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Research Article

Bryophyte diversity of Thamarassery pass (Wayanad pass) in the Western Ghats of Kerala

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Abstract

The bryophyte diversity in the Thamarassery pass (Wayanad pass) a historically important place of Kozhikode district is documented. This report represents many interesting finds such as *Taxiphyllum girdalii* (C.Muell.) M.Fleisch., *Taxithelium laeviusculum* Dixon are new records for Peninsular India.

Keywords

Bryophytes; distribution; Thamarassery pass; Western Ghats

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Introduction

Wayanad pass or Thamarassery pass is in the gateway to Wayanad district. Since it takes us to Wayanad, the Ghat is also known as Wayanad Churam. This Ghat road or National Highway (NH 212) connects Calicut (Kozhikode) with Wayanad. It is just a road to Wayanad from Calicut beginning from Adivaram. The Ghat attracts hundreds of travellers every day. Starting from Adivaram and covering a distance of 12 km the Ghat road ends at top view point, Lakkidi. It has 9 sharp curves described as hairpins. Wide variation in the altitude from 1st hairpin to 9th hairpin (86 - 826 m) determines the diversity of the species.

From the base of the pass in Adivaram from the 1st hairpin to 9th one, the species composition varies. The 1st hairpin area is opened with very few trees and higher up to the hairpin the diversity and the altitude increases and it is too cold during the rainy season. After midday and in the evening from 3rd to 9th hairpin it is covered with mist and canopy is closed (Plate 1 and 2). The diverse vegetation and

the altitudinal difference make the place an abode of a variety of Bryophytes and Pteridophytes that we cannot see before and after the pass. All hairpin is with a good flow of water through the rocky patches. The pass also provides a good number of microhabitat which is an abode of several Bryophytes.

List of bryophytes recorded from Wayanad pass

Bryophytes of wayanad pass are represented based on the three divisions of bryophytes, the Marchantiophyta (Liverworts), Anthocerotophyta (Hornworts) and Bryophyta (mosses). The taxa are arranged in alphabetical order. After the scientific name with citation follows the microhabitat, specimen examined (the collection date and herbarium) and distribution.

Division: Marchantiophyta (Liverworts)

Aneura pinguis (L.) Dum. - They are mainly seen on damp places and rock surfaces near streams.



Plate.1 Study area; Macrohabitat. a. f different views of the hairpin area; f. The area were Thamarassery churam ends and Wayanad district begins

Wayanad pass, hairpin point-9 (826 m) 25.1.2015, *Mithun Venugopal* 3875 (ZGC). Is distributed in South India (Tamil Nadu (Shembaganur, Kodaikanal, Kotagiri), Maharashtra (Poona), Kerala (Eravikulam National Park); North-East India (Boshar, Dalhousie, Sahastradhra, Mussoorie, Lahul, Koylang, Punjab, Darjeeling); Sri Lanka, China, Japan, Taiwan, Manchuria, Siberia, Australia, Java, New Zealand, West Indies, N & S. America, Greenland, Europe, Brazil and Africa (Bapna & Kachroo, 1999). From Kerala this species was reported only from Eravikulam National Park (Madhusoodhanan *et.al.*, 2007).

Asterella khasiana (Griff.) Grolle - on land cuttings in shady regions. Kerala, Wayanad pass,

hairpin point- 7 (640 m), 29.11.2014, *Mithun Venugopal*, 15200, (ZGC). It is distributed in Kerala (widely distributed); North-East India (Himalaya, Darjeeling), Nepal and China.

Cyathodium cavernarum Kunze in Lehm. - on concrete blocks, walls, land cuttings and on wet soil. Kerala; Wayanad pass, hairpin point 5 (603 m), 29.11.2014, *Mithun Venugopal* 3851, (ZGC); Hairpin No.4 (480 m) *MCN 120341* (CALI). It is a widely distributed species in the low and medium altitude areas and in some vegetations, it is found in higher altitude areas also. Peninsular India (Kerala, Tamil Nadu, Karnataka, Goa, Gujarat); Central India (Maharashtra, Madhya Pradesh, Rajasthan); North-East India (Uttaranchal, Uttar



Plate 2. Different Hairpin areas on the Ghat area

Pradesh, West Bengal, Arunachal Pradesh, Sikkim, Assam, Meghalaya); Myanmar, Cuba, Africa, Java, Mexico and America.

Dumortiera hirsuta (Sw.) Nees - mostly seen in shady wet areas, on rocks near water courses. Kerala; Wayanad hairpin point - 3 (300m), 13.9.2014, *Mithun Venugopal* (1300) (ZGC). It is also collected from the nearby areas such as Kakkayam, and Vellarimala in Kozhikode and Aralam WLS of Kannur district (Nair *et al.* 2005). Srivastava and Sharma (2000) had reported this species from Silent Valley NP. It has wide

distribution in South India (Tamil Nadu, Karnataka, Kerala), North India (Simla, Mussoorie, Kumaon, Pachmahri), Nepal, Japan, Brazil, Mexico, Jamaica, North & South America, Europe, New Zealand, Hawaii and Africa (Nair *et al.* 2005; Singh & Nath, 2007).

Pallavicinia lyellii (Hook.) S.Gray - on land cuttings and rocky patches where water drips regularly in moist deciduous forests. Wayanad pass, Hairpin No. 7, 8 (450 -560 m) MCN 76096 (CALI). It is distributed in South India (Kerala; Karnataka, Tamil Nadu), North-East India (Assam,

Gauhati, Shillong, Pachmahri), Sri Lanka, Europe, Jamaica, Cuba, Brazil, Java, Singapore, Philippines, Ryukyu, Japan, Moluccas, New Zealand, Africa and America.

Riccardia multifida (L.) S.Gray. - it is present on the buttresses of trees and on rocky patches near streams. Kerala; Wayanad pass, hairpin point-9 (826m) 25.1.2015 *Mithun Venugopal 3876* (ZGC). Srivastava and Sharma (2000) recorded this species from Silent Valley National park. It is distributed in South India (Kerala; Tamil Nadu: Madura, Kodaikanal, Palni hills), North India (Eastern Himalayas, Darjeeling), Sri Lanka, China, North America, Europe, Alaska and Hawaii (Nair *et al.* 2005).

Riccia billardieri Mont.& Nees - on the moist land cuttings. Kerala; Wayanad, hairpin point - 1 (98m), 13.9.2014, *Mithun Venugopal 15199* (ZGC). It is distributed in North east India (Himalayas, Darjeeling); Central India (Rajasthan); South India (Tamil Nadu, Kerala, Karnataka).

Division: Anthocertophyta (Hornworts)

Anthoceros crispulus (Montin) Dowin. - on moist land cuttings. Kerala; Wayanad pass, Hairpin no. 4&5 (400-530 m) *Manju 120363* (CALI). It is distributed in South India (Kerala; Tamil Nadu-Khandala, Kodaikanal, Shembaganur, Perumalmalai, Ooty, Naduvattom); Western Himalayas, Eastern Himalayas; Sri Lanka, Japan, Korea, Malaysia, Europe and United States of America.

Notothylas levieri Schiffn. ex Steph. - Grows in shady rocky patches of semi-evergreen and evergreen forests where water drips regularly along with *Riccardia multifida*. Kerala; Wayanad pass, Hairpin No. 3-5 (420-500 m) *Manju 120342* (CALI). From South India the species was first described from Palakkad of Kerala State by Madhusoodanan and Nair (2003). Nair *et al.* 2005 also reported this species from hair pin area on the way to Wayanad. The species has wide distribution in Northern and Central India (Western Himalaya, Central Himalaya, Mussorie, Simla).

Division: Bryophyta (Musci)

Anomobryum auratum (Mitt.) A.Jaeger - plants grow on moist exposed rocks. Kerala; Wayanad pass, hairpin point-9 (802 m), 25.1.2015, *Mithun Venugopal 3883* (ZGC); Hairpin point (500 m) *Manju 80082* (CALI). It is distributed in South India (Kerala- Eravikulam NP; Chinnar WLS; Karnataka-Mahabaleshwar; Tamil Nadu), North-East India (Darjeeling, Western Himalayas, Kashmir, Meghalaya, Naga hills, Sikkim), Sri Lanka, China, Bhutan, Nepal, Korea, Japan, Phillipines, Tanzania,

Kenya and Madagascar (Gangulee, 1969-80; Nair *et al.* 2005).

Barbula unguiculata Hedw. - on moist rock surface. Kerala; Wayanad Pass, hairpin point-9 (803m), 12.7.2014, *Mithun Venugopal 1215c* (ZGC). It is distributed in India (Kashmir, Uttarakhand), China, Japan, North and South America, Mexico, Europe, Algeria, North West and Central Asia, Australia.

Brachymenium bryoides Hook. ex Schwaegr. - on concrete block. Kerala; Wayanad pass, hairpin point-9 (806 m), 12.07.2014, *Mithun venugopal, 121, (ZGC)*. It is distributed in South India (Nilgiri), North-East India (Darjeeling, Khasia Hills, Western Himalaya (Simla, Almora) and East Nepal.

Bryum coronatum Schwaegr. - on calcareous soils or walls and also on rocks along with *Hyophila involuta*. Kerala; Wayanad pass, hair pin point- 5 (345m), 12.7.2014, *Mithun Venugopal 1292a* (ZGC); Hairpin point (550 m) *Manju 80115b* (CALI). It is commonly found throughout the study area. It is widely distributed in India, China, Borneo, Philippines, Thailand, Bolivia, Peru, Brazil and Mexico.

Bryum paradoxum var. **reflexifolium** (Ochi) Ochi - on moist concrete cuttings and land cuttings. Kerala; Wayanad Pass, Hairpin point- 1 (90 m), 13.9.2014, *Mithun Venugopal 1299* (ZGC). It is distributed in North-East India (Darjeeling, Sikkim), East Nepal, Tokyo.

Bryum wightii Mitt. - near wet areas such as waterfalls, often on moist rocky substratum. Kerala; Wayanad pass, hairpin point-9 (802 m, 806 m), 25.1.2015, *Mithun Venugopal 3885a, 3880, 1219* (ZGC). It is a high altitude species collected from the adjacent areas such as Vellarimala in Kozhikode and Aralam WLS in Kannur districts. It is also distributed in South India (Kerala- Idukki, Thiruvananthapuram; Mahabaleshwar, Nilgiri, Palni, Kodaikanal, Maharashtra).

Chionostomum rostratum (Griff.) C.Muell. - epiphytic; collected from the base of the trees. Kerala; Wayanad pass, hairpin point- 1 (86 m) 3.9.2014, *Mithun Venugopal 1296* (ZGC). It is a South East Asiatic species distributed in North-east India (Darjeeling, Khasia Hills); South India (Coorg), Sri Lanka, Thailand, Northern and Southern Vietnam, Philippines, Taiwan.

Entodon plicatus C.Muell. - on rock surface near stream. Kerala; Wayanad pass, hairpin point-7 (602 m), 25.1.2015, *Mithun Venugopal 3887, (ZGC)*. A Southeast Asiatic species distributed in South India (Tamil Nadu- Nilgiri, Palni, Karnataka-

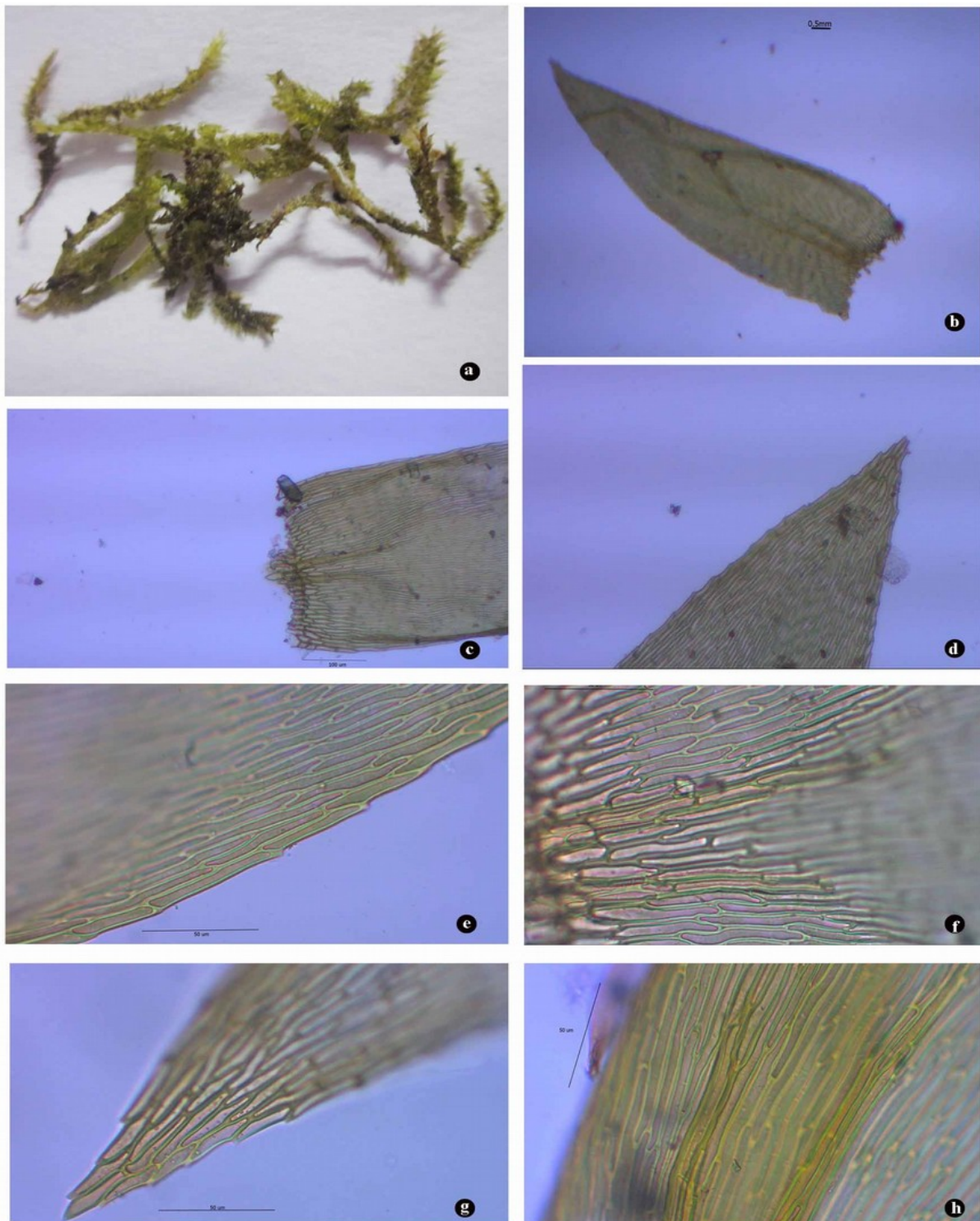


Plate 3. *Taxiphyllum giraldi* a. habit; b. single leaf (4x); c. leaf base (10x); d. leaf apex (10x); e. leaf margin (40x); f. costa (40x); g. leaf apex (40x); h. justa costal cells (40x).

Kanara), North-East India (Kumaon Himalaya), Sri Lanka, China, Myanmar, Thailand, Celebes, Philippines.

Fissidens bryoides Hedw. - on soil and on roots of higher plants near to streams. Kerala; Wayanad pass, hair pin point-7 (603 m), hairpin point-1, 12.7.2014, 13.9.2014, *Mithun Venugopal 1240,1272* (ZGC). India (Western Himalaya), South India (Nilgiri, Coonor, Kerala); East Nepal, Sri Lanka,

Europe, Taiwan, China, America, North Central, Africa, Malay, Java and Philippines.

Fissidens crispulus Brid. This species is common and occurs as dense mats on rocks. Kerala, Wayanad pass, hair pin point-9 (802- 806m.), hairpin point-8 (735m), hairpin point-7 (693m), hairpin point-3 (301m), 12.07.2014, 13.9.2014, *Mithun Venugopal 1215b, 3886, 3885b, 1220, 1222, 1250, 1272, 1245, 1252, 1238, 1254, 1271, 980, 1256*

(ZGC). It is common in the area. It is distributed in South India (Kerala, Tamil Nadu, Karnataka) North-east India (locality unknown), China, Malaysia, Madagascar, Reunion and Cameroon.

Fissidens flaccidus Mitt. - on wet land cuttings. Kerala; Wayanad pass, hair pin point - 8 (603 m), 12.7.2014, *Mithun Venugopal 1241a* (ZGC). It is distributed in South India (Tamil Nadu, Western Ghats of Kanyakumari, Kerala), North-East India (Assam), Andaman Islands and East Nepal.

Fissidens zollingeri Montin - on moist land cuttings. Kerala; Wayanad pass, hair pin point-8 (603 m), 12.7.2014, *Mithun Venugopal 1241b* (ZGC). It is distributed in South India (Kerala, Tamil Nadu- Palni hills, Karnataka- Coorg, Kanara); Sri Lanka, Bolivia, Java, Fiji, Myanmar, Malaysia, New Guinea, Peru, Philippines, Samoa, Sumatra, Tahiti, North & Central Vietnam.

Funaria hygrometrica Hedw. - grow on moist soil, rocks and brick walls in large patches associated with other mosses in homestead areas. Hairpin point (550 m) *MCN 80115a* (CALI). The species distributed in South India (Kerala- Chinnar WLS, Tamil Nadu- Nilgiri hills, Palni hills), North-East India (Himalayas, Kashmir, Manipur, Naga hills, Orissa), Sri Lanka, China, Japan, Korea, Myanmar, New Zealand, Siberia, Taiwan, Thailand, Tibet, Europe, North & South America, Africa, Australia and Oceania.

Hymenostylium recurvirostre (Hedw.) Dix. - on moist rocky surface. Kerala, Wayanad pass, hairpin point-9 (826m), 12.7.2014, *Mithun venugopal 1227* (ZGC). It is distributed in North-east India (Western Himalayas, Kashmir), South India (Tamil Nadu, Kerala); Burma, Afghanistan, Tajikistan, Western Tibet, Europe (including Great Britain), Caucasus, Central Asia, New Guinea, Philippines, China, Japan, Korea, North Central South Africa, North-Central - South America, Australia and New Zealand. It is a cosmopolitan species.

Hyophila involuta (Hook.) A.Jaeger - on rocks, crevices of rocks and land cuttings. Kerala, Wayanad pass, hairpin point-4 (306m), 13.9.2014, *Mithun Venugopal 1292 b* (ZGC); Hairpin point (800 m) *Manju 80084* (CALI). It is distributed in Peninsular India (Kerala, Karnataka- Mysore; Tamil Nadu- Palni hills; Nilgiri hills; Gujarat), Central India (Madhya Pradesh, Orissa), North-east India (Assam, Arunachal Pradesh, Bengal, Bihar, Chotanagpur, Darjeeling, Khasi hills, Western Himalayas) Sri Lanka, Nepal, China, Japan, Korea, Borneo, Myanmar, Celebes, Manchuria, New Guinea, Oceania, Philippines, Sumatra, Taiwan, North & South Vietnam, North, Central & South America and Europe.

Hypnum sikkimense Ando - on moist concrete cuttings and on rocky patches. Kerala, Wayanad pass, hair pin point -9 (802 m): 25.12.2015, *Mithun Venugopal 3884*, (ZGC). It is distributed in South India (Kerala, Tamil Nadu); North-East India (Sikkim), East Nepal and Bhutan.

Leucoloma taylorii (Schwagr.) Mitt. - on roots and buttresses of trees. Kerala, Wayanad pass, hairpin point-1 (86m), 12.7.2014, *Mithun Venugopal 1266* (ZGC). It is distributed in South India (Kerala, Tamil Nadu), North East India, East Nepal and Myanmar.

Octoblepharum albidum Hedw. - on exposed roots, branches, logs, on soil and rocks in scattered colonies. Kerala, Wayanad pass, hair pin point-9 (802m), 12.07.2014, *Mithun Venugopal 1208* (ZGC). It is a common species found in the study area and it has earlier reported from South India (Kerala, Karnataka, Tamil Nadu), North East India (Himalaya, Sikkim), Sri Lanka, Java, New Guinea, China, Bolivia, Columbia, Indonesia, Indo Malayan region, Madagascar, Myanmar, Nepal, Peru, Philippines and Venezuela (Gangulee, 1969-80; Nair *et al.* 2005).

Philonotis hastata (Duby) Wijk & Marg. - on soil and rocky patches. Kerala, Wayanad pass hairpin point-1 (90m), 13.9.2014, *Mithun venugopal 1290* (ZGC). It is distributed in South India (Kerala), North-east India (Calcutta, Assam, Sikkim), Sri Lanka, Borneo, Bolivia, Java, Thailand, Celebes, Philippines, Japan, Taiwan, Chile, Oceanic Island, Peru, Venezuela, Africa, South America and Australia.

Philonotis mollis (Dozy & Molk.) Mitt. - on moist rocks covered with soil. Kerala, Wayanad pass, hairpin point-9 (802 m), 12.7.2014, *Mithun Venugopal 1226* (ZGC); Hairpin point-6 (550 m) *Manju 80092* (CALI). It is distributed in South India (Kerala, Karnataka- Kanara, Coorg), Central India (Rajasthan), Andaman Islands, Sri Lanka, Borneo, Java, Indonesia, Japan, Madagascar, Philippines, Sumatra and Tonkin.

Philonotis seriata Mitt. - on concrete cuttings. Kerala, Wayanad pass, hairpin point- 3 (300m), 13.9.2014, *Mithun Venugopal 1292c* (ZGC). It is distributed in South India (Kerala, Tamil Nadu); North-east India (North West Himalaya, Kashmir); Caucasus, central Asia, Mongolia, Korea, Japan, Europe including Great Britain (Scotland), North Africa, Greenland, Alaska, Canada, California and North Carolina.

Pinnatella calcutensis M.Fleisch. - on basal and upper part of tree trunk. Kerala, Wayanad pass, hairpin point-9 (803 m), 25.1.2015, *Mithun*

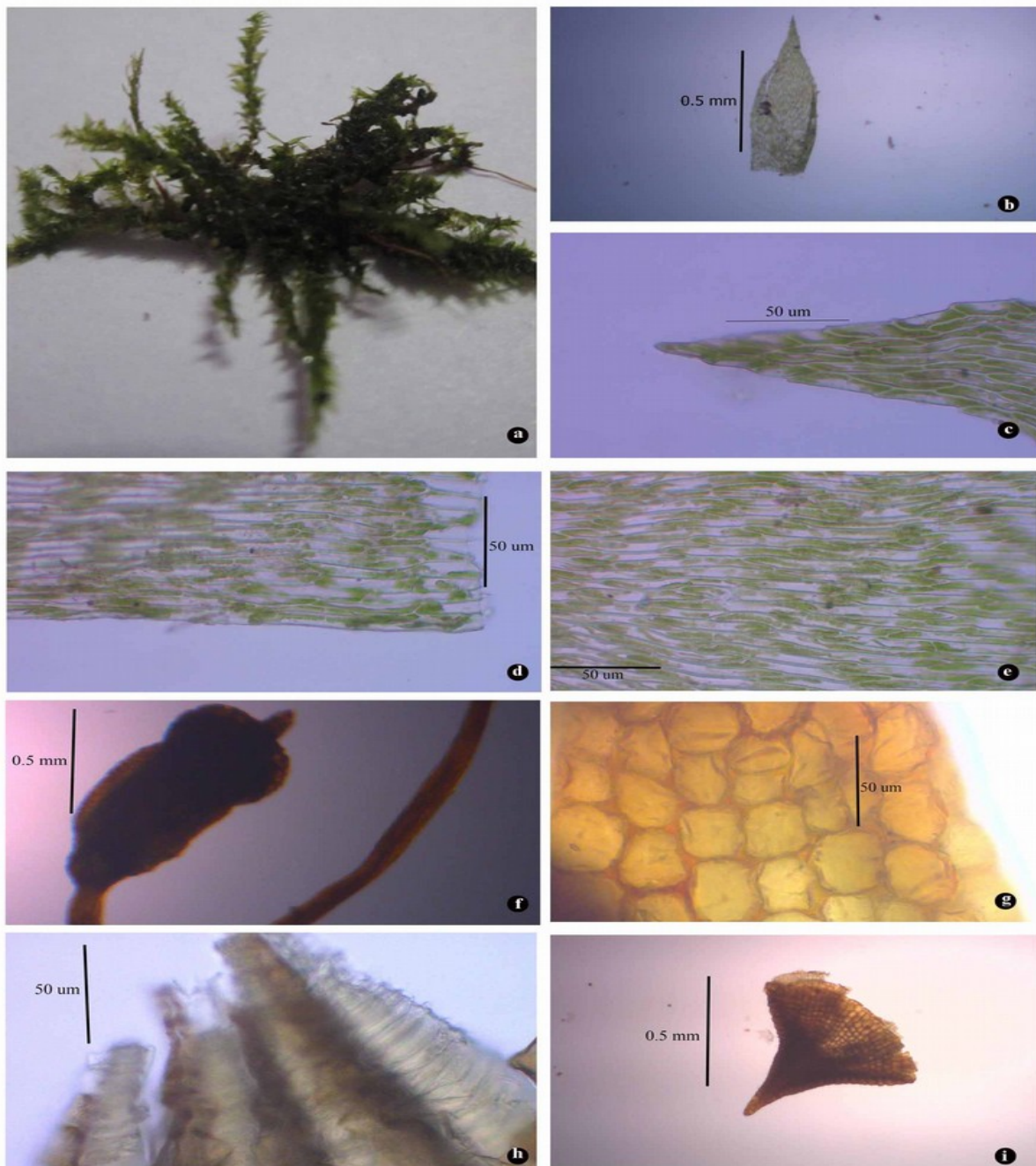


Plate 4. *Taxithelium laevisculum* a. habit; b. single leaf (4x); c. leaf apex (40x); d. leaf base (40x); e. leaf cells (40x); f. capsule (4x); g. capsule cells (40x); h. peristome (40x); i. operculum (4x).

Venugopal 3877b (ZGC). It is distributed in South India (Kerala, Karnataka- Kanara, Mahabaleswar), North-East India (West Bengal, Darjeeling, Orissa) and Thailand.

Pterobryopsis acuminata (Hook.) M.Fleisch. - on Lower part of the tree bark. Kerala, Wayanad pass, hairpin point-9 (803 m), 25.01.2015, *Mithun Venugopal 3877a* (ZGC). This species is distributed in South India (Kerala, Tamil Nadu- Nilgiri hills), North-East India (Sikkim, Khasi hills), Nepal and Myanmar.

Sematophyllum subpinnatum (Brid.) E.G.Britton - on base of the tree trunk. Kerala, Wayanad pass, hairpin point-2 (130m) 13.9.2014, *Mithun Venugopal 1268* (ZGC). It is distributed in South India (Tamil Nadu- Palni Hills), North-east India (Darjeeling, Assam, Khasi hills), Sri Lanka, Japan, Sumatra, Java, Philippines, Australia, Central & South Africa, Madagascar and America.

Stereophyllum ligulatum A.Jaeger - on bark of trees. Kerala, Wayanad pass, hairpin point- 9 (826 m), 25.1.2015, *Mithun Venugopal 3878* (ZGC). It is distributed in South India (Kerala, Western Ghats of Pune, Palni hills).

Taxiphyllum giraldii (C.Muell.) M.Fleisch. - near wet areas, often on moist rocky substratum. Kerala, Wayanad pass, hair pin point-8,9 (603 m, 803m), 25.1.2015, *Mithun Venugopal 3881, 3887* (ZGC). This species is earlier reported from North India (Kumaon); East and Central Nepal, E. China, Taiwan and Japan. This species was not reported earlier from peninsular India. Hence this collection is the first report of the species from Peninsular India. (Plate 3)

Taxithelium laeviusculum Dixon - on rocky patch near stream. Kerala, Wayanad pass, hairpin point-8 (700 m) 12.7.2014, *Mithun Venugopal 1239* (ZGC). This species has been reported earlier from Arunachal Pradesh. Hence the present collection is a new record for Peninsular India. (Plate 4)

Trematodon longicollis Michx. - on soil cuttings in moist deciduous forests. Hairpin point 6 (550m) *Manju 99663* (CALI). It is a cosmopolitan species distributed in South India (Kerala- Chinnar WLS, Tamil Nadu- Palni hills, Karnataka: Coorg), North-east India (Darjeeling, Bengal, Assam, Manipur, West Bengal, Western Himalaya), Sri Lanka, China, Japan, Ryukyu, Korea, Myanmar, Philippines, New Guinea, Taiwan, Siberia, South Africa, Europe and New Zealand.

Discussion

The area is with unique landscape and the altitude ranges from 86-826m. But the species diversity also ranges from the occurrence of low altitude species to species occurring in the high altitude evergreen forests. The area span only in 12 kms, but the diversity and frequency of the species is very high. The present study include almost all the types of microhabitats except epiphyllous one. Terrestrial species are most common in the area. More than 100 specimens of bryophytes were collected during the survey from Wayanad pass in three seasons. The critical study yielded a total of 37 species belonging to 28 mosses, 7 liverworts and two Hornworts. The monotypic family Fissidentaceae with the genus viz., *Fissidens* represented by four species in the hairpin points of Wayanad pass is the most widely distributed genera. Mosses were represented by both Pleurocarpic and Acrocarpic species. Among 28 mosses 10 are Pleurocarpic and 18 are acrocarpic. *Taxithelium laeviusculum* Dixon and *Taxiphyllum giraldii* (C.Muell.) M.Fleisch. was not reported earlier from Peninsular India. Hence the present collection forms the first report of these species from Peninsular India. The liverworts collected from the study area include only the thalloid type. The family Aneuraceae is the largest family distributed with two genera viz., *Aneura* and *Riccardia* each with single species. *Cyathodium cavernarum*, *Bryum coronatum*, *Fissidens crispulus* and *Hyophila involuta* are the widely distributed

species and prefers to grow in a wide range of habitats. Species reported as new to Thamarassery churam after Manju *et al.*, 2005 are *Aneura pinguis*, *Barbula unguiculata*, *Brachymenium bryoides*, *Bryum paradoxum var. reflexifolium*, *Chionostomum rostratum*, *Hypnum sikkimense*, *Leucoloma taylorii*, *Philonotis seriata*, *Riccia billardieri*, *Stereophyllum ligulatum*, *Taxiphyllum giraldii* and *Taxithelium laeviusculum*.

Competing Interest

The authors declare that they have no competing interests.

Authors' contributions

VM carried out the field studies, identified the specimens and MCN confirmed the species and prepared the manuscript. All authors read and approved the final manuscript.

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