

Contribution to the bryophyte flora of India: the Aralam Wildlife Sanctuary in the Western Ghats

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Abstract. The bryophyte flora of the Aralam Wildlife Sanctuary in the Western Ghats of India is catalogued for the first time. The catalogue consists of 116 taxa (89 mosses, 27 liverworts), of which two are new for India (*Plagiochila singularis*, *Vesicularia dubyana*), 21 species are newly reported for Peninsular India (*Clastobryopsis planula* var. *delicata*, *Barbella chrysonema*, *Brachymenium leptophyllum*, *Brachythecium rutabulum*, *Cololejeunea longifolia*, *Cyathodium tuberosum*, *Dicranella amplexans*, *Didymodon vinealis*, *Duthiella wallichii*, *Fabronia assamica*, *Haplocladium microphyllum*, *Himantocladium cyclophyllum*, *Homalia trichomanoides* var. *trichomanoides*, *Isopterygium serrulatum*, *Leskea perstricta*, *Lopholejeunea kashyapii*, *Leptotrichella assamica*, *Macromitrium turgidum*, *Rhynchostegium hookeri*, *Splachnobryum assamicum*, *Thamnobryum siamense*) and another 14 species are new for Kerala State (*Atrichum pallidum*, *Chionostomum rostratum*, *Claopodium prionophyllum*, *Cololejeunea lanciloba*, *Cyathophorum adiantum*, *Dicranella divaricata*, *Entodontopsis wightii*, *Fissidens pellucidus*, *Glossadelphus glossoides*, *Isopterygium lignicola*, *Leucodon secundus*, *Neckeropsis exserta*, *Plagiochila bischleriana*, *Timmiella anomala*). The species *Jungermannia obliquifolia* has also been reported as a taxon new to India (Nair *et al.* in press (a) from this area.

Introduction

This paper is a continuation of the research initiated some years ago by the authors¹ on the Western Ghats bryophytes and its vegetation (Nair *et al.* 2005a&b, 2006; Pocs *et al.* 2007; Madhusoodanan *et al.* 2007). Previous studies on the Western Ghats bryophytes were mostly random collections made in 19th and 20th century. These often consisted of incomplete floristic lists from small areas, consequently most of the protected and unprotected areas remains under explored or totally unknown bryologically. The checklist of the bryophytes of Kerala State in the Peninsular India (Nair and Madhusoodanan 2002; Easa 2003) summarized the published data from this region, but

without any opinion about the taxonomic validity of the taxa presented. Manju *et al.* (2008) reported the checklist of the bryophytes of Kerala with up to date nomenclatural changes.

The Aralam Wildlife Sanctuary is floristically poorly known, particularly its bryological diversity as compared with nearby areas. The previous reports from this area include only three bryophyte species (*Heteroscyphus argutus*, *Cololejeunea furcilibulata*, *Jungermannia obliquifolia*) (Pocs *et al.* 2007, Nair *et al.* in press(a))

The Aralam Wildlife Sanctuary, with an area of 55 km², situated between north latitude 11°50' and 11° 52' and east longitude 75° 49' and 75° 57', is a part of the Nilgiri Biosphere Reserve of the Western Ghats extended to the Kannur district of the Kerala State in the Peninsular India (Fig.1). Eventhough it is comparatively a small protected area, it is notable for holding a good assemblage of some of the rare Western Ghats endemics. Administratively, the entire Protected Area is comprised of single Forest Range namely, the Aralam Range and was constituted in the year 1984. Since 1998, for management purpose the area is divided into the Core Zone and the Buffer Zone. It is contiguous with the Wayanad-Brahmagiri, Wayanad northern slopes and the protected areas of the Karnataka State namely the Brahmagiri Wildlife Sanctuary and also with the forests of Coorg area of Karnataka (<http://www.aralam.org>).

The area is highly undulating, typical of the Western Ghats, and the elevation varies from 60 m to *ca.* 1,500 m. One of the major peak, the *Katti Betta*, covered with tropical and semi- evergreen forests rises to the altitude of 1,145 m above sea level. Another major peak, the *Ambalappara* with an altitude of about 1500 m, is with the Southern hilltop evergreen forest, which support unique assemblage of rich biodiversity. There are about 490 ha of teak and eucalyptus plantations within the forest area. The temperature at the foothills varies from 21° C to 40°C and at the higher reaches from 8°C to 25°C. The south-west and the north-eastern monsoons bless the Sanctuary with annual rainfall in between 3,745 mm to 5,052 mm and with *ca.* 100-120 rainy days. In some localities in the higher reaches, the rainfall even goes as high as over 6,000 mm. The area receives regular winds during the south-west monsoon period but strong winds of dry nature blow from September to April, causing dryness in the locality. The Sanctuary land slopes from the east to the west, is drained by the *Cheenkannipuzha*, which flows to the west. There are three smaller rivers namely, *Narikkadavuthodu*, *Kurukkathodu* and *Meenmuttithodu*, and many streamlets all flow southwards to join the *Cheenkannipuzha*. The soil is mainly of laterite, red soils and forest and hill soils with fairly good soil depth in the lower reaches.

This is the only Protected Area of west coast tropical evergreen forest where the unique *Dipterocarpus-Mesua-Palaquim* sub-type is seen (Nair, 1991). About 22 sq. km (34 %) of the forest is fairly undisturbed belonging to this type. The major vegetation of this Sanctuary is evergreen. However, in some areas such as *Valayamchal*, *Narikkadavu* and *Paripputhode*, the forest is semi-evergreen type intermixed with a small patches of moist deciduous forests. The forest from *Chavachi* to *Ambalappara* is an intact stretch of west coast tropical wet evergreen forest. On the upper reaches of the *Ambalappara* (at about 1,500 m above MSL), there is physiognomically distinct, stunted evergreen forest, the Southern hilltop evergreen forest. Even though, the vegetation is rich and diverse no detailed floral exploration has been carried out in this Sanctuary. A rapid biodiversity assessment survey conducted during 2004 in the Sanctuary recorded 961 flowering plants (Augustine *et al.* in press).

The *Ambalappara* region (*ca.* 1500 m) is distinct by the presence of the Southern hilltop evergreen forest, a kind of shola-like (montane forest) forest, though the typical *shola* in the Western Ghats are found above 1800 m altitude only. The *Ambalappara* is the boundary of the Aralam Wildlife Sanctuary, where the diversity of bryophytes is very high compared to other areas. The floristic composition of this part differs considerably. The trees of this part are stunted, usually below 20 m, and belonging to Laurales and Myrtales, and the trunks of which are heavily overgrown with epiphytic ferns, mosses, orchids and balsams.

Results

Enumeration of species

The specimens were collected by Manju C.N. and K.P. Rajesh between 2001-2005 and were identified by Manju C.N., (first author), W.R. Buck, New York Botanical Garden, Brian O' Shea of London, L.T. Ellis of Natural History Museum and T. Pócs (Eger College, Hungary) during 2003-2008. The specimens are deposited in the Calicut University Herbarium (CALI). Each species is listed with author citation followed by the observations on the substrate/s on which it was found growing in the study area, the locality, altitude, the collector's name (acronyms: *KPR* = K.P. Rajesh, *MCN* = Manju C.N.) and collection number. The comments on the distribution of species is given to new records of species only. In the distribution the term Peninsular India comprises five states, Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Gujarat and three Union territories viz., Goa, Lakshadweep and Pondicherry.

Marchantiophyta

Asterella khasiana (Griff.) Pandé, K.P.Srivast. & Sultan Khan "*khasiana*"; On rocky patches. *Ambalappara* (1400 m) *KPR 106674*. It has earlier recorded from North-eastern India (Himalaya, Darjeeling), Southern India (Kerala), Nepal and China.

Cephaloziella kiaeri (Austin) S.Arnell, On bark. *Ambalappara* (1400 m) *KPR 106678*. It is distributed in Southern India (Tamil Nadu, Kerala), North-eastern India (Meghalaya), Sri Lanka and China.

Cololejeunea furciculobulata (Berrie & E.W. Jones) R.M. Schust., On rocks. *Chavachi* (180 m) *MCN 87579*, *KPR 80377/b*. Distributed in the tropical Africa and India. According to Asthana and Srivastava (2003) in India it is rare and occurs only in the Karnataka and Kerala States.

Cololejeunea haskarliana (Lehm. & Lindenb.) Steph., Epiphyllous on the fern *Leptochilus* sp. *Ambalappara* (1100m) *KPR 99844*. It is distributed in India (North-east (locality unknown) and Kerala), Japan, China and Africa. It is an Indian endemic species distributed in the Andaman & Nicobar Islands, Meghalaya, Mysore and the Eastern Himalayas. The present collection is a new record for the Kerala State.

Cololejeunea lanciloba Steph., Epiphyllous on *Mangifera indica*. *Valayamchal* (40 m) *MCN 99709*. It is an Indian endemic species distributed in the Andaman & Nicobar Islands, Meghalaya, Mysore and the Eastern Himalayas. The present collection is a new record for Kerala State.

Cololejeunea longifolia (Mitt.) Benedix, On bark. *Ambalappara* (1100 m) *KPR 99768* (CALI). It is distributed in North-eastern India and China. The present collection is a new record for Peninsular India. It is distributed in North-eastern India and China. The present collection is a new record for the Peninsular India.

Cololejeunea raduliloba Steph., Epiphyllous on *Crepidomanes indicum*. *Valayamchal* (60 m) *KPR 80398*. It has been reported from North-eastern India (locality unknown). Nair *et al.* (2005) reported this species as new record for the Peninsular India from the Wayanad district of Kerala State. It is also reported from China, Japan, Vietnam and Taiwan.

Cyathodium tuberosum Kashyap, Epiphytic. *Valayamchal* (60 m) *MCN 99723*. Kashyap (1914) reported this species from the Western Himalayas. The present collection is a new record for Peninsular India.

Dumortiera hirsuta (Sw.) Nees, On rocky patches where water drips regularly. *Ambalappara* (1400 m) *KPR 106675*, *KPR 99741*. A widely distributed species.

Fossombronia japonica Schiffn., On moist land cuttings or rocks along with grasses. *Ambalappara* (1350 m), *KPR 106676*. It is a common species distributed in Southern India (Kerala, Tamil Nadu), Japan, Massachusetts, New York, North America and West Virginia. Earlier reported from Kerala as *Fossombronia foveolata* Lindb. var. *cristula* (Austin) R.M.Schust. and as *F. cristula*.

Frullania acutiloba Mitt., Upper part of tree trunk and on branches in moist and shady areas. *Ambalappara* (1100 m) *KPR 99866*. Srivastava and Sharma (2000) reported this species from the Silent Valley of Palakkad district in Kerala. It is distributed in Southern India (Kerala, Tamil Nadu), Eastern India (Khasi hills, Assam), Sri Lanka, China, Java and Japan.

Frullania tamarisci (L.) Dumort. subsp. *moniliata* (Reinw., Blume & Nees.) Kamim., Epiphytic. *Ambalappara* (1400 m) *KPR 106679*. This species is distributed in Southern India (Kerala, Tamil Nadu), Northern India (Himalaya), Sri Lanka, Malaysia, China, Formosa, Korea, Japan, Europe and Asia minor.

Heteroscyphus argutus (Nees) Schiffn., Common species usually found on rotten logs, rocky patches, soil and exposed roots of higher plants along stream banks. *Valayamchal* (180 m) *KPR 80388*; *Ambalappara* (1400 m) *KPR 99854*. In India common in Southern India (Kerala, Karnataka, Tamil Nadu) and North-eastern India (Darjeeling, West Himalaya, Pachmahri, Assam, Sikkim, Manipur, Meghalaya). Its distribution extends to Borneo, Brazil, Myanmar, China, Java, Japan, New Guinea, New Zealand, Philippines, Sumatra and Taiwan.

Jungermannia obliquifolia (Schiffn.) Vana, On land cuttings in wet evergreen forests. *Chavachi* (400 m), *MCN & KPR 87649*. It is a rare species reported from Java, Celebes, Sumatra, Philippines and Australia. Nair *et al.* (in press (a)) reported this species as new record for India.

Lejeunea flava (Sw.) Nees, On base of tree trunks along with *Trichomanes* sp. *Ambalappara* (1100 m). *KPR 99845/ b*. It is a widespread Pantropical species. Pócs *et al.* (2007) reported this species from the Wayanad district in Kerala State.

Lopholejeunea kashyapii U.S.Awasthi, S.C. Srivast. & D.Sharma, On small rocks. *Paripputhodu* (150 m) *MCN 87597/a*. It is an Indian endemic species distributed in the North-eastern India (Eastern Hiamalayas, Meghalaya, Cherapunji). The present collection shows its extended distribution to the Peninsular India.

Marchantia paleacea Bertol., On rocky patches. *Ambalappara* (1400 m) *KPR 106372*. It was reported from India as *M. nepalensis* Lehm. & Lindenb., from Central and Western Himalayas, Assam and Southern India (locality unknown).

Plagiochila bischleriana Grolle & M.L.So, On rocky patches. *Meenmutty* (450 m), *MCN 87477/a*; *Ambalappara* (1050 m) *KPR 99850*. Distributed in Northern India (West Bengal, Western Himalaya), Southern India (Tamil Nadu), China and Nepal. The present collection is a new record for Kerala State.

Plagiochila chinensis Steph., Epiphytic on trunk and on small twigs. Distribution mentioned in Nair *et al.* 2005b.

Plagiochila khasiana Mitt., Corticolous. *Ambalappara* (1100 m) *KPR 99784*. It is distributed in Southern India (Kerala), Northern India (Uttar Pradesh, West Bengal), Bhutan, China, Thailand, Nepal and Sri Lanka.

Plagiochila parvifolia Lindb., On rocky patch. *Valayamchal* (60 m) *KPR 80377/a*. Distribution mentioned in Nair *et al.* 2005b.

Plagiochila singularis Schiffn., Epiphytic and on land cuttings. *Ambalappara* (1100 m) *KPR 99827*. It is distributed in China, Indonesia, Myanmar, Papua New Guinea and Philippines. As commented by So (2001) the verruculose cuticle, the unusual character found in this species is the main distinguishing feature. No other species of *Plagiochila* shows this character. It is rare in the area and was collected only from one locality. This is the first record from India.

Radula japonica Gottsche ex Steph., On branches as well as on soil and rocky patches in shola forest. *Ambalappara* (1000 m) *KPR 99777*. It is distributed in the high altitude evergreen and shola forests of Kerala State. It was earlier reported from the Northern India (Himalayas), Southern India (Kerala) China, Japan and Korea.

Radula meyeri Steph., On bark. *Paripputhodu* (150 m) *MCN 87613/a*. It is distributed in North-eastern India (Eastern Himalayas, Meghalaya, Khasi hills), Southern India (no precise locality (Parihar *et al.* 1994)), Thailand, Sumatra and Africa.

Riccardia levieri Schiffn., On exposed roots of higher plants. *Ambalappara* (1350 m) *KPR* 106677. Common species in the riparian habitats. It has a wide distribution in Southern India (Kerala, Tamil Nadu, Karnataka), Central India (Madhya Pradesh) Northern India (Meghalaya, Western Himalaya) and Bhutan.

Riccia fluitans L., The terrestrial form occurs along the muddy margins, or in wet sandy soils in semi-evergreen forests. *Ambalappara* (1400 m), (Aqua.) *KPR* 99809. This species has a wide distribution in Southern India (Tamil Nadu, Kerala), Central India (Mt. Abu), North-eastern India (Assam, Himalayas, Garhwal, Kashmir, Kumaon, Pachmahri), Bangladesh, China, Japan, Malaysia, Nepal, Taiwan, Korea, Siberia, Java, Borneo, New Zealand, South America, North America, Europe, West Indies and Britain.

Targionia hypophylla L., On land cuttings in hill top evergreen forests. *Ambalappara* (1100 m), *KPR* 99807. A widely distributed species in Southern India (Kerala, Tamil Nadu, Karnataka), Central India (Mt. Abu), North-eastern India (Western Himalayas, Mussoorie, Pachmahri, Simla, Sikkim, Chirapunji, Khasi hills), Japan, Chile, Korea, Taiwan, China, Hawaii, Peru, Europe, N. & S. America and Australia.

Bryophyta

Aerobryum speciosum Dozy & Molk., Epiphytic. *Ambalappara* (1075 m) *KPR* 99818/a.

Anomobryum filiforme var. *concinatum* (Spruc.) Amann, On rocky patches. *Meenmutty* (430 m), *MCN* 87483/a. An east and south-east Asiatic species, distributed in North-eastern India (Darjeeling, Arunachal Pradesh, Khasi hills, Manipur, Meghalaya, Sikkim) and Southern India (Western Ghats of Tamil Nadu and Kerala), Sri Lanka, Bhutan, Celebes, China, Taiwan, Indonesia, Japan, Philippines, New Guinea and Tonkin.

Atrichum pallidum Renauld & Card., On land cuttings. *Ambalappara* (1000 m), *KPR* 99824. It is a South east Asiatic species distributed in India (Western Himalayas), Burma, Japan, Philippines and Nepal. The present collection is a new record for Kerala.

Barbella chrysonema (Müll.Hal.) Broth., On rocky patches and on land cuttings. *Ambalappara* (1075 m), *KPR* 99773, *Meenmutty* (450 m), *MCN* 87486, *MCN* 87493. This species was earlier known only from Darjeeling in India as *Floribundaria chrysonema* and also reported from Bhutan. The present collection is a new record for Peninsular India.

Brachymenium leptophyllum (Bruch & Schimp. ex Müll.Hal.) Bruch & Schimp. ex A.Jaeger, On rocky patches. *Ambalappara* (1100 m), *KPR* 99772; *KPR* 99795. It is distributed in North-eastern India (Sikkim), East Nepal, Thailand and Africa. The present collection is a new record for Peninsular India.

Brachythecium rutabulum (Hedw.) Schimp., On rocky patches. *Ambalappara* (1100 m), *KPR* 106368. A cosmopolitan species distributed in Northern India (Kashmir) Nepal, Bhutan, Sri Lanka, China, Japan, New Zealand, Papua New Guinea, Australia and America. The present collection is a new record for Peninsular India.

Bryum argenteum Hedw., On land cuttings and on small rocks. *Ambalappara* (1050 m), *KPR* 99770. Widely distributed species.

Bryum wightii Mitt., On rocky patches. *Ambalappara* (1100 m), *KPR* 99793. Distributed in Southern India (Maharashtra, Tamil Nadu, Kerala), Sri Lanka and Nepal.

Calymperes afzelii Sw., On bark. Valayamchal (150 m) *MCN* 87605. A widely distributed species in tropics.

Calymperes erosum Müll. Hal., On logs along with *Octoblepharum albidum*. *Chavachi* (180 m), *MCN* 87549/a. It is a common species known from South India (Goa, Kerala and Tamil Nadu), Sri Lanka, Myanmar, China, Africa and America.

Calymperes graeffeanum Müll.Hal., On bark. Uruppukunnu (750 m) 99721. On land cuttings. It is distributed in main land of India (locality unknown), Andaman Islands, China, Sri Lanka, Philippines, Australia and Reunion.

- Calymperes tenerum* Müll.Hal., On bark. *Valayamchal* (40 m), *MCN & KPR 99705*. It is distributed in Northern India (Bengal), Southern India (Tamil Nadu, Kerala), Sumatra, Malay, Java, Molucca, New Guinea, Philippines, New Caledonia, Hawaii, Caroline Is., Samoa and Tahiti.
- Campylopus ericoides* (Griff.) A.Jaeger, On rocky patches. *Ambalappara* (1050m), *KPR 99847*. It is a South east Asiatic species distributed in Southern India (Kerala), North-east India (Darjeeling, Khasi hills, Manipur), Myanmar, Thailand, Vietnam, Java, East Nepal and Philippines.
- Campylopus flexuosus* (Hedw.) Brid., On rocks and soil in grassland. *Ambalappara* (1450 m), *KPR 106682*. This is a cosmopolitan species mostly occurring in high altitude areas of grasslands. It has been reported earlier from Southern India (Kerala), Northern India (Western Himalaya), China, East Nepal, Algeria, Abyssinia, Madagascar, New Zealand, Oceania and Siberia.
- Chionostomum rostratum* (Griff.) Müll.Hal., On small branches. *Ambalappara* (1050 m), *KPR 99798*. It is distributed in North-eastern India (Darjeeling, Khasi hills), Andaman & Nicobar Islands, Southern India (Karnataka), Sri Lanka, Nepal, Bhutan, Bangladesh, China, Taiwan and Philippines. The present collection is a new record for Kerala State.
- Claopodium prionophyllum* (Müll.Hal) Broth., On bark. *Ambalappara* (1480 m) *KPR 99816/b*. It is distributed in North-eastern India (Sikkim, Darjeeling, Arunachal Pradesh, Khasi hills, Naga hills, Garhwal), Southern India (Tamil Nadu), Sri Lanka, Myanmar, Java, Celebes, China, Korea and Japan. This is the first record for Kerala State.
- Clastobryopsis planula* var. *delicata* (Broth. & M.Fleisch.) B.C.Tan & Y.Gia, On rocks near water course. *Meenmutty* (450 m), *MCN 87470*. It is an East Asiatic species distributed in India (Darjeeling, Khasi hills), Yunnan and Japan. The present collection is a new record for the Peninsular India.
- Cryptopapillaria fuscescens* (Hook.) A.Jaeger, On tree trunks. *Meenmutty* (445 m), *MCN 87489/b*. a widely distributed species.
- Cyathophorum adiantum* (Griff.) M.Fleisch., On rocky patches and on roots of higher plants. *Ambalappara* (1000 m), *KPR 99802*, *KPR 99805*, *KPR 99830/a*. It is distributed in North-eastern India (Sikkim, Darjeeling, Khasi hills, Western Hiamalayas), Peninsular India (Nilgiri hills) Nepal and Philippines. The present collection is a new record for Kerala.
- Dicranella amplexans* (Mitt.) A. Jaeger, On land cuttings. *Ambalappara* (1000 m), *KPR 99763*. Gangulee (1971) recorded this species as endemic to Eastern Nepal. The species also occurs in China. The present collection is a new record for Peninsular India.
- Dicranella divaricata* (Mitt.) A. Jaeger, On land cuttings. *Ambalappara* (1030 m) *KPR 99774*. It is distributed in North eastern India (Western Hiamalayas) and peninsular India (Nilgiri and Palni hills). The present collection is a new record for Kerala State.
- Didymodon vinealis* (Brid.) R.H.Zander, On rocky patches. *Ambalappara* (1100 m), *KPR 106370*. It is distributed in North-eastern India (Kashmir, Himachal Pradesh, Uttarkhand, West Bengal, Sikkim, Arunachal Pradesh), China, Japan and Philippines. The present collection is a new record for Peninsular India.
- Diphyscium mucronifolium* Mitt., On exposed roots of higher plants and on rocks. *Ambalappara* (1050m) *KPR 99846*. A South-east Asiatic species, In India distributed in North-eastern India (Khasi hills) and Southern India (Tamil Nadu, Kerala). Known in India as *D. involutum* Mitt.
- Dixonia orientalis* (Mitt.) H.Akiyama & Tsubota., On bark. *Ambalappara* (1000 m), *KPR 99801*. It is distributed in North-eastern India (Sikkim, Assam) Southern India (Kerala).
- Duthiella wallichii* (Mitt.) Müll.Hal., Epiphytic. *Ambalappara* (1050 m), *KPR 99815*. A south-east and east-Asiatic species distributed in North-eastern India (Western Himalayas, Khasi hills), Nepal, Thailand, Yunnan, Taiwan, Japan and Java. This is a new record for Peninsular India.
- Entodon flavescens* (Hook.) A.Jaeger, On rocks and logs. Way to *Ambalappara* (1250 m), *KPR 106693*. A widely distributed species.
- Entodontopsis nitens* (Mitt.) W.R.-Buck, On bark. *Chavachi* (180 m), *MCN 87558/b*. This species was earlier reported from India as *Stereophyllum ligulatum* A.Jaeger from Pune (Maharashtra) and Palni Hills (Tamil Nadu). Buck and Ireland (1985) synonymised it under *Entodontopsis nitens*

based on a collection from Paraguay. It is a common species in low altitude areas of the Kerala State.

Entodontopsis wightii (Mitt.) W.R.-Buck & Ireland, On bark. *Uruppukunnuu* (700 m), *MCN 99726*. It is distributed in North-eastern India (Assam, Khasi hills, Bengal, Chhotanagpur, Orissa, Dehradun, Mussorie) Southern India (Tamil Nadu, Karnataka), Sri Lanka, Myanmar, Thailand, Vietnam and Java. The present collection is a new record for Kerala State.

Entosthodon wichurae M.Fteisch., On land cuttings in grasslands and on wet stream bank near hilltop evergreen forest. *Ambalappara* (1100 m), *KPR 99811*. It is distributed in Southern India (Kerala, Tamil Nadu), North-eastern India (Meghalaya, Uttar Pradesh), Sri Lanka, Indonesia and Myanmar.

Fabronia assamica Dixon, Epiphytic. *Ambalappara* (1500 m), *KPR 99808/b*. Gangulee (1971) reported this species as endemic to Khasi hills. The present collection is a record of its extended distribution to the Peninsular India.

Fissidens anomalus Mont., On base of tree trunks. *Ambalappara* (1400 m), *KPR 106683*. A south east Asiatic species distributed in North east India (Khasi hills, Western Himalayas), Southern India (Tamil Nadu, Kerala), Nepal, Sri Lanka, Thailand, Vietnam, Java, Philippines, Yunnan.

Fissidens asperisetus Sande-Lac. var. *andamanensis* Gangulee, *Chavachi* (180 m), *MCN 87558/c*. It is a South east Asiatic species distributed in India (Andaman, Kerala) Sri Lanka, Java, Celebes and Philippines.

Fissidens ceylonensis Dozy & Molk., On land cuttings. *Valayamchal* (50 m) *MCN 106695*. Widely distributed species.

Fissidens pellucidus Hornsch., On soil covered bark. *Uruppukunnuu* (750 m), *MCN 99712*. A south east Asiatic species distributed in the Peninsular India (Maharashtra) Nepal, Sri Lanka, Myanmar, Thailand, Singapore, Sumatra, Java, Philippines, Taiwan and Vietnam. The present collection is a new record for Kerala State.

Fissidens pulchellus Mitt., On land cuttings. *Paripputhodu* (150 m), *MCN 87597/b*; *Ambalappara* (1110 m), *KPR 99823*. It is an Indian endemic species distributed in the Eastern Himalayas (Abor hills) and Kerala.

Fissidens serratus var. *serratus* Müll.Hal., On rocky patches. *Chavachi* (180 m), *MCN 87539, 87494 b*. It is a common species in India, distributed in the North-eastern India (Darjeeling, Khasi hills, Assam, Bihar, Bengal, Orissa), Southern India (Kerala, Tamil Nadu), Andaman Islands, Nepal, Sri Lanka, Taiwan, Sumatra, Java, New Guinea and Philippines. Known in India as *Fissidens sylvaticus* var. *zippelianus* (Dozy & Molk.) Gangulee.

Fissidens virens Thwait. ex Mitt., On rocky patches near riverine areas. *Ambalappara* (1000 m), *KPR 99845/a*. A South-east Asiatic mainland species distributed in North-eastern India (Assam, West Bengal), Nepal and Vietnam. Nair *et al.* (2005) reported this species as new record for the Kerala State.

Foreauella orthothecia (Schwaegr.) Dixon. & P.Varde., On rocky patches and on bark. *Uruppukunnuu* (750 m), *MCN 99724*. It is a common species in the deciduous forests of the Kerala State. This Indo-Malesian species was earlier recorded from Southern India (Tamil Nadu, Kerala), North-eastern India (Darjeeling, Assam, Khasi hills, Orissa), Nepal, Thailand, Philippines and the Pacific Ocean Islands.

Funaria hygrometrica Hedw., On rocks. *Way to Ambalappara* (1250 m), *KPR 106685*. A widely distributed species in tropics.

Garckea flexuosa (Griff.) Marg. & Nork., On the edges of land cuttings. *Ambalappara* (1450 m), *KPR 106682*. A widely distributed species in tropics.

Glossadelphus glossoides (Bosch & Sande-Lac.) M. Fleisch., On rocky patches. *Meenmutty* (450 m), *MCN 87501*. A south-east Asiatic species found in India (Nilgiri) China, Nepal, Thailand, Indonesia and New Guinea. The present collection is a new record for Kerala.

Groutiella tomentosa (Hornsch.) Wijk & Marg., On small branches of hilltop evergreen trees. *Ambalappara* (1050 m), *KPR 99834/c*.

Haplocladium microphyllum (Hedw.) Broth., On small branches. *Ambalappara* (1050 m), *KPR 99834/b*. A widespread species distributed in North-eastern India (Sikkim, Assam, Garhwal, Mussoorie, Kashmir), Nepal, Bhutan, China, Tonkin, Korea, Japan, Taiwan, Siberia, Cuba, Europe, Mexico, Canada and South America. The present collection is a new record for Peninsular India.

Himantocladium cyclophyllum (Müll.Hal.) M.Fleisch., Epiphytic. *Ambalappara* (1000 m), *KPR 99830/d*, *Chavachi* (180 m) *MCN 87577*, *Paripputhodu* (150 m) *MCN 87632/a*. It is distributed in North-eastern India (Assam), Thailand, Java, Borneo, Celebes, New Guinea, Philippines, Taiwan, Japan, Fiji and Australia. The present collection is a new record for Peninsular India.

Himantocladium plumula (Nees) M.Fleisch., Epiphytic. *Chavachi* (180 m), *MCN 87531*.

Homalia trichomanoides (Hedw.) Schimp. var. *trichomanoides* (Hedw.) Bruch, Schimp. & W.Gümbel, On rocky patches. *Meenmutty* (445 m), *MCN 87489*. It is distributed in India (Himalayas, Andaman & Nicobar Islands), Western Tibet, Nepal, Bhutan and Bangladesh. The present collection is a new record for Peninsular India.

Homali dendron flabellatum (Sm.) M.Fleisch., On rocky patches near streams and also epiphytic. *Ambalappara* (1050 m), *KPR 99830/c*, *99840*. It is a common species distributed in India (Eastern Himalayas), Southern India (Kerala, Tamil Nadu), Sri Lanka, Thailand, Sumatra, Australia and Pacific Ocean Islands.

Homali dendron microdendron (Mont.) M.Fleisch., On small twigs. *Uruppukunnuu* (750 m), *MCN 99717*. It is distributed in North-eastern India (Sikkim, Darjeeling, Khasi hills, Manipur, Western Himalaya), Southern India (Tamil Nadu, Kerala), Nepal, Myanmar, Thailand, Vietnam, Borneo, Philippines, Yunnan, Taiwan and Ryuku.

Hyophila involuta (Hook.) A.Jaeger, Prefers to grow in almost all habitats such as on land cuttings, soil, small rocks, large rocky patches, on base of trees, etc. Way to *Ambalappara* (1250 m), *KPR 106684*. A widely distributed species.

Hypopterygium tamarisci (Sw.) Brid. & Müll.Hal., On rocky patches. *Ambalappara* (1050 m), *KPR 99828*. It is distributed in Southern India (Tamil Nadu, Kerala); Sri Lanka, Borneo, Java, Malaya, Sumatra, Philippines, New Guinea, Pacific Islands, Central Africa and Madagascar. It is a Pantropical species, extending to the south temperate regions of Africa and Australasia.

Isopterygium lignicola (Mitt.) A.Jaeger, On logs. *Chavachi* (180 m), *MCN 87573*. It is distributed in North-eastern India (Sikkim, Khasi hills), Southern India (Tamil Nadu, Karnataka) Sri Lanka and Myanmar. The present collection is a new record for Kerala.

Isopterygium serrulatum M.Fleisch., On bark. *Valayamchal* (40 m), *MCN & KPR 99701*. Gangulee (1980) reported this species as endemic to eastern Himalayas. The present collection is a new record for Peninsular India.

Leptotrichella assamica (Dixon) Ochyra, On rocky patches. *Meenmutty* (430 m), *MCN 87483/b*. It was earlier recorded as endemic to Assam. The present collection is a record of its extended distribution to the Peninsular India.

Leskea perstricta Dixon, On rocky patches. *Ambalappara* (1000 m), *KPR 106369*. It is distributed in Nepal, Bhutan, Bangladesh and India (Himalayas, Andaman Islands, Arunachal Pradesh). The present collection is a new record for Peninsular India.

Leucobryum bowringii Mitt., On base of tree trunk. *Ambalappara* (1000 m), *KPR 99842*.

Leucodon secundus (Harv.) Mitt., Epiphytic. *Ambalappara* (1120 m), *KPR 106373*. It is distributed in India (Darjeeling, Arunachal Pradesh, Western Hiamalayas, Andaman and Nicobar Islands), Nepal, Tibet, Japan, Bhutan and Bangladesh. The present collection is a new record for Kerala State.

Leucoloma mittenii M.Fleisch., On logs and on bark. *Uruppukunnuu* (700 m), *MCN 99710*; *Chavachi* (180 m), *MCN 87533*. A south-east Asiatic species; in India it is distributed in the Western Himalayas, Tamil Nadu and Kerala.

Macromitrium turgidum Dix., Epiphytic. *Ambalappara* (1500 m), *KPR 99808*, *KPR 99816/a*. It is distributed in Eastern India (Arunachal Pradesh) and Thailand. The present collection is a new record for Peninsular India.

Macrothamnium macrocarpum (Reinw. & Hornsch.) M.Fleisch., On tree trunks. *Ambalappara* (1450 m), *KPR 106694* (CALI). A widespread Indo-Pacific species.

Meteoriopsis reclinata (Müll.Hal.) M.Fleisch., On small branches of trees and shrubs. *Ambalappara* (1400 m), *KPR 106691*. It is distributed in North-eastern India (Darjeeling, Manipur, Naga hills, Khasi hills, Assam, Arunachal Pradesh), Southern India (Kerala, Tamil Nadu, Karnataka), Bhutan, Nepal, Thailand, Laos, Yunnan, Taiwan, Japan, Java, Celebes, New Guinea and Australia.

Neckeropsis andamana (Müll.Hal.) M. Fleisch., On small branches. *Chavachi* (180 m), *MCN 87587*. It is distributed in India (Andaman & Nicobar Islands, Kerala), Sri Lanka, Burma, Thailand, Vietnam, Singapore, Java and Philippines.

Neckeropsis exserta (Hook. ex Schwaegr.) Broth., Epiphytic. *Chavachi* (400 m), *MCN & KPR 99728*. It is distributed in North-eastern India (Darjeeling, Assam, Khasi, Orissa, Mussoori), Peninsular India (Andhra Pradesh, Tamil Nadu), Thailand, Malaya and Philippines. The present collection is a new record for Kerala State.

Octoblepharum albidum Hedw., Epiphytic and on logs. *Chavachi* (150m), *MCN 87577*.

Oxystegus tenuirostris (Hook. & Taylor) A.J.E.Sm., On small rocks. *Ambalappara* (1100 m), *KPR 99764*. A widely distributed species.

Pelekium velatum Mitt., On rocky patch. *Uruppukunnu* (750 m), *MCN 99713*, *Valayamchal* (40 m) *MCN & KPR 99708/a*. It is an Indo-Malesian species distributed in North-eastern India (Arunachal Pradesh), Southern India (Tamil Nadu), Myanmar, Thailand, Singapore, Sumatra and Java. This is a new record for the Kerala State.

Philonotis fontana (Hedw.) Brid., On land cuttings and on rocky patches. *Ambalappara* (1000 m), *KPR 106375*. Distributed in Northern India (Himalaya, Kangra, Kedar Nath, Sikkim), Southern India (Kerala), Western Tibet, Philippines, North and Central Asia, Europe and North Africa.

Philonotis hastata (Duby) Wijk & Marg., On soil and rocky patches. Way to *Ambalappara* (1150 m), *KPR 106689*. A widely distributed species.

Philonotis thwaitesii Mitt., On land cuttings. Way to *Ambalappara* (1250 m), *KPR 106692*. It is a widely distributed species.

Pinnatella calcutensis M.Fleisch., Epiphytic. *Ambalappara* (1000 m), *KPR 99818/b*, *Meenmutty* (430 m) *MCN 87475*. It is a South-east Asiatic species reported from Southern India (Kerala, Karnataka), North-eastern India (West Bengal, Darjeeling, Orissa) and Thailand.

Plagiobryum cellulare (Hook.) J.R.Spence & H.P.Ramsay, On land cuttings along with other mosses. *Ambalappara* (1370 m), *KPR 106687*. A wide spread species distributed in Northern India (Western Himalayas), Southern India (Kerala), Nicobar Islands, Nepal, Myanmar, China, Japan, Sumatra, Java, Philippines, Taiwan, Europe, North & Central Africa and Australia. Nair *et al.* (2005) reported this species as new record for the Peninsular India as *Bryum cellulare*.

Plagiomnium rostratum (Schrad.) T.J.Kop., On wet rocks, earth cuttings and base of trees near streams. *Ambalappara* (1500 m), *KPR 106688*. A widely distributed species.

Pogonatum microstomum (Schwaegr.) Brid., On land cuttings. *Ambalappara* (1450 m), *KPR 106680*. A widely distributed species.

Pterobryopsis acuminata (Hook.) M.Fleisch., Epiphytic. *Ambalappara* (1500 m), *KPR 99822*. It is distributed in North-eastern India (Sikkim, Khasi hills), Southern India (Tamil Nadu, Kerala), Myanmar and Nepal.

Pterobryopsis orientalis (Müll.Hal.) M.Fleisch., Epiphytic. *Ambalappara* (1100 m), *KPR 99817*. A South-east Asiatic species found distributed in Southern India (Tamil Nadu, Kerala), North-eastern India (Mussoorie, Kumaon, Darjeeling, Sikkim, Naga hills), Nepal, Myanmar, Thailand, North Vietnam and Yunnan.

Ptychostomum capillare (Hedw.) D.T.Holyoak & N.Pedersen, On damp soil or on small rocks in semi-shaded areas. *Ambalappara* (1350 m), *KPR 106686*. It is a cosmopolitan species found distributed in Southern India (Tamil Nadu, Kerala), Northern India (Western Himalaya, Kashmir), China, Thailand, Vietnam, Taiwan, Korea, Japan, Siberia, Central Asia, Europe, North & Central Africa, North & South America, Australia and New Zealand. Earlier known from India as *Bryum capillare*.

Ptychostomum pseudotriquetrum (Hedw.) D.T.Holyoak & N.Pedersen, On soil in grasslands and on rocky patches. *Ambalappara* (1050 m), *KPR 99789/b*. A cosmopolitan species distributed in North-eastern India (Kumaon Himalaya, Sikkim, Kashmir), Nepal, Korea, Columbia, Ecuador, Siberia, Venezuela; Europe, Australia, Africa and Antarctica. Nair *et al.* (2005) reported this species as new record for the Peninsular India as *Bryum pseudotriquetrum*.

Racopilum orthocarpum Wils. & Mitt., On a wide variety of habitats such as bark of trees, logs, bare rocks and soil. *Ambalappara* (1350 m), *KPR 106690*. A widely distributed species.

Rhodobryum roseum (Hedw.) Limpr., On rocky patches near stream. *Ambalappara* (1075 m), *KPR 99836*. A cosmopolitan species.

Rhynchostegium hookeri Sauerb., Epiphytic. *Ambalappara* (1100 m), *KPR 99853/a*. It is distributed in North-eastern India (Sikkim, Darjeeling, Arunachal Pradesh, Nainital), Sri Lanka. The present collection is a new record for Peninsular India.

Schizomitrium papillatum (Mont.) Sull., Epiphytic. *Paripputhodu* (150 m), *MCN & KPR 87619*, *MCN & KPR 87620*. It is a wide spread species distributed in Southern India (Kerala), Andaman Islands, Sri Lanka, Vietnam, Malay, Sumatra, Java, Borneo, New Guinea, Philippines, New Caledonia, Fiji and Samoa. Earlier known in India as *Callicostella papillata*.

Splachnobryum assamicum Dix., On land cuttings. *Meenmutty* (450 m), *MCN 87479*. It is an Indian endemic species earlier recorded only from Assam. The present collection is a new record for Peninsular India.

Taxiphyllum taxirameum (Mitt.) M.Fleisch., Epiphytic. *Meenmutty* (450 m), *MCN 87472*. A widely distributed species.

Thamnobryum siamense (Horik. & Ando) Nog., Epiphytic. *Meenmutty* (450 m), *MCN 87505*. A south-east Asiatic species distributed in India (Assam; Lushai hills), Eastern Nepal and Thailand. The present collection is a new record for Peninsular India.

Thuidium pristocalyx (Müll.Hal.) A.Jaeger, Epiphytic and also lithophytic. *Ambalappara* (1000 m), *KPR 99778*. Widespread in tropical and subtropical areas of Asia and Oceania.

Timmiella anomala (Bruch & Schimp.) Limpr., On rocky patches where water drips regularly. *Ambalappara* (980 m), *KPR 106374*. It is distributed in Northern India (Kashmir, Uttarkhand, Nainital, Himalayas) Southern India (Tamil Nadu), Pakistan, China, Melanesia, Mexico, Central America, Siberia, Central Asia, Mongolia, Europe, Africa and America. The present collection is a new record for Kerala.

Trachypodopsis serrulata (P. Beauv.) M. Fleisch., Epiphytic. *Ambalappara* (1000 m), *KPR 99853/b*. Widely distributed in North-east India (Simla, Mussoorie, Sikkim, West Bengal), Southern India (Tamil Nadu, Kerala), Andaman Islands, Nepal and Bhutan.

Trachypus bicolor Reinw. & Card., On tree trunks and on branches. *Ambalappara* (1050 m), *KPR 99788*. It is distributed in Southern India (Kerala, Tamil Nadu), North-eastern India (Western Himalayas, Sikkim, Assam), Nepal, Myanmar, Sri Lanka, Indonesia, Celebes, Philippines, Sumatra, Barnes, Australia, New Guinea, China, Japan, French Guinea, Brazil, Mexico and Guatemala.

Trematodon longicollis Michx., On rocky patches. *Meenmutty* (430 m), *MCN 87483a*. It is a cosmopolitan species distributed in Southern India (Kerala, Tamil Nadu, Karnataka), North-eastern 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.

Vesicularia dubyana (Müll.Hal.) Broth., It is submerged and attached to rocks. *Chavachi* (180 m), *MCN & KPR 87536*. A widespread Asian aquatic moss distributed in Philippines, Singapore, China and New Caledonia. This has been largely used in the aquarium trade. However, in the present study area it was found growing wild in the forest stream. There is no other record of its occurrence from India in wild or cultivation. Hence it is reported here as a new record for India.

Discussion

The Aralam Wildlife Sanctuary, a part of the Nilgiri Biosphere Reserve in the Western Ghats of India is rich in bryophyte diversity, with unique combination of species, not seen in other parts of the Western Ghats. The occurrence of 116 species of bryophytes from a comparatively small area (55 km²) highlights its high biodiversity potential and conservation values. When compared to other bryologically well explored Protected Areas such as Eravikulam National Park with 115 species in 97 km² (Madhusoodanan et al. 2007); Chinnar Wildlife Sanctuary with 60 species in 90.442 km² (Nair et al. 2006); Wayanad Wildlife Sanctuary with 170 species in 344.44 km² (Nair et al. 2005a), Kakkayam Forests (the proposed Malabar Wildlife Sanctuary) with 52 species in 34 km² (Nair et al. in press (b)), the Aralam WLS is thus unique in holding the richest bryodiversity. The present report is based on the rapid biodiversity assessment programme conducted in this Sanctuary. In addition to the presence of many phytogeographically significant new records, the occurrence of *Vesicularia dubyana* in the wild is a notable feature of the area. This submerged aquatic moss, reported as largely been used in aquarium trade, is found growing naturally in the forest stream. Most of the new records were from the hilltop evergreen forests of *Ambalappara* region, which indicates the unique nature of this vegetation type as well as its high conservation potential.

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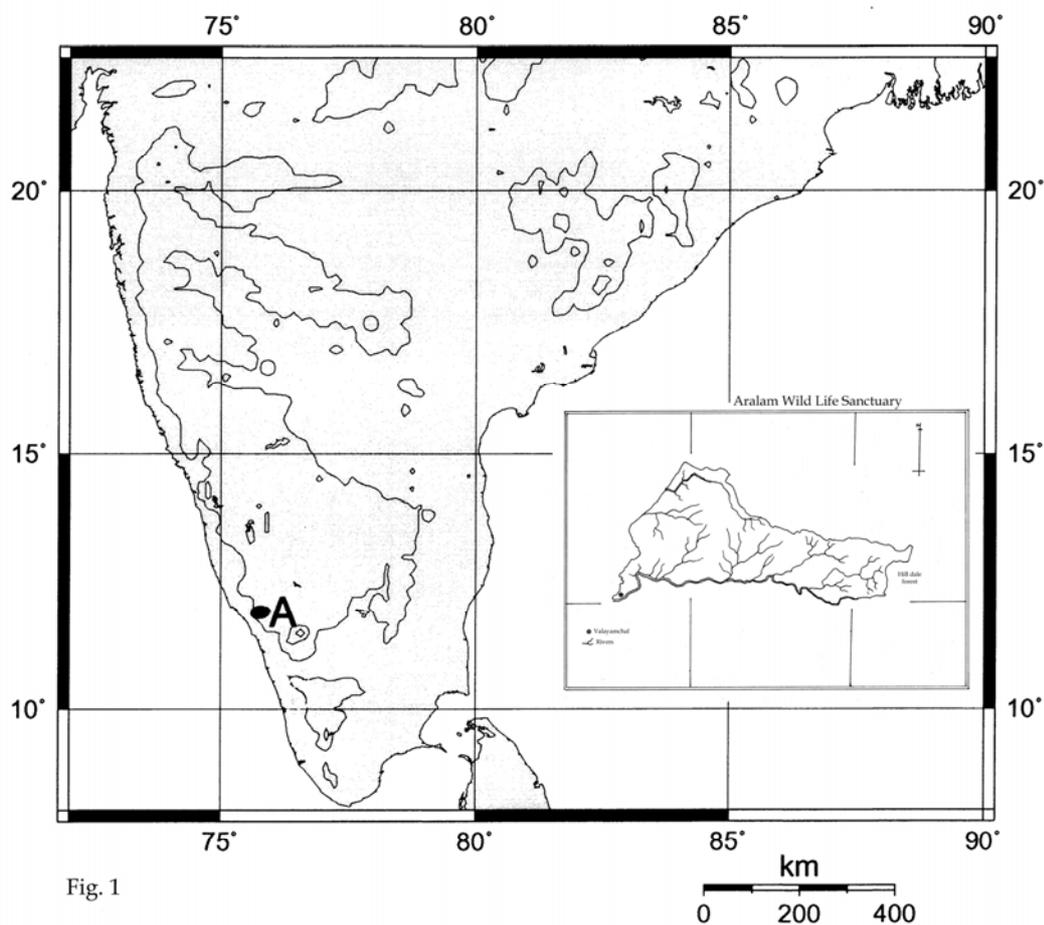


Fig. 1