimla), Uttarakhand (Garhwal, Nainital, Ranikhet, Almora, Mussoorie). Australia, Bangladesh, Bhutan, Indonesia, Japan, Java, Korea, Myanmar, Nepal, New Guinea, N. Vietnam, Oceania, Phillipines, Siberia, Sri Lanka, Sumatra, Taiwan, Tonkin and Yunnan.

Specimen examined: India, central India: 5 km away from Chaparwa on Kota road, 21.3.2004, leg. A. K. Asthana and party, 226179 (LWG).

VII. Family–Pottiaceae Schimp., Coroll. Bryol. Eur. 24, 1855, 1856.

27. *Hydrogonium arcuatum* (Griff.) Wijk. & Marg. in Taxon, 7: 289. 1958; Chen in Hedwigia, 80: 234. 1941; Gangulee, in Moss. E. Ind. and adjacent regions, 3: 725. 1972.

Habitat and distribution: Plants grow on soil, at 5 km before Chaparwa on Amarkantak road, Achanakmar sanctuary border on the way to Kota, altitude ca 445-473 m.

Range of distribution: India: central India-Orissa, Rajasthan (Mt. Abu), eastern Himalaya- Arunachal Pradesh, Assam, Meghalaya (Khasi hills), Sikkim, West Bengal (Darjeeling, Kolkata, lower Bengal, Lateritic west Bengal), Gangetic plains, Gangetic plain-upper, south India-Maharashtra (Khandala), western Himalaya-Kashmir, Uttarakhand (Garhwal). China, E. Nepal, Japan, Java, Malaya, Molucca, New Guinea, North and South Myanmar, Oceania, Philippines and Singapore.

Specimens examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg.

A. K. Asthana and party, 226125 (LWG).

28. *Hyophila nymaniana* (Fleisch.) Menzel, 22: 198. 1992; Zander, Bull. Buffalo Soc. Nat. Sc., 32, 174. 1993; Nair M. C., et al., Moss. Waynad in W. Ghats, 117. 2005.

Habitat and distribution: Plants growing on rocks as well as on soil, at 5 km before Chaparwa on Amarkantak road, Gabhighat, Ataria, altitude ca 473-515 m.

Range of distribution: India: central India - Gujarat, Pachmarhi, Orissa, south India-Palni, Travancore, western Himalaya-Garhwal, Kumaon, Philippines.

Specimens examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226125 (LWG); Gabhighat, 20.3.2004, 226149 226155 (LWG); Ataria, 22.3.2004, 226215 (LWG).

29. *Semibarbula ranuii* Gangulee in *Nova Hedwigia*, 8: 149, 1964.

Habitat and distribution: Plants growing on rock in association with *Reboulia hemisphaerica*, at 5 km before Chaparwa on Amarkantak road, altitude ca 473m.

Range of distribution: India: central India, Gangetic plain- Jharkhand (Chhotanagpur), Eastern Himalaya-Assam, West Bengal (Kolkata),

Specimen examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226111 (LWG).

VIII. Family- Bruchiaceae Schimp.

30. *Trematodon longicollis* Michx., Fl. Bor. Am. 2: 289. 1803; Gangulee, in Moss. E. Ind. and adjacent regions, 2: 231, 1971.

Habitat and distribution: Plants grow on soil, 5 km before Chaparwa on Amarkantak road, altitude ca 473 m.

Range of distribution: India: central India, eastern Himalaya - Assam, Manipur, Sikkim, Tripura, West Bengal (Darjeeling, North Bengal), Gangetic plains - Jharkhand (Chhotanagpur), south India-Karnataka (Coorg), Tamil Nadu (Palni hills), western Himalaya-

Himachal Pradesh (Narkanda). Bonin, China, Cuba, Eastern United States, Europe, Hawaii, Japan, Korea, Mexico, Myanmar, New Guinea, New Zealand, Philippines, Ryuku, Siberia, S. Africa, S. America, Sri Lanka and Taiwan.

Specimen examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226121 (LWG).

Other specimens examined: Naples, 12.4.1914, leg. H. N. Dixon & W. E. Nicholson, 000844313 (BM).

IX. Family- Fissidentaceae Schimp., Coroll. Bryol. Eur. 20, 1855, 1856.

31. *Fissidens diversifolius* Mitt. in Musc. India Or.: 140, 1959.

Habitat and distribution: Plants grow on rocks near stream or on soil covered rocks, 5 km before from Chaparwa on Amarkantak road, 5 km away from Chaparwa on Kota road, altitude ca 436-473 m.

Range of distribution: India: central India-Orissa, eastern Himalaya - Arunachal Pradesh, Assam, Gangetic plains-Bihar, Punjab and West Rajasthan plains, south India-Tamil Nadu (Nilgiri hills), western Himalaya-Himachal Pradesh (Shimla), Uttarakhand (Mussoorie). Bhutan, China, East Nepal, Japan, Malaysia, Myanmar, Pakistan and Sri Lanka.

Specimens examined: India, central India: 5 km before from Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226119, 226137, 226140 (LWG); 5 km away from Chaparwa on Kota road, 21.3.2004, 226182, 226188 (LWG).

32. *F. involutus* Mitt. ssp. *curvato-involutus* (Dix.) Gangulee, in Mosses of Eastern India and Adjacent Region 2: 548-549. 1971.

Basionym: *Fissidens curvato-involutus* Dix. in Not. R. Bot. Gard. Edinb., 19: 279. 1938.

Habitat and distribution: Plants grow on tree bark as well as on soil, 5 km before Chaparwa on Amarkantak road, Gabhighat, altitude ca 473-488 m.

Range of distribution: India: central India-Chhattisgarh (Bastar), Gangetic plains-Haryana (Pinjore, Kalka), Uttar Pradesh (Saharanpur), North-

West Himalaya, Punjab and West Rajasthan plains, western Himalaya-Uttarakhand (Dehradun). Myanmar, Thailand and Vietnam.

Specimen examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226101, 226108, 226124 (LWG); Gabhighat, 20.3.2004, 226147 (LWG).

33. *F. subpulchellus* Norkett in *Gangulee in Mosses of Eastern India and Adjacent Regions* 2:521-523. 1971.

Habitat and distribution: Plants grows on bark of tree, on soil covered rocks as well as on rocks, at 5 km before Chaparwa from Amarkantak road, Gabhighat, altitude ca 473-488 m.

Range of distribution: India: central India-Amarkantak, eastern Himalaya-Arunachal Pradesh.

Specimens examined: India, central India: 5 km before Chaparwa from Amarkantak road, 19.3.2004, leg. A. K. Asthana and party, 226105, 226115, 226127, 226129, 226132 (LWG); Gabhighat, 20.3.2004, 226148, 226158 (LWG).

34. *F. taxifolius* Hedw. Sp. Musc.: 155, 1801.

Habitat and distribution: Plants grow on soil, at 5 km before from Chaparwa on Amarkantak road, 5 km away from Chaparwa on Kota road, altitude ca 436-473 m.

Range of distribution: India: eastern Himalaya-West Bengal (Darjeeling), Meghalaya (Khasi hills), Gangetic plains - Bihar (Rajmahal), western Himalaya - Himachal Pradesh, (Kufri, Shimla, Solan), Jammu & Kashmir (Gulmarg), Uttarakhand (Mussoorie, Nainital, Ranikhet). Azores, Central and South America, East Nepal, Europe, Caucasus, Canary Island, Central Asia, China, Japan, Korea, Ryukus North, Sakhalin, Madeira, North Africa and Persia.

Specimen examined: India, central India: 5 km before Chaparwa on Amarkantak road, 19.3.2004, 226136 (LWG); 5 km away from Chaparwa on Kota road, 21.3.2004, leg. A. K. Asthana and party, 226172, 226177, 226178, 226182, 226188 (LWG).

Other specimen examined: Europe, Western Carpathians, Poland, Beskid Wyspowy Mts, Bialawoda, 25.8. 1997, leg. A. Stebel, 000844316 (BM).

DISCUSSION

The present study revealed the occurrence of 34 species belonging to 24 genera and 15 families. Out of these, 3 species belong to 3 genera and 2 families of order Jungermanniales; 6 species belong to 5 genera distributed in 3 families of order Marchantiales (liverworts); 2 species belong to 1 genus and 1 family of order Anthocerotales (Text-figure 1); 23 species belong to 15 genera and 9 families of order Bryales (Text-figure 2). Maximum distribution of the taxa was found to be in the Chaparwa area while minimum in the Chaparwa Tiger Resort Campus. A critical observation on their habitat diversity indicates that most of the taxa were found to be terricolous, i.e. about 40.9%, followed by 21% saxicolous, 15.1% corticolous, 17% terricolous + saxicolous, 6.0% corticolous + terricolous, 5% corticolous + saxicolous (Text-figure 3). *Fissidens subpulchellus* Norkett was found growing on varied habitats, viz. on rocks, soil as well as on tree bark. Taxa of Achanakmar Wildlife Sanctuary show maximum similarity with that of eastern Himalaya, i.e. 23.5%, followed by western Himalaya, i.e. 20%, central India, i.e. 19.5%, South India, i.e. 18%, 13% of Gangetic plain and 6% with Punjab and Rajasthan plain (Text-figure 4).

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