SYSTEMATIC STUDIES ON THE BRYOPHYTE FLORA OF MATHIKETTAN SHOLA NATIONAL PARK, KERALA, INDIA

Thesis submitted to the
University of Calicut in partial fulfillment of the
requirements for the award of the Degree of

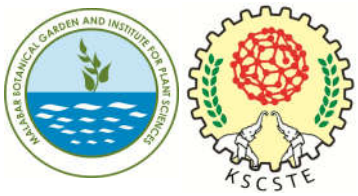
Doctor of Philosophy in Botany

by

RAJILESH, V.K.
U.O. No. DOR/B3/3296/Ph.D. - 2012 dtd. 29. 10. 2012

under

Dr. R. Prakashkumar
(Guide)
&
Dr. Manju C. Nair
(Co guide)



KSCSTE-Malabar Botanical Garden and Institute for Plant Sciences
Kozhikode, Kerala-673 014, INDIA
October 2019

KSCSTE-Malabar Botanical Garden & Institute for Plant Sciences (KSCSTE-MBGIPS) is an institution of the Government of Kerala, administered by the Kerala State Council for Science Technology and Environment (KSCSTE), dedicated to the conservation and research on aquatic plant diversity, lower group plants, endangered plants of the erstwhile Malabar Region, as well as disseminating knowledge on various facets of plant sciences. By virtue of possessing a vast morass land, the Malabar Botanical Garden and Institute for Plant Sciences becomes unique in the nation ideal for ex situ conservation of aquatic/wetland plants and for undertaking research on them. The educational value of the Garden lies with the descriptive labels displayed for the different sections and plants.

KSCSTE-MBGIPS

KSCSTE - MALABAR BOTANICAL GARDEN AND INSTITUTE FOR PLANT SCIENCES

(An Institution under Kerala State Council for Science, Technology & Environment)

Post Box No. 1, Kozhikode - 673 014, Kerala, India. Phone: +91 495 2430939

Email: malabarbot.garden@gmail.com, www.mbgs.in

CERTIFICATE

This is to certify that the thesis titled **"Systematic studies on the Bryophyte flora of Mathikettan Shola National Park, Kerala, India"**, submitted to the University of Calicut by **Mr. Rajilesh V. K.** in partial fulfilment for the award of the degree of Doctor of Philosophy in Botany is the bonafide record of research work done under my guidance and supervision. No part of this work has been presented elsewhere for any degree or diploma previously.

Calicut-14
Date:

Dr. R. Prakashkumar

POST GRADUATE & RESEARCH DEPARTMENT OF BOTANY
THE ZAMORIN'S GURUVAYURAPPAN COLLEGE
(Established in 1877. Affiliated to University of Calicut. Re-accredited by NAAC with A Grade)
Guruvayurappan College P.O., Kozhikode-673014, Kerala
Web. www.zgcollege.org Phone: 0495-2331516 Email zgckozhikode@gmail.com

Dr. Manju C. Nair, M.Sc., Ph.D., PDF
Assistant Professor of Botany

CERTIFICATE

This is to certify that the thesis entitled entitled **"Eco-Systematic Studies on Bryophytes of Malabar Wildlife Sanctuary, Kerala"** submitted to the University of Calicut by Ms. Prajitha B., Research Scholar, Malabar Botanical Garden & Institute for Plant Science, Kozhikode, in partial fulfillment of the requirements for the award of the degree of Doctor of Philosophy in Botany, has been carried out by her under my Co-Guidance. This work is original and has not been submitted in part or full for the award of any degree or diploma in any University.

Place: ZGC
Date:

(Dr. Manju C. Nair)
Co-guide

DECLARATION

I, Rajilesh V.K., hereby declare that the thesis entitled "**Systematic studies on the Bryophyte flora of Mathikettan Shola National Park, Kerala, India"**, being submitted in part fulfilment of requirements for the degree of Doctor of Philosophy in Botany of the University of Calicut embodies the results of a bonafide research work done by me under the guidance of Dr. R. Prakashkumar, Director, JNTBGRI, Palode, Thiruvananthapuram and co-guidance of Dr. Manju C. Nair, Assistant Professor of Botany, The Zamorin's Guruvayurappan College, Kozhikode and that no part of it has previously formed the basis for the award of any degree, diploma, associate ship, fellowship, title or recognition.

Place: MBGIPS **Rajilesh. V.K.**
Date:

ACKNOWLEDGEMENTS

I express my heartfelt gratitude and indebtedness to my research guide Dr. R, Prakashkumar, Director, KSCSTE Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Palode, Thiruvanathapuram (Former Director, KSCSTE-MBGIPS, Kozhikode-14) for his full support, understanding and consistent encouragement throughout the course of my work. I express my sincere gratitude to Dr. Manju C. Nair, Assistant Professor, PG & Research Department of Botany, the Zamorin's Guruvayurappan College, Kozhikode for her co-guidance, inspiring comments, expertise opinion and encouragement throughout my work.

I wish to place on record my sincere gratitude to Dr. S. Pradeep Kumar, Director in Charge, KSCSTE-Malabar Botanical Garden & Institute for Plant Sciences (MBGIPS), Kozhikode for providing the necessary facilities and infrastructure to carry out my work.

With great pleasure I record my sincere thanks to the Kerala State Council for Science Technology & Environment for the fellowship in the Science Research Scheme during the period 2011-2014.

It is my pleasure and privilege to place on record my respect, love and indebtedness to Prof. P.V. Madhusoodanan, Emeritus Scientist, MBGIPS, Kozhikode for his constant encouragement since the very beginning of the work till the end. I am indebted to Dr. R. Ansari, eminent taxonomist and former Managing Director of MBGIPS, Kozhikode for providing valuable suggestions and support throughout my work.

I sincerely acknowledge the help and encouragement of Dr. N.S. Pradeep, Senior Scientist, KSCSTE-MBGIPS and Dr. P.N. Krishnan, Emeritus Scientist, KSCSTE-MBGIPS, Kozhikode.

I am indebted to many scientists for their generous support in helping identification of some difficult taxa, for providing literature, guidance and encouragement, especially to Dr L.T. Ellis, Senior Curator, Natural History

Museum, London; Dr. Dulip Daniels, Associate Professor; Dr. Kariyappa K.C., Research Scholar, Scott Christian College, Nagercoil, Tamil Nadu; Dr. P. Uniyal, Department of Botany, Delhi University; Dr. A.K. Asthana, Principal Scientist & Group Leader, Bryology Laboratory & Dr. Ajith Pratab Singh, Scientist-C, CSIR-National Botanical Research Institute, Lucknow.

I am thankful to Dr. Santhosh Nampy, Professor of Botany & former Director of Research, University of Calicut; Dr. M. Sabu, Rtd. Professor of Botany, Dr. Jayaram, Rtd. Professor of Botany, Dr. Jos T. Puthur, Professor of Botany and Dr. A.K. Pradeep, Assistant Professor of Botany & Curator in charge, and the Librarian, the University of Calicut for constant encouragement, providing specimens lodged in University Herbarium and for providing literatures.

I am thankful to Dr. Udayan P.S., Assistant Professor, P.G. Department of Botany and Research Centre, Sree Krishna College, Guruvayur; Dr. Stephen Sequiera Assistant Professor, Maharaja's College, Ernakulam and Dr. S.V. Predeep, SVR NSS College, Vazhoor, Kottayam for their help rendered during the field trips.

I owe special thanks to the Chief Wildlife Warden of Kerala state, Divisional Forest Officer, Munnar and Range Officer and other forest staff of Mathikettan Shola National Park, Idukki for granting permission in the field studies and rendering necessary assistance in the field.

My sincere and heartfelt thanks to Research Fellows and Post Doc. Fellows of MBGIPS; Mrs. Prajitha B., Dr. Anoop K.P., Dr. Anoop. P. Balan, Dr. Neethu R.S., Mrs. Swetha Thilak, Mr. Mithun Venugopal, Mrs. Saranya Babu, Mrs. Athulya C.P., Mr. Rahul R., for their constant help and encouragement throughout the period of the study. I extend my thanks to Dr. R.B. Smitha, Dr. Abhilash Joseph, Dr. Sibi M.C and Dr. Arun K. Das of MBGIPS for their constant support and encouragement.

The meticulous assistance rendered by my other colleagues in MBGIPS;

Mr. Hareesh K.T. in field collections, Mr. Prasobh, Mrs. Priya Andrews, Mrs. Pavisha, P., Mr. Ajesh, P.P., Mrs. Liji, M., Mrs. Shilpa Raj and Ms. Aiswarya Srinivas in various stages of this work are gratefully acknowledged.

I wish to thank all the administrative and non-administrative staff of MBGIPS, Kozhikode for their valuable helps in various occasions during the course of this study.

I am deeply indebted to my beloved parents, my loving sister and her family for all their support, encouragement and blessings to accomplish this study. Above all, I thank the Almighty for showering the unseen blessings on me with which I am able to complete my work successfully.

Rajilesh V.K.

CONTENTS

INTRODUCTION

Bryophytes are the second largest group of land plants next to flowering plants and are considered as 'Amphibians of Plant Kingdom' due to their preference to aquatic or wet habitats. Earlier the bryophytes are considered as the non vascular plants, but the recent studies revealed that the bryophytes shows vasculatures like xylem and phloem known as hydroids and leptoids and are non tracheophytes due to the absence of tracheids and vessels (Glime, 2017).

The term 'bryophyta'(a Greek word means moss plant) introduced by Braun (1864) derived from '*bryon'* means a moss and '*phyton'* means a plant. He treated these plants under Acotyledonae with algae, lichens and fungi. Later this term has been used to denote the group of plants which includes the Hepaticae, Anthocerotae and Musci.

The life cycle of bryophytes is similar to pteridophytes in having two distinct phases the gametophytic and sporophytic phases. But they differ each other that in bryophytes gametophyte is prominent and sporophyte is short lived but in pteridophytes gametophyte is short lived and the main plant body is sporophyte. In bryophytes the first phase is haploid, which is dominant phase of the life cycle and the second phase is diploid, which depended on the gametophyte for its survival.

Bryophytes include three distinct lineages *viz*. Marchantiophyta (Liverworts), Anthocerotophyta (Hornworts) and Bryophyta (Mosses). Mosses have differentiated stem and leaves whereas liverworts lack such differentiation. Liverworts are with prostrate leafy thallus and thalloid forms which are deeply lobed or segmented. There are more than 20,000 bryophytes have been identified in the world. Among these, mosses comprising over 13,000 species (Goffinet *et al*., 2009). Liverworts (Marchantiophyta) and Hornworts (Anthocerotophyta) comprising 7486 species (Soderstrome *et al*., 2016). There are more than 600 species of liverworts in India and 190 species in Kerala (Manju & Rajesh, 2017). They inhabit in a variety of microhabitats such as soil (terrestrial), bark (epiphytic), leaves (epiphyllous), rocks (lithophytes) and water (aquatic) and play an important role in ecosystem

functions such as sequestering nutrients, retaining water, regulating the soil microenvironment and acting as carbon sinks (Vitt, 1990). Like other plant groups, bryophytes are threatened by habitat loss, pollution, over exploitation, invasive species and other factors. Several species of bryophytes (e.g.*Orthotrichum truncato-dentatum* Mull.Hal. and *Dactylolejeunea acanthifolia* R.M. Schust.) have been found extinct in the wild for many years especially because of the depletion of their original habitat. There has been less focus on bryophytes than on seed plants by botanical gardens and other conservation organization, just because they are often less charismatic or less known than seed bearing taxa, and their identification demands specialised expertise.

Bryophytes are ecologically and economically very significant. But due to less studies and unavailability of reference manual they have been treated as insignificant for the last few decades. But recently the studies on bryophyte taxonomy and other aspects has been increased tremendously and taxonomists and nature lovers give due preference to these tiny plants.

Multidimensional aspects of bryophyte taxonomy, ecology and molecular approaches have received attention all over the world during the last 50 years. This includes quantitative estimation of bryophyte communities, defining bryophyte growth forms, species diversity, correlation with environment and multivariate techniques, statistical methods such as regression, cluster and niche analysis and the use of these in various epiphytic, epilithic, mountain and aquatic bryophyte communities, mineral nutrition and molecular genetic studies.

Bryophytes which usually acting as space fillers in the ecosystem not only add visual richness to the natural beauty, but also plays key roles in the ecosystem dynamics such as nutrient and water recycling, soil protection, preventing leaching, making suitable microhabitats for the germination and establishment of seedlings and sporelings, providing food and shelter to many invertebrates, etc. These have been used as experimental models and as biomonitors and bioindicators of heavy metal pollution. They have proved to be invaluable in the investigations on the effects of atmospheric deposition of nitrogen and sulphur-containing compounds on

uplands. They are also important in preventing soil erosion and nutrient leaching. In addition to this, they are economically important being the source of food, medicine, preservatives, energy sources, etc. They can also be used as potential system in pollution monitoring and other experimental purposes. The evolutionary significance due to the prominence of gametophytes and other ecological preferences make them an ideal group for detailed studies.

Bryophytes are the oldest of all lineages of land plants and are believed to be the vital link in the migration of plants from aquatic environments into land. A number of physical features link bryophytes to both land plants and aquatic plants. The origin of bryophytes and their relationship to early land plants have been explained from fossil records. The ancestors of land plants were considered as fresh water origin and they were growing mostly close to the terrestrial habitat and thus exposed to temporal water level fluctuations. Such species in the course of time have overcome exposures to the aerial environment by developing drought resistant structures mostly the spores. The oldest spores which show the characteristics permanent tetrads a feature characteristic to land plants could have reported from the sediments of mid-Ordovician. The ultrastructure of spore wall of *Dyadospora* species and Sphearocarpelean liverworts give evidence to that at least some of the land plants have affinities with the liverwort lineage (Goffinet, 2000).

The *Sporogonites* from lower Devonian of Norway and Belgium (Halle, 1916) consists of long, erect, and unbranched axes bearing terminal sporangia similar to extant hepatics and the moss *Takkakia* (Goffinet, 2000). Moreover, *Sporogonites* has a columella – like projection a feature present in hornworts and primitive mosses Sphagnopsida, Andreaopsida and Takkakiopsida (Schofield, 1985). But the systematic position of *Sporogonites* and thus its significant in the evolution of bryophytes remain uncertain.

Hepaticites devonicus is the oldest fossil bryophyte dates from the upper Devonian and this plant is similar to extent taxon *Pallavicinia.* Other fossils such as *Muscites polytrichaceous* and *M. betrandi* are from the Upper Carboniferous (Krassilov & Schuster, 1984). The ornamentation of the Palaeozoic spores

Streelispora and *Aneurospora* has been compared to that of *Anthoceros* and used as evidence to support the presence of bryophytes in the Silurian (Richardson, 1985)

The antithetic and homologous theories of land plants discuss the relationship of bryophytes and its origin. Bryophytes show a peculiar feature where the sporophyte is short lived and attached to gametophyte. The gametophyte is free living and the biflagellate male gametes require water to reach archegonia. These reproductive constrains point to an aquatic ancestry and thus to the possible significance of bryophytes in the phylogeny of land plants. Hofmeister (1851) proposed that lifecycle of plants composed of two phases a gametophyte bearing sexual organs and sporophyte bearing spores and these fundamental phases are homologous among plants.

Bryophytes share some common features with Algae and on the other hand with Pteridophytes. The similarities with algae are in the nature of photosynthetic pigment, chlorophyll, cell wall component, photosynthetic product, flagella etc. Pteridophytes and Bryophytes share common life cycle pattern. According to Shaw and Goffinet (2000) liverworts were the first to diverge followed by mosses, while hornworts were the closest relatives of the vascular plants.

The bryophyte diversity of India is known with more than 2500 species. Even though this plant group is widely distributed in India, majority of it is concentrated in the Himalayan regions, and the Western Ghats. The efforts to document the diversity of these areas, are ongoing since long. However the large part of these areas are still remain unexplored or under explored. The data on Bryophyte diversity of the Western Ghats is meagre when considering the known values. At present it is known by about 950 species. Compared to the drier northern parts, the more moist southern part of the Western Ghats are diverse in terms of Bryophytes. The part of this hill chain, from the states of Karnataka, Tamil Nadu and Kerala, forms the biodiversity rich southern Western Ghats. The state of Kerala, completely influenced by the Western Ghats, harbours rich Bryophyte diversity. It is known by more than 630 species. However, it is assumed that, the extent of Bryophyte diversity of the state is yet to be known in full. The detailed search in

biodiversity rich areas such as Shola forests will be more productive. The present study was undertaken with this aspect. The Mathikettan Shola National Park (MSNP) is one of the most prominent patches of vegetation in Kerala, hence planned to explore its Bryophyte diversity in detail.

Objectives

- Explore the bryophyte diversity of Mathikettan shola National Park in different seasons.
- Systematic treatment of Bryophyte flora of Mathikettan Shola National Park with up to date nomenclature.
- To find out the present status of the taxa and to suggest the conservation measures.
- Studies on the ecological aspects of the species.
- Ex-situ conservation of collected specimens at Malabar Botanical Garden.

AREA OF STUDY

Mathikettan Shola National Park (MSNP), the present study area is located in the high ranges of South Western Ghats in the Idukki district of Kerala state. The name 'Mathikettan' has been derived from a Tamil term which literally means 'mind confuser', i.e. one who enters in to the National Park will struggle to find out the right path to outside.

Mathikettan forest area was part of the Cardamom Hills Reserve (CHR) notified in the erstwhile Travancore Government Gazette dated 24th August 1897, wherein the area was constituted as a Reserve Forest under section 18 of Regulation II of 1868. Subsequently various Government orders were issued for assigning the CHR area for cardamom cultivation as well as the control of the land and trees. The provisions contained in G. O. (MS) 804/58/Rev. dated the 9th August 1958 were being followed for the management of the CHR areas, wherein the control over the tree growth was vested with the Forest Department and control of land vested with Revenue Department. Hence there was a dual control over the CHR areas. Subsequently, vide G. O. (MS) No. 328/2002/RD dated the 17thOctober 2002, Government transferred 1281.7419 hectares of the said land to the administrative control of Forest Department. The Park represents the unique montane evergreen forest ecosystem and is an excellent habitat for a wide variety of plants and animals. Considering the unique nature of the Shola forests in Mathikettan and its importance as an elephant corridor, the State Wildlife Advisory Board recommended to declare the area as a National Park. (Department of Forests and Wildlife, Management plan of Mathikettan Shola National Park, 2009-18).

Location and terrain

The Park is situated within the geographic co-ordinates of 76°14' to 76°16'E longitude and 9°57' to 10°01'N latitude in the Poopara village, Udumbanchola taluk of Idukki district. The Eastern boundary of the National Park is contiguous with the

forests of Theni Forest Division, Tamil Nadu. The north, west and south area bounded by cardamom plantations of CHR (**Plate 2.1**).

The terrain is undulating with hillocks of varying heights. The altitude ranges between 1200-1984 m. The elevation increases from west to east and the highest point Madigatta (1984 m) is located in the eastern border of the Park adjoining Tamil Nadu. The forest is seen as a continuous patch from 1200 m up to 1500 m, above which it is seen as small patches dispersed among the grass land. Three streams namely *Uchinikuthipuzha*, *Mathikettan Puzha* and *Njandar* being the tributaries of *Panniyar* originate from these forests.

Soil

The soil is very dark brown, granular, porous and friable, low in gravel content, rich in organic matter and all nutrients. Soil physical and chemical properties such as estimation of particle–size separates, soil pH, and organic carbon, available N, P, K, Ca and Mg were noticed from the records of Forest Department. The characteristic features of the upper slope soil and lower slope soil from Mathikettan Shola are shown in Table 1.

Table 1. Soil Properties (Department of Forests and Wildlife, Management plan, 2009-18).

Location	**Sand** %	**Silt** %	**Clay** %	**Soil pH**	**Organic carbon** %	**Av. N %**	**Av P** ppm	**Av.K** %	**Av.Ca** %	**Av. Mg** %
Upper Slope	67	11	22	4.9	3.30	0.03	10	0.24	0.05	0.03
Lower Slope	62	13	25	4.9	4.05	0.04	11	0.25	0.05	0.02

Climate

Rainfall

The MSNP lies on the Kerala-Tamil Nadu interstate border. The Park receives southwest and northeast monsoon, the North East being the prominent one. The average annual rainfall ranges between 2000-2700 mm. The previous data indicate that the maximum annual rainfall observed was 2892 mm during 2014 while the minimum rain recorded was 1615 mm during 2008. The last 5 years annual rainfall details are given in Table 2.

Table 2. Rain fall Data (Department of Forests and Wildlife, Management plan, 2009-18).

Year	Rain Fall (mm)
2012	2249.13
2013	2198.22
2014	2892.00
2015	2272.82
2016	2576.00
2017	1915.11

Temperature

The temperature varies with a minimum of 9.5˚C (December) to a maximum of 30˚C (April). The Maximum temperature ranges from 27.6˚C to 33˚C and the minimum temperature ranges from 9.5˚C to 16.74˚C. The coldest months are December and January when the minimum temperature inside forests falls up to 9˚C even at lower elevations. The last 5 year maximum and minimum temperature is given in Table 3.

Table 3. Temperature Data. (Department of Forests and Wildlife, Management plan, 2009-18).

Year	Max. Temp.	Min. Temp.
2012	25.72	15.92
2013	29.31	16.66
2014	31.33	16.44
2015	28.62	16.43
2016	25.64	15.90
2017	24.33	15.92

Humidity

During southwest and northeast monsoons the average humidity of the area is maximum and varies from 80% to 90%. Humidity is low during summer months (February-April), i.e. 50% to 60%.

Vegetation

The dominant vegetation types of the study area are West coast tropical evergreen forests, Shola forest and Grasslands.

West coast tropical evergreen forests:

It is the climax vegetation in Kerala and is best represented at 600 to 1200. At certain places it extends up to 1400 m. The forest type is reaching a height of 0-45 m and is encountered at places where the minimum rainfall is at least 2000 mm. /year. Most of the trees are buttressed up to about 15 m with festooning of trees with Bryophytes, lichens, aroids, ferns, orchids, etc. Common trees of the top storey include species like *Bhesa indica* (Bedd.) Ding Hou*, Calophyllum calaba* L., *Canarium strictum* Roxb*., Chionanthus* sp., *Cullenia exarillata* A. Robyns, *Drypetes* sp., *Dysoxylum malabaricum* Bedd. ex C.DC., *Elaeocarpus* sp., *Holigarna* sp. *Litsea* sp., *Mesua ferrea* L*., Palaquium ellipticum* (Dalzell) Baill., *Persea macrantha* (Nees) Kosterm., *Syzygium* sp., *Vateria indica* L*.,* etc. The second storey of the forest formation is about 20 m height dominated by species like *Aglaia* sp.,

Actinodaphne sp., *Baccaurea courtallensis* (Wight) Mull.Arg., etc. The third storeys are generally less than 15 m height and are represented by small trees like *Agrostis* sp., *Euonymus* sp., *Memecylon* sp., *Syzigium* sp., *Turpinia malabarica* Gamble, etc.

Grasslands

In Kerala grasslands are generally found above 1500m altitude. The grasslands are characterised by herbaceous and shrubby species mixed with grasses. The high altitude natural grasslands are located along the northern and eastern boundaries of MSNP. These high altitude grasslands consist of grasses, herbs and shrubs. The grasslands are adjacent to medium or high elevation evergreen forests, where sparsely found trees like *Careya arborea* Roxb., *Phyllanthus emblica* L., *Terminalia* sp. and in some places a dwarf palm *Phoenix loureiroi* Kunth is found in patches. The commonly represented grasses are *Agrostis pilosula* Trin., *Androprogon* sp., *Arundinella* sp., *Chrysopogon* sp., *Cymbopogon* sp., *Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult., etc. In cattle grazed and frequently burnt areas, unpalatable *Cymbopogon* sp. and *Pteridium* sp., a fern are frequent. The Shrubby plants like *Berberis* sp., *Gaultheria fragrantissima* Wall., *Hypericum mysurense* F. Heyne , *Lobelia* sp., *Oldenlandia* sp., *Osbeckia* sp. etc. are frequent in the grasslands. The grasses in this zone are mixed with other herbs like *Crotalaria* sp., *Desmodium* sp., *Polygala* sp., etc.

Shola Forest

Shola forest is the continuation of the 'West Coast Tropical Evergreen Forests' in the higher altitudes. Shola forests have high ecological significance in protecting the head waters of rivers. They have the capability of holding up of water received by precipitation like a sponge and thus preventing rapid run off. The vegetation is also very characteristic. The trees are stunted with an umbrella shaped canopy. The branches are crooked and densely covered with epiphytic mosses, ferns lichens and orchids. The shola patches are seen from about 1500-1800 m. The dominant tree species are *Beilschmiedia wightii* Benth. & Hook. f., *Cinnamomum wightii* Meisn., *Elaeocarpus munronii* Mast., *Eurya japonica* Thunb., *Isonandra perrottetiana* A.DC., *Pittosporum dasycaulon* Miq., *Rhododendron arboreum* Sm., *Syzigium* sp., *Vaccinium leschenaultii* Wight., *etc*. As the extent of sholas is so small and as they occupy very inaccessible mountain tops,

having a very hostile climate, there are still some regions, which remain unexplored. (**Plate 2.2-2.4**. shows different vegetation view of the study area).

Fauna

The MSNP provides an excellent habitat for a wide variety of mammals, butterflies, reptiles and birds. The important mammals found in the Park are Tiger, Panther, Elephant, Nilgiri Tahr, Flying Squirrel, Gaur, Wild Boar, Sambar, Common Langur, Wild Dog, Civets, Jungle Cat, etc.

REVIEW OF LITERATURE

The first ever work in Taxonomy of bryophytes was "*Historia Muscorum*" by Dillenius (1741). Later Linnaeus (1753) included some mosses in his "*Species Plantarum*". The work in Nepal was published by Hooker (1808) as "*Musci Nepalensis*" later Hooker (1818-20) again studied further on it and published two volumes of *Musci Exotici,* included several new species. Hooker and Greville (1825) jointly published two papers on Indian Musci. Schwaegrichen (1811-1842) included some Indian mosses in his supplement to Hedwig's Species Muscorum. Extensive collection made by Wallich (1828-1832) to Burma, Nepal and Western Himalayas and published a list of 114 mosses in "Wallich Catalogue". Wallich (1841) enumerated 148 mosses collected from East Indies. The first important contribution to Indian bryology was 'Notulae and plantae Asiaticae'by Griffith (1842) included mosses and liverworts collected from Khasi hills in Assam.

Mitten (1859) recorded nearly 800 species of bryophytes under 95 genera and 19 families including many new species. A comprehensive list of 290 Liverworts species with several new one was published by Mitten (1860, 1861) in his Hepaticae Indiae Orientalis, which was mainly based on the collections from the Himalayas and Khasia hills and Sri Lanka. Mueller (1853, 1854a,b, 1871, 1878) presented many articles on the Indian mosses. Brotherus (1898, 1899) described a few mosses from North Western Himalayas and published 96 moss species with 20 new ones from Coorg in the Western Ghats in the successive years. Schiffner (1898) emphasized a large list of species from East India. A world monograph on liverworts '*Species Hepaticarum'*, published in six volumes by Stephani (1906-1924), which included description of a many bryophytes from the countries *viz.*, India, Myanmar, Sri Lanka, Andaman and Nicobar Islands, etc. Mueller's (1901) "*Scapaniae Indiae Orientalis*" and Gola's (1914) Kashmir Hepatics were valuable contributions on this topic. Contributions by Dixon (1910, 1930, 1942), Bartram (1955, 1960) and Robinson (1956) on Indian hepatics are also some valuable contributions. *Brachymenium turgidum* collected from Western Ghats by L. J. Sedgewick, was

described by Dixon (1909a). L J. Sedgewick collected mosses from southern regions of Bombay Presidency (Dixon, 1909b), sent to G. B. Savery, who published these with his Western Ghats collection including two new species is very valuable data of the mosses. Dixon (1914a, b) reported 42 species under 34 genera of mosses from Assam and 58 species under 40 genera from South India and Sri Lanka (collected by C.E.C.Fischer and others). Sedgewick's collections from North Kanara were designated by Dixon (1921) into 43 species of mosses under 27 genera. Dixon (1922) proposed seven new genera of mosses of which *Beddomiella funarioides* Dixon was from the Nilgiri hills. Dixon (1931) published 6 new genera which includes *Nanothecium* (Entodontaceae) collected from Travancore by Foreau. *Orthithecia delphus* (Entodontaceae) collected in 1928 by R. L. Bardhwar from Northwest Himalayas and *Hydrocryphae* (Cryphaceae) collected by F Kingdon ward from Abor Hills, Assam. On the basis of the collection made by Dr. Dixon (1937) recorded 208 species of mosses from Naga Hills in Assam. Dixon and Badhwar (1938) reported 17 mosses from Northwest Himalayas. Dixon (1942) recorded 16 new species mosses from North western Himalayas.

The detailed study on Indian bryology was started by S.R. Kashyap, later known as father of Indian Bryology. His contribution on various aspects of hepaticology was a great and valuable work to Indian Bryology (1914-1932). His first published article was on West Himalayan Hepatics (1914). Kashyap (1915) described two new species of *Anthoceros viz.*, *A. erectus* and *A. himalayensis* (the latter one is now called as *Phaeoceros himalayensis* (Kashyap) Prosk. from the Western Himalayas. Kashyap (1917) discovered another species of *Anthoceros viz., A. chambensis* from same locality. Kashyap (1929-1932) published "*Liverworts of Western Himalayas and Punjab Plain"*, which include 50 new species out of 161 species under 4 genera. *Anthoceros koshii* was described by Khanna (1936) from Kerala as new species of *Anthoceros*. They made a comparison of all the available species in India and described their sexuality, size, structure and distribution.

A list of the mosses collected from the Bombay Presidency was provided by Blatter (1929). The details of mosses collected from Madurai by Foreau, Andre,

Roin and Velle was published by Varde (1922, 1923a & b, 1924). Later, Varde (1925) described 14 new species and reported 32 mosses new to Southern India based on the explorations by Foreau from Madurai district, Tamil Nadu. Foreau (1930, 1931) detailed the bryological geography for the Presidency of Madras holds a list of 323 species. Pande (1936) described the earliest records of Indian liverworts collected by Dr Wallich and Wight in *Historical Review on studies of Indian Liverworts.*

Chopra (1938a) based on the Herbarium specimens in the Punjab University, recorded three new species and several new records in his notes on "*South Indian Hepatics"*. Chopra (1938b) also described three new species of *Riccia* with several new distributional records to South India. Pande and Srivastava (1942), from the Western Himalayas, illustrated new species of *Nowellia indica* (*Delavayella serrata* Steph). Later, from this area, Pande and Misra (1943) published a new species *Leptocolea himalayensis*. An illustrated account of five species of epiphyllous liverworts *viz. Rectolejuenea aloba* (Sande-Lac.) Steph., *Leptolejuenea lanciloba* Steph., *Cololejuenea hispidissima* (Steph.) Herzog. including two species new to the science – *Leptolejuenea himalayensis* Pande and Misra and *Cololejuenea himalayensis* Pande and Misra was published by Pande and Misra (1943). Chopra (1943) enumerated 626 species representing 114 genera and 18 families in his publication *Census of Indian Hepatics*, which also functions as a key to genera. *Pallavicinia canarus* Steph. is a species established by Ghosh and Chakravarthy (1943).

Mehra and Handoo (1953) provided a note on the phylogeny of Anthocerotales by carrying out a study on the morphology of *Anthoceros erectus* Kashyap and *A. himalayensis* (*Phaeceros himalayensis* (Kashyap) Prosk. An account of the distribution of *Pallavicinia* species including *P. canarus* was given by Pande and Srivastava (1953). Pande *et al.* (1954) gave an elaborate study on some of the little known species of *Asterella* and reported *A. multiflora* Steph. and *A. maculata* (Steph.) Parihar. They also provided an account on the distribution of Indian species of *Asterella.*

Kachroo (1954)) studied the distribution of the family Rebouliceae with about 39 species in India. An account on the morphology of *Pallavicinia abmbigua* (Mitt.) Steph., *P. lyellii* (Hook.) Gray and *P. longispina* Steph. was specified by Kachroo (1956). A preliminary list of the mosses of Mussorie was published by Chopra *et al.* in 1956. This includes 143 species belonging to 77 genera and 27 families.

Gangulee described the bryophyte taxa of order Fissidentales, Ditrichaceae, Dicranaceae and Leucobryaceae in the year 1957, 1959, 1960 and 1961 respectively in his continuous of papers on the mosses of Eastern India. Gangulee (1985) presented 100 species of mosses with colour photographs in his *Hand book of Indian Mosses.* Noteworthy contributions including detailed taxonomic description, illustration and distribution map of each species of mosses was reported by Gangulee (1969-80) in his work *Mosses of Eastern India and adjacent regions-A monograph.*, being the basic reference manual to study the Indian Mosses.

Culture studies on *Phaeceros* sp. from the monsoon flora of Mussorie in the Western Himalayas was done by Proskeur (1957). Pande and Srivastava (1958) carried out systematic handling of *Riccardia levieri* Schiffin. A note on the morphological and ecological aspects of 23 liverworts of east Nepal was published by Banerjee (1958). The development of sex organ and morphology of family Rebouliaceae was presented by Kachroo (1958). Based on the collections made from Kodaikkanal, Coonoor and Ootacamund by T S Rao, studies were done by Noguchi (1958) reported 27 taxa including a new variety in his revision of the family Trachypodaceae of India.

Bapna (1958) made a study on the hepatic flora of the Mt. Abu and published a note on it. A detailed account of *Riccardia palmatiformis* Schiffin and *R. decolyana* Schiffin in their series on the genus *Riccardia* Gray in India was given by Schiffner *et al.* (1959).

Pande *et al.* (1960) provided a comprehensive description of the Indian species of the genus *Chiloscyphus* and *Heteroscyphus*. Srivastava (1960) made a thorough study on the species *Riccardia levieri* Schiffin. from India. He added

further information on Indian Metzgerinae in 1961 after making a detailed study on *Pallavicinia lyellii* (Hook.) Carruth. Inoue (1960) discussed some species of *Plagiochila* from the Himalayas and Inoue (1965) gave a synopsis of *Plagiochila* in the Himalayan region including North Western India, Nepal, Bhutan and Sikkim.

Detailed accounts on the morphology of *Anthoceros crispulus* (Montin) Douin and *A. gemmulosus* (Steph.) was published by Bhardwaj (1950, 1960), a noted contributor to the group Anthocerotales. Foreau (1961) gathered all the results on the moss flora of Palni Hills and specified 424 species. Some species including one new species and a new variety of the family Bryaceae and Bartramiaceae was enumerated by Ochi (1964) from Darjeeling & Sikkim. 60 species of mosses under 35 genera and 13 families were collected by Vohra and Wadhwa (1964) from Nilkanth and Chaukhamb. Based on expedition collections made to Chooyu, Wadhwa and Vohra (1965) reported 36 species of mosses under 26 genera and 25 families.

137 species of mosses belonging to 70 genera and 27 families was listed by Srivastava (1966) from Kumaun. *Bryum klinggraeffi* was reported new to India along with 17 species of mosses from Delhi by Chopra and Kanta (1966).

A study on 12 species of *Bazzania* from the Himalayas including the territories of Nepal, Sikkim, Bhutan and north eastern India was made by Mizutani (1967) and thereby gave an account of five species of doubtful occurrence. The information of *Lepidozia flexuosa* Mitten from Darjeeling, Sikkim and Myanmar was also provided by Mizutani (1968). An ecological and distributional resume of the liverworts and mosses of India was given by Srinivasan (1968).

Several Indian species of the genus *Porella,* among its Asiatic genus are illustrated by Hattori (1967, 1969, 1970, 1971a) in a series of papers. Detailed study on the Anthocerotae and Hepaticae of eastern Himalayas was made by Hattori (1971b, 1975a-f).

Along with detailed description of 6 other species of *Habrodon* from Kashmir, Tehri and Dehra Dun, Vohra (1969a) reported the new species *H.*

kashmiriensis. Following this Vohra (1969b, 1970) reported 165 species of mosses including 3 species were new distributional record to India and 5 species new to Western Himalayas.

Udar and Nath (1973, 1975) reported *Cephalozia siamensis* N. Kitag. and *Leucolejeunea xanthocarpa* (Lehm. & Lindenb) A. Evans as new records to India during their studies on South Indian Hepaticae.

Srinivasan (1974) described 64 species of mosses collected from various parts of South India. In the monumental work *Taxonomy of Indian Mosses* published by Chopra (1975) includes about 2000 taxa under 329 genera and 56 families. It also contains the collection from neighbouring areas such as Pakistan, Nepal, Bhutan and Western and South Eastern areas of Tibet taking into account the extension of the species to other regions too.

Udar (1976), in his highly valued work *Bryology in India,* presented the detailed studies of Indian Bryophytes. Udar report the current trends in Indian Bryology. He made effort to revise the information on a wide range of topics *viz.* Cytology, Physiology, etc. In India Udar *et al.* (1970) began studies on oil bodies in liverworts, the foliose forms of taxonomic relevance. Udar and Nath (1971, 1976, 1977) were successful in describing the details of oil bodies in 12 South Indian liverworts from Palni Hills.

Srivastava and Udar (1979) conducted a study on the distribution of Metzgerials in India. Their study discloses that 25 species are found in Southern India and 13 of them are found in Eastern Himalayas. *Notothylas dissecta* Steph was reported from Agumbe, Karnataka and it was added to Indian Flora by Udar and Singh (1979a). Udar and Singh (1979b) described *Notothylas pfleidereri* from Mangalore.

Sharma *et al.* (1981) noticed the diversity in sporomorhs on a palynological study on 20 species of liverworts of Garhhwal Himalayas. 29 thallose liverworts were reported from Srinagar and adjacent areas by Gaur and Nautiyal (1981). The

detailed taxonomic description and illustrations of 65 mosses of Western Himalayas and adjacent plains was given by Chopra and Kumar (1981).

Udar and Kumar (1981) recorded the taxonomic details of *Jackiella javanica,* a rare and remarkable liverwort. Udar and Kumar (1982) also studied the genus *Chandonanthus* and reported the existence of all the three species of this genus only in Eastern Himalayas. An explanatory account on the Hypnobryales suborder Leskeineae of the Himalayas was given by Vohra (1983) he also recorded 42 genera and 161 species from Himalayas out of the 45 genera and 177 species occurring in India.

Porella chiinensis var. *crispata* is a variety from the Himalayas described by Udar and Shaheen (1982a). Udar and Shaheen (1982b) also described *Marchantia kashyapii* of common occurrence in Nilgiri and Palni hills. Udar and Shaheen (1982c) again reported *Folioceros pandei* from Kodaikanal with its taxonomic details.

Udar and Srivastava (1982, 1983a) were able to describe 3 new species of *Cololejeunea* viz., *C. pandei*, *C. dentifolia* and *C. mizutaniana* on grounds of *Cololejeunea* collection from Agumbe, Karnataka. Again from Agumbe, Udar *et al.* (1982) described *Caudolejeunea pluriplicata* and Udar *et al*. (1983) illustrated *Lopholejeunea gradstenii* Udar.

On a study on the genus *Leucolejeunea* in India, conducted by Udar and Awasthi (1983) it was noted that *L. xanthocarpa* (Lehm. & Lindenb.) A. Evans was the only species reported from Southern India, other than the 2 species represented in India. On a study carried out by Udar and Srivastava (1983b) on the reproductive biology of some Indian liverworts it was revealed that great restraints are imposed on the distribution due to reproductive limitations like non-viability of spores, etc.

A comprehensive report of the rare genus *Ceratolejeunea* in India was given by Udar and Shaheen (1985) with its only representative collected from wayanad in Kerala, *C. singapurensis* (Lindenb.) Schiffin.

Mohamed *et al.* (1986) contributed 42 species of mosses from Mahabaleswar, Pune and Khandale in North Western Ghats. The morpho-taxonomical studies of *Anthoceros crispulus* (Montin) Douin from South India was recorded by Srivastava and Asthana (1987). Cytochemical studies on the developing sporophyte in the moss *Physcomitrium cyathicarpum* Mittel was done by Ekalavya (1987). *Cololejeunea cardiocarpa* (Mont.) Steph. was reported as a new record to India by Srivastava and Srivastava (1989). They also described a new species *C. foliicola* from Southern India without details of the locality.

A clear depiction of the taxonomy of Indian Anthocerotae was given by Asthana and Srivastava (1991). Srivastava *et al.* (1994) studied liverworts in tea plantations in a tea garden in Darjeeling hosting 6 species *viz., Plagiochila duthiana* Steph., *P. forficate* Schiffin., *Porella campylophylla* var. *lingulifera* (Tayl.) Hatt., *Frullania neurota* Tayl., *Lejeunea flava* (Sw.) Nees and *Microlejeunea punctiformis* (Tayl.) Spr.

Chilosyphus polyanthus (L.) Corda is the only representative of *Chilosyphus* in Eastern Himalayas and a thorough study on this species was made by Srivastava and Udar (1995). Mitra (1995) studied growth and development of moss protonema and its morphology.

Negi and Gadgil (1997) studied species diversity of Garhwal Himalayas and they assessed that ecological factors like microhabitat and altitude are effect the species diversity and composition.

A detailed morpho-taxonomic account of 12 species of *Frullania* distributed in South India incorporating a key to species was given by Nath and Asthana (1998), along with a report on the distributional pattern and altitudinal range of each taxon. On account of the morphological and anatomical characters, Daniels (1998) provided ecological adaptations of some Bryophytes of Western Ghats.

A comprehensive depiction and general characters of Hepatics known in India is included in *Hepaticology in India* by Bapna and Kachroo (1999a &b). Srivastava and Sharma (2000) reported 29 species including a novel one,

Texilejeunea indica from Silent Valley of Kerala. This introductory account reports Liverworts and Hornworts belonging to Metzgeriales (4 spp.), Jungermanniales (17 spp.), Marchantiales (5 spp.) and Anthocerotales (3 spp.). So and Grolle (2001) reported 8 little known species of *Plagiochila* in Asia of which 6 species are from Himalayas.

Joshy (2001) made a floristic study on the 45 taxa of liverworts from Andaman Islands and evaluated it with those of Eastern and Western Himalayas, South India and neighbouring countries of India.

Daniels (2001) reported *Cololejeunea furcilobulata* (Berrie & Jones) Schust. and *Heteroscyphus argutus* (Reinw. *et al.)* Schiffin from Kanyakumari district. Singh *et al.* (2001) added *Porella hattorii* Udar & Shaheen to the bryoflora of Eastern Himalayas, which was reported earlier from Western Himalayas only.

The comprehensive taxonomic details of 8 species of mosses under 6 genera and 6 families from Great Himalayan National Park, Himachal Pradesh was described by Narayan *et al.* (2001). A preliminary study on certain liverworts of selected study areas of Garhwal Himalaya was made by Negi and Gadgil (2001).

After a gap of 150 years, *Folioceros glandulosus* (Lehm. & Lindb.) Bhard. was rediscovered from Arunachal Pradesh by Singh and Narayan (2002). The species shows an interesting bicentric, transoceanic, disjunct distribution between India and Australia. A detailed analysis on the family Geocalycaceae was made by Srivastava and Srivastava (2002). In it 27 taxa from India belonging to 4 genera is described *viz., Chiloscyphus* (5 spp.), *Heteroscuphus* (13 spp.), *Lophocolea* (7 spp.) and *Geocalyx* (1 sp.). Among them a few were novel introduction to science.

A detailed report on 25 species of mosses belonging to 18 genera and 8 families collected from Mt. Abu was given by Chaudhary and Deora (2001). Pant (2001) emphasized the check list of bryophyte diversity and its habitat of Kumaon Hills. The biochemical regulation of protonema differentiation in *Funaria hygrometrica* was reported by Kapoor and Bhatla (2001). A study was conducted by Pandey *et al*., (2001) regarding the bryophytes inhabit the bank of Ganga river,

which accumulate heavy metals such as Cu, Cr, Pb, Zn, Ni and Cd. A study on Indian Liverworts, its status, vulnerability and conservation was made by Singh (2001).

Mosses are the most studied one after thalloid and leafy worts. The anti-microbial activities of Bryophytes were studied by Banerjee (2001).

Fissidens grifithi from Kanyakumari district was added to Indian Bryoflora by Daniel and Daniel (2003a). In 2003b, they added 6 species as new record to Peninsular India.

Bryum tuberosum Mohamed and Damanhuri was recorded earlier from Peninsular Malaysia. Nair *et al.* (2004) recorded the same from Uduppi, Karnataka, as a new record for India. An addition to the Indian Bryoflora, *Frullania rotundistipula* Steph. from Khasi Hills was done by Singh and Nath (2004). Singh and Singh (2004) reported an addition of species, *Lejeunea flava* (Swartz) Nees, to the bryoflora of Western Himalayas.

Phytosociology, biomass and net primary production of bryophyte community growing on decaying logs in silver fir forest of Central Himalaya were recorded by Pande and Joshi (2004).

The epiphytic diversity of Hepaticae found in Cinchona plantations in Dodabetta, Nilgiri Hills was reported by Srivastava and Verma (2004). They reported a total of 13 species belonging to Jungermanniales and a single species of Metzgeriales.

Daniels (2010) provided a checklist of bryophytes of Tamil Nadu and 712 species were listed out, of which 211 species of liverworts belong to 56 genera and 32 families and 493 species of mosses belonging to 189 genera and 44 families. Singh *et al.* (2010) investigated Hepaticae of Andaman Island and 12 species were reported, of which 11 species belonging to the family Lejeuneaceae and one species under the family Marchantiaceae, three species *viz.*, *Cololejeunea gottschei* (Steph.) Mizut., *Lejeunea anisophylla* Mont. and *Marchantia linearis* Lehm. & Lindenb. were added to Anadaman & Nicobar Island. Dandotiya *et al.* (2011) provided a

checklist of bryophytes of India and reported 2489 species from India. It included 1786 species of mosses under 355 genera, 675 liverworts under 121 genera and 25 species of hornworts under six genera, of which 340 species were endemic to India. Singh and Singh (2011) added a species, *Ptilidium pulcherrium* (G. Weber) Vainio to Indian bryoflora. Dey and Singh (2011) described a new species *Lopholejeunea udarii* M. Dey & D.K Singh from Eastern Himalayas. Daniels *et al.* (2011) reported seven moss species new to Western Ghats from Agasthyamala Biosphere. Which include *Chaetomitrium papillifolium* Bosch &Sande Lac., *Entodon ovicarpus* Dixon, *Entodon scariosus* Renauld& Cardot, *Glossadelphus bilobatus* (Dixon) Broth., *Pseudobarbella ancistrodes* (Renauld& Cardot) M.G.Manuel, *Sematophyllum micans* (Mitt.) Braithw. and *Taxithelium kerianum* (Broth.) Broth. Daniels and Kariyappa (2012a) reported two liverworts new to Peninsular India *viz*., *Mastigophora diclados* (Brid. Ex F. Weber) Nees ex Schiffn and *Plagiochilion oppositum* (Reinw.) S. Hatt from Agasthyamalai Biosphere Reserve. Daniels and Kariyappa (2012b) described a little known moss species, *Lepidopilidium furcatum* (Thwaites & Mitt.) Broth. from Agasthyamala. Daniels *et al.* (2012) have studied Erpodiaceae of India and described taxa *viz*., *Aulacopium glaucum* Wilson, *Aulacopium beccarii* (Mull. Hal. Ex. Venturi) Mitt., *Erpodium glaziovii* Hampe, *Erpodium mangiferae* Mull. Hal and *Solmsiella biseriata* (Austin).

Schwarz (2013) updated that checklist of bryophytes of Karnataka and provided history of bryological explorations of Karnataka. The checklist included 113 liverworts under 42 genera and 20 families, nine hornworts under genera and two families and 216 mosses under 97 genera and 35 families. Verma *et al.* (2013) updated catalogue of Hepaticae and Anthocerotae of Nilgiri Hills. Hepaticae included 164 species under 55 genera and 29 families and Anthocerotae included five species under three genera and two families. Sahaya Sathish *et al.* (2013) studied status of bryophytes in India and listed out 2489 species, of which 1786 species under 355 genera, 675 species of liverworts under 121 genera and 25 species of hornworts under six genera.

Aruna (2014) studied the distribution of Bryophytes in Malanad Regions of Chick Mangalur district, Karnataka and reported 62 species from that region. Alam *et al.* (2015) enumerated the mosses of Central India comprising 210 species under 94 genera and 30 families.

Manjula and Manju (2016) revealed the distribution pattern of the genus *Fissidens* in the Eastern Ghats of Andhra Pradesh with eight species *viz., F. flaccidus* Mitt., *F. zollingeri* Mont., *F. diversifolius* Mitt., *F. crenulatus* Mitt., *F. crispulus* Brid., *F. taxifolius* Hedw., *F. ceylonensis* Dozy & Molk. and *F. pallidinervis* Mitt. Of which, *F. taxifolius* Hedw. and *F. pallidinervis* Mitt. were new for Eastern Ghats; *F. crispulus* Brid. and *F. ceylonensis* Dozy & Molk. were new for the state of Andhra Pradesh. Deepa and Manju (2016) reported a rare species of the genus *Clevea viz*., *C. pusilla* (Steph.) Rubasinghe & D.G. Long of the family Cleveaceae from the Western Ghats of Valpa0rai area of Tamil Nadu. Magdum (2017) provided a checklist of mosses of Maharashtra compiling 128 moss species.

Daniels *et al*. (2018) reported 2 species of *Symphysodontella* M. Fleisch. *viz*., *S. cylindracea* (Mont.) M. Fleisch. and *S. involuta* (Thwaites & Mitt.) M. Fleisch. from the Kolli Hills of Eastern Ghats. *S. cylindracea* is a new record to the moss flora of India and *S. involuta* is new to the moss flora of Eastern Ghats. Daniels *et al*. (2018) studied the bryoflora of Indira Gandhi National Park in Anamalai hills.

Manju *et al.* (2019) reported *Oreoweisia brevidens* Herzog an Indian endemic species of the family Dicranaceae as new record to Western Ghats. The species is reported from Nandhi hills in Karnataka state.

Bryophyte study with special reference to Kerala

Van Rheede (1678-1703), in his monumental work on South Indian Plants, Hortus Malabaricus, described one moss from Kerala known as '*Poovan-peda*' (Vol.12, t.37, p 71, 1693). This is taken as the first record on the bryophytes of Kerala. Nicolson *et al*. (1988) identified 'Poovan-peda' as *Bryum bicolor* Dickson. This is contradiction to the earlier interpretation as *B. coronatum* Schwaegr which is now treated as synonym of *B. dichotomum.* Dixon (1914b) recorded *Erythrodontium*

julaceum (Schwaegr) Par. as collected from Attappadi, Palakkad while reporting the mosses from South India and Sri Lanka, which were collected by C.E.C Fischer and others. *Census of Indian Mosses* is an exhaustive compilation by Bruehl (1931) which contains 2471 species under 371 genera of which 3 species are from Kerala *viz., Fissidens zippelianus* Dozy & Molk from the Travancore, *Webera rostrata* (C. Muell.) Broth. from the Malabar and *Brachymenium fischeri* Cardot & Dixon from Palakkad.

Depends up on the explorations made by T. K. Koshy from Idukki, Khanna (1936) described a new species *Anthoceros koshii.* Chopra (1938b) noted two species *viz., Riccia cruciata* Kashyap and *Aspirimitus erectus* Kashyap from Travancore without any record on the exact locality. Kachroo and Bapna (1963) reported *Riccia cruciata* Kashyap from the Travancore area. Kachroo (1956) collected *Pallavicinia ambigua* from some areas of Travancore while studying the genus.

Foreau (1964) reported *Bryum coronatum* Schwaegr from Idukki district and *B. curyphyllum* Dixon & P. Varde, *Philonotis subrigida* var. *adpressa* Cardot & P. Varde and *Physcomytrium insigne* Dixon & P.Varde from Kerala, but without a clear note on the localities. Bhardwaj (1965a) clearly illustrated *Anthoceros mamillisporus* (Bharadwaj) Bhardwaj collected from Kottayam and *A. dixitianus* (Mahabale) Prosk. A comparative morphological analysis of the genus *Phaeoceros* and *Anthoceros* was carried out by Bhardwaj (1965b). From Kerala, Kachroo (1967) described a new species *Anthoceros shivanandini.*

Srinivasan (1974) reported 64 species of mosses from South India but among them only *Fissidens schmidii* C. Muell from Thiruvananthapuram. Chopra (1975) on a detailed account of 200 species of mosses includes a few from Kanna Devan Hills of Travancore. Other reports from Kerala are *Homalothecium nilgheriense* (Montin) Robinson and *Stereophyllum subacuminatum* Dixon and P. Varde from the Travancore, *Leucoloma malabarense* Besch. ex Ren and Cardot from the Malabar area and *Syrrhopodon leucophanoides* Cardot and P Varde.

Pogonatum hexagonum is an endemic species reported from Silent Valley by Vohra (1981a). Vohra (1981b) pointed out 250 mosses were collected from Mullaperiyar and its catchment area in Idukki district. 83 species of mosses including 43 epiphytes, 37 growing on soil and rocks, 3 both epiphytic and epilithic, were reported from Silent Valley National Park by Vohra *et al.* (1982). They also described the 3 new species, one from the genus *Pinnatella* and two from *Fissidens. Handeliobryum setschwanicum* Broth. a saprophytes were also reported by them from this area .

The South Indian endemic species *Radula pandei* Udar and Kumar was recorded from Mukkali – Silent Valley of Kerala by Udar and Kumar (1983). 14 species of Marchantiales belonging to 8 genera was listed by Udar and Jain (1984) from Trissur, Idukki, Wayanad and Kottayam districts, being the first studies on the liverworts of Kerala. Udar and Awasthi (1984) collected *schiffneriolejeunea indica* from Kottayam and Mannarkkad in Kerala. Following this, Awasthi (1984), Awasthi and Srivastava (1985) report *Acrolejeunea* sikkimensis (Mizut.) Gradst from Kerala.

The report by Awasthi and Udar (1984) shows that *Mastigolejeunea humilis* (Gottsche) Schiff. has cosmopolitan distribution in Kerala. The genus of *Cephaloziella kiaerii* (Austin) Arnell., was recorded from Silent Valley, Munnar and Ponmudi areas by Udar and Kumar (1985). Nair and Madhusoodanan (2001) collected this species from Eravikulam National Park, Idukki. Udar and Kumar (1985) reported *Cylindrocolea tagawae* (N.Kitag.) Schust., a monotypic genus of the family was reported for the first time from Ponmudi, Thiruvananthapuram. The study on the genus *Ceratolejunea* was conducted by Udar and Shaheen (1985) and reported the occurrence of *C. singapurensis* (Lindenb.) Schiffin from Lakkidi, Kerala.

A new species *Folioceros udarii* reported from Silent Valley was described by Asthana and Srivastava (1986). Ellis (1989) taxonomically revised the genus *Calymperes* in Southern India and Andaman Nicobar Island includes two species from Ponmudi *viz.*, *Calymperes lonchophyllum* Schwaegr. and *C. tenerum* C. Muell.

Rajeevan (1990) in his Ph.D. theses enumerated 76 species of mosses and 19 species of liverworts from the high ranges of Idukki including 5 new species *viz. Diaphanodon ganguleei, Fissidens choprai, Macromitrium vohrai, Pohlia foreaui* and *Pterobryopsis keralensis* and three new varieties *Entodon macroporus* var. *indica, Philonotis hastata* var. *idukkiensis* and *Calycularia crispula* var. *udarii*.

Asthana and Srivastava (1991) recorded *Anthoceros bharadwajii, A.subtilis, A. erectus*, *Folioceros spinisporus* and *Phaeceroslaevis* subsp. *laevis* from Idukki district in the monographics studies on the Anthocerotales of India. *Fissidens ceylonensis* Dozy and Molk the common of species of Kerala was reported from Kallar, Thiruvananthapuram and *F. ceylonensis* var. *acutifolius* Dixon and P.Varde from Kumili, Idukki by Ellis (1992) .

A detailed morpho-taxonomic account of the genus *Cheilolejeunea* in India was given by Asthana *et al.* (1995) in which the description of *C. ghatensis* from Ponmudi, Thiruvananthapuram is provided. They also reported two species *viz, C.serpentina* (Mitt.) Mizut & *C. imbricita* (Nees) S. Hatt from Wayanad. *Frullania squarrosa* (R.Bl. & Nees) Dumort. from Wayanad and *F. tamarisci* (L.) Dumort from Idukki was recorded by Nath and Asthana (1998).

Srivastava and Sharma (2000) reported 29 species of liverworts and hornworts including *Texilejeunea indica, a* new record from Silent Valley. Awasthi *et al.* (2000) provided detailed account of the genus *Lopholejeunea* (Spruce) Schiffn of India and the recorded 5 species from Silent Valley and also provide one new variety of the genus *Lopholejeunea* from Palakkad.

Nair and Madhusoodanan (2001) reported 19 species of liverworts and mosses from Eravikulam National Park, Idukki including 6 new records to the state of Kerala. Further studies by Madhusoodanan *et al.* (2007) reported 115 species under 87 mosses and 28 liverworts from the same place. Nair and Madhusoodanan (2002) studied bryophyte flora of Kerala. Easa (2003) recorded 232 species including 63 liverworts and 169 mosses in a collection of the bryophytes of Kerala.

Madhusoodanan and Nair (2003) described *Ricciocarpos natans* (L.) Corda from Wayanad district and *Notothylas levieri* Schiffn. ex Steph. from Palakkad, as new record for South India. Nair and Madhusoodanan (2003a) presented the unexplored bryodiversity of Wayanad district giving a checklist of 100 species including 72 mosses, 25 liverworts and 3 hornworts. Among these 6 species *viz., Entodon flavescens* (Hook) A. Jaegr. & Sauerb., *Eurhynchium vagans* (A. Jaegr.) E. B. Bartram, *Floribundaria walkerii* (Ren & Cardot) Broth., *Heteroscyphus coalitus* (Hook.) Schiffn., *Marchantia linearis* L.and *Ricciocarpus natans* (L.) Corda were new records for South India and 12 species were new for Kerala.

Seven little known species of *Plagiochila* (Dumort.) Dumort. *viz., P. arbuscula* (Brid. ex Lehm. & Lindenb.) Lindenb., *P. beddomei* Steph., *P. chinensis* Steph., *P. devexa* Steph., *P. fruticosa* Mitt., *P. parvifolia* Lindenb. and *P. sciophila* Nees. ex Lindenb. from Eravikulam National Park in South India were described by Manju *et al.* (2008b), among these a few are new records to South India.

Madhusoodanan and Nair (2004) recorded 8 species of mosses from the Eravikulam National Park. Among them the species, *Chaetomitriopsis glaucocarpa* was new to *South India* and four species *viz., Hedwigidium integrifolium*, *Racopilum orthocarpum, Diaphanodon procumbens* and *Diaphanodon blandus* were new to Kerala. The book "Bryophytes of Wayanad in Western Ghats" was published by Nair *et al*. (2005a), which includes 171 species of bryophytes belonging to 105 genera and 47 families among these several new distributional records and 2 new species viz., *Trichostomum wayanadensis* and *Amphidium gangulii*. Nair *et al*. (2005b) recorded seven species of *Plagiochila* with one species *viz. P. arbuscula* (Bridv & Lindenb.) and three species *viz. P. chinensis* Steph., *P. devexa and P. fruticosa* Mitt. were new distributional record to India and Peninsular India respectively from Eravikulam National Park, Idukki. Nair and Madhusoodanan (2006) presented a checklist of bryophytes collected from the Vellarimala of Kozhikode district, Kerala. Nair *et al.* (2006) enumerated a preliminary account on bryophytes of Chinnar Wildlife Sanctuary, Idukki includes total 60 species viz.19 Liverworts, 1 hornwort and 40 mosses. The three taxa *viz.*, *Calypothecium wightii*

(Mitt.)M. Fleisch and *Pelekium gratum* from Wayanad and *Fabronia schensiana* C.Muell from Idukki and Wayanad were reported Nair *et al.* (2007) as new distributional record to Peninsular India. Based on the collections of Nair (2001-2014), Pocs *et al*. (2007) reported 33 Hepatic taxa from Kerala. Manju *et al*. (2008a) made a check list of bryophytes of Kakkayam forests in the Western Ghats of Kerala state which reported 52 species including 28 liverworts and 24 mosses. Manju *et al.* (2008a) presented a checklist of 148 liverworts species, 10 hornworts and 307 moss species of Kerala including several new reports to the State. Manju *et al*. (2009a) enumerated 90 species of bryophytes including 58 mosses and 32 liverworts from Agasthyamalai Biosphere Reserve, among these 16 taxa were new distributional record to Peninsular India. In the same year (2009b) they described 116 taxa from Aralam Wildlife Sanctuary, Kannur including 89 mosses and 27 Liverworts with 2 taxa were new addition of India and 21 taxa were new to Peninsular India. Shantanu (2010) reported 135 moss species belonging to 75 genera and 25 families in his P hD thesis, "Mosses of Idukki In Western Ghats". In 2010 Manju & Rajesh reported the genus, *Leptohymenium* Schwegr. was a new distributional record to Western Ghats.

The new species *Chiloscyphus chinnarensis* from Chinnar Wildlife Sanctuary, Idukki Dt. was reported by Manju *et al*., 2011. Followed by Manju and Rajesh (2011) enumerated a Checklist of the Bryophyte flora of Parambikulam Tiger Reserve, which includes 18 Liverworts, 1 hornwort and 39 mosses, among these total 58 taxa *Grimmia funalis* (Schwagr.) Bruch & Schimp. and *Thuidium subdeolicatulam* (Hedw.) Schimp. reported as new record to India, 10 taxa were new to Peninsular India and 4 taxa were new to Kerala. The bryophyte diversity of Kakkavayal Reserve Forest in the Western Ghats was studied by Manju *et al.* (2011).

Daniels *et al.* (2011) contributed two new records to India through the collection and description of *Daltonia angustifolia* Dozy & Molk and *D. contorta* Mull. Hall. from Agasthyamalai Biosphere reserve. Daniels *et al.* (2011) gave a detailed description and illustration of seven moss species from Agasthyamalai

Biosphere Reserve in India. Two new reports of liverworts from Agasthyamala Biosphere Reserve of Southern Western Ghats, Kerala were illustrated by Daniels and Kariyappa (2012a). Manju *et al.* (2012) reported *Trichosteleum stigmosum* Mitt. from Silent Valley National Park, Palakkad district, Kerala which was a new record for India. In the same year Manju *et al*. (2012) enumerated 76 taxa of Lejeuneaceae in Western Ghats of Kerala including three new taxa to India *viz., Archilejeunea abbreviate* (Mont.) Vanden Berghen from Agasthyamala, Thiruvananthapuram, *Otolejeunea semperiana* (Gottsche et Steph.) Grolle and *Tuyamaella angulistipa* (Steph.) Schust. & Kachroo from Aralam Wildlife Sanctuary, Kannur. The work also report one taxa new to South India *viz., Lejeunea cocoes* Mitt from Malabar Wildlife Sanctuary, Kozhikode and three taxa new to Kerala. *Archilejeunea minutilobula* Udar & Awasthi form Aralam Wildlife Sanctuary, Kannur, *Cololejeunea appressa* (A.Evans) Benedix and *Cololejeunea udarii* Asthana & Srivast. from Kakkavayal, Kozhikode. One new species *Symphysodontella madhusoodananii* reported Manju & Rajesh (2012) from New Amarambalam forest in Western Ghats of India.

Manjula *et al.* (2013) described the genus *Bazzania* in Kerala collected from Idukki, Munnar, Agastharmala, including *B. praerupta* (Reinw. Bl. et Nees) a new record to Peninsular India. Manju *et al.* (2014) enumerated 148 taxa including 36 liverworts, 3 hornworts and 109 mosses from Silent Valley National Park, Kerala. Among these 148 taxa, nine taxa were new distributional record to Peninsular India and four were new to Kerala. Rajesh and Manju (2014) reported list of 57 taxa based on their studies on the diversity of low land and mid land of Kozhikode District. Manjula *et al.* (2015) reported *Fissidens linearis* var. *obscurirete* for the first time from India from Kerala. The genus *Calycularia* reported from Mathikettan Shola National Park was first time from Kerala by Manju *et al.* (2015). Jyothilekshmi *et al.* (2016) reported 10 Liverworts and 19 Mosses from Vallikattukavu, Kozhikode. Rajilesh *et al.* (2016) presented 65 species of bryophytes were established at conservatory of Bryophytes in Malabar Botanical Garden and Institute for Plant Sciences.

Manju *et al.* (2017) reported a new leafy liverworts species *Cololejeunea manilalia* from New Amarambalam Reserve Forest. In 2017 Manju and Rajesh published a book "Bryophytes of Kerala-Liverworts", which includes 101 liverworts species. Rajilesh & Prakashkumar (2017) enumerated the genus *Entodon* from Mathikettan Shola National Park which includes *E. nepalensis*, a new record for Peninsular India. Mithun and Manju (2017) enumerated 37 species from Thamarassery pass, including 7 Liverworts, one Hornwort and 28 mosses, out of 37 taxa 2 mosses viz., *Taxiphyllum giraldii* (C.Muell.) M. Fleisch. and *Taxithelium laeviusculum* Dixon. were new to Peninsular India. Prajitha *et al.* (2017) described two mosses *viz*., *Phyllodon subretusus* (Thwaites. & Mitt.) and *Bryocrumia vivicolor* (Broth. & Dixon) Buck, new to India and Kerala respectively. Based on the collection from Malabar Wildlife Sanctuary Prajitha *et al.* (2017) reported a rare leafy liverwort *Nardia assamica* (Mitt.) Amakawa as new distributional record to Peninsular India.

Mufeed and Manju (2017) reported a rare liverwort *Porella perrottetiana* (Mont.) Trevis. from the Anamudi shola National Park as new record for Kerala. Manju *et al*., (2017) reported a tiny moss *Physcomitrium immersum* from the Peechi-Vazhani Wildlife Sanctuary as new record for Western Ghats. Manju *et al*., (2017) reported *Amblystegium serpens* (Hedw.) Schimp. of the family Amblystegiaceae collected from the Anakkampoyil area of Kozhikode district as new record for Peninsular India.

Rajilesh *et al*. (2018) reported *Plagiochila magna* Inoue for the first time to Peninsular India from Mathikettan Shola National Park in Idukki district. Mufeed and Manju (2018) reported a rare taxa *Gottschelia schizopleura* (Spruce) Grolle, of Jungermanniales collelcted from Anamudi shola National Park in the Western Ghats of Kerala. Mufeed *et al*. (2018) reported *Colura calyptrifolia* (Hook.) Dumort. of the family Lejeuneaceae, a rare leafy liverwort from the Anamudi shola National park of Idukki district.

Deepa *et al*. (2019) reported *Wiesnerella denudata* (Mitt.) Steph. of the family Wiesnerellaceae a genus similar to *Dumortiera* collected from the Anamudi

shola National park in the Western Ghats of Kerala. A new species, *Riccia sahyadrica* Manju & Cargill is described and illustrated and compared to the only other morphologically similar species, *R. caroliniana* endemic to northern Australia by Cargill *et al.* (2019). Both species possess the unique characteristic of bearing ventral photosynthetic tissue in contrast to the dorsal position typically seen in all other *Riccia* species. Manju *et al*. (2019) reported a new species of tiny moss *Micromitrium vazhanicum* Manju, Chandini & Rajesh of the family Micomitriacecae from the Vazhani area of Peechi-Vazhani Wildlife Sanctuary of the Western Ghats of Peninsular India. Manjula *et al.* in Ellis, *et al*. (2019) reported three new records of species from India viz., *Fissidens speluncae* Broth. a new record for India, *Fissidens viridulus* (Sw.) Wahlenb. A new record for Western Ghats and *Fissidens brevinervis* Broth. a new record for north-east India.

From this review it is clear that the taxonomic studies on the bryophytes of Kerala are fast increasing recently by adding many new additions and new species. This study is also relevant with respect to the new additions to the biodiversity and report of bryophytes of protected areas of Kerala.

MATERIALS AND METHODS

The present work is the result of intensive and extensive field explorations conducted in the study area, Mathikettan shola National Park during the period 2012-2018. The study area was thoroughly explored in different seasons of each year and the plants were collected from various localities in the park *viz.*, Thakkalikavala, Sivanpara, Vellapara, Mannankudi, Karipara, Changalakavala, Aduvilanthankudi, Udumbupara, Kadayirippu, Vattapara, Chundel, Njandar, Company estate, Muthupara, etc. Field trips were undertaken with all necessary items required for collection such as herbarium packets, field book, specimen bottles, hand lens, sharp edged knife, scalpel, newspaper, pencil, slip pad, collection bag and altimeter. The field data of each plant, such as habitat, locality, altitude, availability, Photo number, substratum, associated species, etc. were recorded in the field book from the field itself. The specimen photographs were taken from the field using SLR Sony α 100 camera and altitude ranges were noted with using Garmin Montana 680 GPS recorder. The plant specimens were collected with the help of sharp edged knife. Terrestrial species were collected with the substratum itself and epiphytic species were collected by climbing up the trees, as far as possible. Some specimens are firmly attached to the substratum, which was collected with a portion of substratum itself.

The collected materials were kept in brown paper packets directly in case of dried specimens while, in wet specimens, news paper packets were used to soak moisture and water to dry the specimens. The collected specimens were cleaned and air dried at room temperature. After drying the specimens were kept in brown herbarium packets of 5”×4”. The herbarium packets were labelled with herbarium specimen number, date of collection, altitude, locality, name, family, habitat, notes and the name of collector, name of the determinator, etc. The Liverworts and Hornworts were preserved in 70% alcohol or 3% formalin. All the preserved specimens were deposited in the Malabar Botanical Garden Herbarium (MBGH).

One part of the all the live collected specimens were introduced to the Bryophyte conservatory (*Apushpi*) of MBGIPS. The lithophytic species are kept on rocks and epiphytic species are kept in the husk of coconut and terrestrial species are kept in vertically arranged round bottomed pots. Suitable microhabitat is maintained in the conservatory with the help of automated fogger system.

For identification of the collected specimens, both live and preserved materials were studied in the laboratory for their morphological and anatomical features. The dry specimens were soaked in water for about 5-10 minutes to stretch the plants till they obtain their original shape. The External features of the specimens have been observed under the stereo dissection microscope (Labomed CZM4), the internal features were studied with the help of compound microscope (Labomed Lx 500) and specimens were measured and photographed with the help of Jenoptic ProgRes C5 USB connected camera. The whole plants specimens, leaf whole mount and sections of specimens were photographed using digital camera (Olympus E-PL1) fitted with microscope attachment. The internal structures of leaf basal, middle, apical parts of each specimen's photographs were taken to facilitate precise identification.

Identifications of specimens were done by referring the available literature. The doubtful specimens were consulted with experts to identify. All the identified plants are described with relevant details as far as possible. The ecological distribution pattern, microhabitats, altitudes and associated species were also noted. All the taxa are arranged in the classification system of different authors *viz*. Marchantiophyta (Stotler & Stotler 2000), Bryophyta (Gofffinet. *et al.,* 2009), Anthocerotophyta (Renzaglia &Vaughn, 2000). Species level taxonomic keys are provided for proper identification.

RESULTS

5.1. Systematic treatment

Key to the Phylum

1a. Plant body differentiated in to root, stem and leaves like structure; sex organ on main stem; sporophytes with well developed foot, seta and capsule ..... …..... **Bryophyta**

1b. Plant body thalloid or foliose form; sex organ dorsally on thallus or embedded in thallus tissue; sporophyte not well developed with foot, seta and capsule. ... 2

2a. Plant body thalloid or foliose; internal tissue of thallus differentiated. ..... …..... **Marchantiophyta**

2b. Plant body thalloid; internal tissue of thallus undifferertiated.. ..... …..... **Anthocerotophyta**

MARCHANTIOPHYTA Stotler & Crand. Stotl.,

Bryoph. Biol. 54, 63. 2000.

The plant body two types thalloid and foliose form. In thalloid form plant body is dorsi-ventrally flattened, dichotomously branched, ribbon like structures. In foliose form leaves in 3 rowed with 2 laterals and 1 ventral (amphigastria); costa absent; thallus with internal tissue differentiated; rhizoides single celled.

MARCHANTIALES Limpr., Kryptogamen-Flora von Schlesien 1: 336. 1876.

Key to the families

1a. Archegonia produced ventrally in receptacles.... ..... **Targioniaceae**

1b. Archegonia produced terminal or dorsal... ..... .**2**

2a. Epidermal pores of thallus simple; air chambers well developed..... **Aytoniaceae**

2b. Epidermal pores of thallus compound; air chambers not well developed. **3**

3a. Plants more than 4cm long; dorsal and ventral tissue not differentiated..... . . ..**Dumortieraceae**

3b. Plants less than 2 cm long; dorsal and ventral tissue differentiated.... .... **Marchantiaceae**

MARCHANTIACEAE Lindl.,

Nat. Syst. Bot. 412. 1836.

Plants greenish, prostrate, dichotomously branched, small-large, midrib narrow, convex, dorsiventral, margin entire, apex slightly concave or not; numerous spores on thallus; rhizoids tuberculate and smooth; scales in two rows on each side of the mid rib, purple; with appendages; midrib present, black; thallus tissue differentiated to assimilatory filament and storage cells; air chambers present in to assimilatory filament.

Marchantia L.,

Sp.Pl.2:1137-1158.1753.

Marchantia linearis Lehm. & Lindenb. in Lehm., Nov. Stirp. Pug. 4: 8. 1932; *Bapna & Kachroo, Hepatic. India 2: 433. 2000;* Nair *et al.,* Bryo. Wayanad W. Ghats. 35-36. 2005; Manju *et al*., Checklist Bryo. Kerala, Trop. Bryol Res. Rep. 7: 5. 2008; Singh & Nath, Hepat. Khas. & Jaint. Hills: East. Himal. 321. 2013; Sandhya Rani *et al*., Bryo. Andhra Pradesh 54-57. 2014; Singh *et al.,* Liverw. & Hornw. India 192. 2016. **(Plate 5.1)**

Plants greenish, 1.5-2 cm long, 4-5 mm wide, prostrate, dichotomously branched, dorsiventral, margin entire, apex slightly concave; midrib narrow, convex, black; ventral surface brownish purple; scales in two rows on each side of the mid rib, purple, with small appendages; rhizoids on ventral surface, smooth and tuberculate; numerous pores on thallus; pores small, barrel shaped, elevated with 6 superimposed concentric rings, 5-6 cells in each ring, 3cells above epidermic level, 3 rings of cells projecting below into the air chamber; assimilatory filaments 3-4

cells high, thin walled; storage cells small, irregular hexagonal, 12-14 cells high to centre gradually reduced to one or two cells high at wings.

Habitat: Seen on rocks and vertical land cutting in dense overlapping patch along with *Jungermannia shinii* Amakaw.

Distribution:

World: India, Indonesia, Malaysia, Nepal and Pakistan.

India: Andaman & Nicobar Is. (Singh *et al.,* 2010), Andhra Pradesh (Sandhya Rani *et al.,* 2014), Kerala (Nair *et al.,* 2005a), Madhya Pradesh (Asthana & Nath, 2007), Maharashtra (Lavate *et al.,* 2014), Manippur (Singh *et al.,* 2010), Meghalaya (Singh & Nath, 2007), Odisha (Dash & Saxena, 2009), Punjab (Bischler, 1989).

Kerala: Idukki (Present collection), Wayanad (Nair *et al*., 2005a).

Specimen/s examined: India, Kerala, Idukki District, Mathikettan Shola National Park, Chundel, 09.04.2013, (1300m), *Rajilesh V.K*. 9480; Vellapara, 26.04.2016, (1650m), *Rajilesh V. K.* 14234 (MBGH); Mathikettan Shola, (1323 m), 27.11.2014, *Rajilesh V.K* 3924 (ZGC), Wayanad, Lakkidi palam (400m), *Manju* 87112, 120357 (CALI).

Notes: Nair *et al.* (2005a) reported this species as new record for Peninsular India. The present collection from Idukki district is an extended distributional record of this rare species in Kerala.

AYTONIACEAE Cavers,

New Phytol.10 (1/2): 42. 1911.

Plants pale yellowish green or bluish green, dichotomously or twice dichotomously branched, 6 mm-2 cm long; lobes oblong-obovate, or strap shaped, margin entire or crenulated, ventral shoots borne apically or at the base; dorsal surface flat, smooth, slightly concave; midrib broad, convex; scales overlapping, alternate rows on each side of the midrib, purple, ovate or triangular, appendaged; appendage linear, or not;

t.s shows dorsal epidermal cells irregularly rectangular, hyaline; air pores prominent, small; air chambers wide, in many layers and empty or not clearly distinct; female receptacles apex on the main thallus or median part of thallus, stalked or not; male receptacle cushion type or not.

Key to the genera

1a. Air chambers many layers, empty; scales ovate with linear appendages..... ….. ..... ***Reboulia***

1b. Air chambers not clearly distinct or 2-3layered at centre of thallus; scales broadly triangular.. ..... ***Plagiochasma***

Plagiochasma Lehm. & Lindenb.,

Nov. Stirp. Pug. 4: 13–15. 1832.

Plagiochasma rupestre (J.R. Forst. & G.Forst.) Steph., Bull. Herb. Boissier 6 (10):783. 1898 & Sp. Hepat. 1. 80. 1898. var. ***rupestre***; *Bapna & Kachroo, Hepatic. India 2: 418. 2000; Bischler-Causse et al., Fl. Neotr. Monog. 201-207. 2005.* Alam & Srivast., Indian J. Forestry 32(4): 624. 2009; Singh *et al.,* Liverw. & Hornw. India 63. 2016; Daniels *et al.,* Bryo. Indira Gandhi N.P., Anam. Hill. 439. 2018. *Aytonia rupestris* G. Forst., Char. Gen. Pl. 148. 1775. *Reboulia chlorocarpa* Nees & Mont., Ann. Sci. Nat., Bot. ser. 2(5): 70. 1836. *Plagiochasma chlorocarpum* (Nees & Mont.) Mont. *in* A. D. Orbigny, Voy. Amer. merid. 7. Bot. 2: 59. 1839. *Rupinia chlorocarpa* (Nees & Mont.) Trevis., Mem. Reale Ist. Lombardo Sci. Ser. 3, Cl. Sci. Mat. 4: 437. 1877. *Aitonia chlorocarpa* (Nees & Mont.) Kuntze, Revis. gen. pl. 1: 143. 1891. *Plagiochasma peruvianum* Nees & Mont, in Montagne, Ann. Sci. Nat., Bot. ser. 2(9): 44. 1838. *P. boliviense* Mont., Cent. 1^{o} pl. cell. 45. 1838. *Rupinia peruviana* (Nees & Mont.) Trevis., Mem. Reale Ist. Lombardo Sci. Ser. 3, Cl. Sci. Mat. 4: 437. 1877. *Aitonia peruviana* (Nees & Mont.) Kuntze, Revis. gen. pl. 1: 143. 1891. *Plagiochasma validum* Bisch., Handb. bot. Termin. 2: 59, tab. 56, fig. 2753 explicatio. 1838. *Rupinia valida* (Bisch.) Trevis., Mem. Reale Ist. Lombardo Sci. Ser. 3, Cl. Sci. Mat. 4: 437. 1877. *Aitonia valida* (Bisch.) Kuntze,

Revis. gen. pl. 1: 143. 1981. *Plagiochasma elongatum* Lindenb. & Gottsche, *in* Gottsche, Lindenb. & Nees, Syn. hepat. 519. 1846. *Rupinia elongata* (Lindenb. & Gottsche) Trevis., Mem. Reale Ist. Lombardo Sci. Ser. 3, Cl. Sci. Mat. 4: 437. *Plagiochasma mexicanum* Lindenb. & Gottsche, in Gottsche, Lindenb. & Nees, Syn. hepat. 519. 1846. *Rupinia mexicana* (Lindenb. & Gottsche) Trevis., Mem. Reale Ist. Lombardo Sci. Ser. 3, Cl. Sci. Mat. 4: 437. 1877. *Aitonia mexicana* (Lindenb. & Gottsche) Kuntze, Revis. gen. pl.1:143. 1891. *Plagiochasma validum* Bisch. var. *B minus* Gottsche, Lindenb. & Nees, Syn. hepat. 520. 1846. *Aytonia lanigera* Spruce, Trans. & Proc. Bot. soc. Edinburgh 15 : 568. 1885. *Plagiochasma lanigerum* (Spruce) Steph., Sp. Hepat. 1: 85. 1898. *Aytonia subplana* Spruce, Trans. & Proc. Bot. Soc.Edinburgh 15: 567. 1885. *Plagiochasma subplanum* (Spruce) Steph., Sp. hepat. 1: 86. 1898. *P. brasiliense* Steph., Sp. hepat. 1: 83. 1898. *Aytonia evansii* Haynes, Bull. Torrey Bot. Club 34: 57. 1907. *Plagiochasma evansii* (Haynes) Steph., Sp. hepat. 6: 7. 1917. *P. bornmülleri* Steph., Sp. hepat. 6: 6. 1917. *P. hosseusii* Herzog, Feddes Repert. Spec. Nov. Regni Veg. 55: 4. 1952. *P. rupestre* (J. R. et G. Forst.) Steph. fo. *glaucum* Schier, Nova Hedwigia 25: 561. 1974. **(Plate 5.2)**

Plants bluish green-greyish green, large patches on wet rocks, thick, fleshy, 1.4-2 cm long, 6-7 mm wide, dichotomously branched, lobes strap shaped, oblong, broad, slightly rounded at apex, dorsiventral; dorsal surface smooth, slightly concave, margin crenulated, purple-brownish; scales pinkish-red, broad, 1-2 appendage, broadly triangular; upper epidermal cells thick walled, air pores minute, simple, pore opening narrow bounded by a 4-5 cells; air chambers not clearly distinct, 2-3 layered at centre of thallus; lower tissue gradually thin, small, triangular, closely packed; male receptacle on median part of thallus, yellowish brown, rounded-cushion type; female receptacle on median part of thallus with partially tinged red scales.

Habitat: Seen on wet rocks in large patches.

Distribution:

World: Africa, Greece, India, Iran, Italy, Nepal, New Zealand, Portugal, South America, Sri Lanka, Taiwan, Tunisia and Turkey.

India: Gujarat (Chaudhary *et al*., 2006), Himachal Pradesh (Kashyap, 1929; Singh & Singh, 2009; Singh *et al*., 2015), Jammu & Kashmir (Furuki *et al*., 1993), Maharashtra (Kashyap, 1932; Chaudhary *et al*., 2008; Bagwan & Kore, 2012), Orissa (Mishra *et al*., 2016), Rajasthan (Alam *et al*., 2011), Tamil Nadu (Kashyap, 1929; Daniels, 2010; Alam & Srivatava, 2012; Daniels & Daniel, 2013; Daniels *et al*., 2018), Uttarakhand (Kashyap, 1932; Bir, 1970).

Kerala: Idukki (Present collection); Kerala (Manju & Rajesh, 2017).

Specimen/s examined: Kerala, Idukki district, Mathikettan shola National Park, Checkpost, 28.11.2012, (1200m), *Rajilesh V. K.* 8214; Sivanpara, 26.04.2016, (1500m), *Rajilesh V. K.* 14255 (MBGH); Marayoor, Chinnar road, 23.12.2015 (1030m), *Chandini* 7220 (ZGC).

Reboulia Raddi.,

Opusc. Sci. 2: 357. 1818.

Reboulia hemisphaerica (L.) Raddi, Opusc. Sci. 2(6): 357. 1818. Kashyap, Liverw. W. Himal. 1: 72. 1929; *Bapna & Kachroo, Hepatic. India 2: 410. 2000;* Nair *et al.,* Bryo. Wayanad W. Ghats 34. 2005*; Bischler-Causse et al., Fl. Neotr. Monog. 207-210. 2005;* Manju *et al*., Checklist Bryo. Kerala, Trop. Bryol Res. Rep. 7: 6. 2008; Singh & Nath, Hepat. Khas & Jaint Hills: East. Himal., 331. 2013; Singh *et al.,* Liverw. & Hornw. India. 63-64. 2016; Daniels *et al.,* Bryo. Indira Gandhi N.P., Anam. Hill. 439. 2018. *Marchantia hemisphaerica* L., Sp. Pl. 1138. 1753. *Grimaldia hemisphaerica* (L.) Lindenb., Nova Acta Acad. Caes. Leop. Carol. Nat. Cur. 14 (106). 1829. *Mindal pangiensis* Kashyap, J. Bombay Nat. Hist. Soc. 24: 346. 1916. *Reboulia hemisphaerica* (L.) Raddi var. *pangiensis* Kashyap, Liverw. W. Himal. 1:74. 1929. **(Plate 5.3).**

Plants yellowish green, margin purple, dense patches of overlapping individuals on wet soil floor, 6-9 mm long, 3-3.4 mm wide, lobes oblong, bilobed at apex, margin ascending; dorsal surface flat, smooth, slightly concave; ventral shoots borne apically or at the base; scales overlapping, alternate rows on each side of the midrib, purple, broad, irregular ovate, appendaged; appendage two, linear, entire; dorsal epidermal cells irregularly rectangular, 8-15×14-16 μm, hyaline; air pores prominent, small, pores a little elevated with 3-5 concentric rings of 6-8 cells each; air chambers wide, many layered, empty; storage cells tightly packed, irregular hexagonal, pinkish coloured at centre, whitish towards wings ; male receptacle not seen; female receptacles hemispherical, 4-lobed, about 4 mm long; capsule spherical; spores brown, rounded reticulate with a broad wing, 90-105 μm in diameter; elaters 2-3 spiraled, yellowish brown, 13 μm wide and 170-240 μm long.

Habitat: Seen on vertical land cuttings.

Distribution:

World: Afghanistan, Africa, Australia, Bhutan, China, Europe, India, Indonesia Japan, Korea, Nepal, New Zealand, New Caledonia, North & South America and Pakistan.

India: Himachal Pradesh (Kashyap, 1929; Kumar & Anand, 1990; Singh *et al*., 2015), Jammu & Kashmir (Kashyap, 1932; Furuki *et al*., 1993; Langer & Tanwir, 2002; Rashid *et al*., 2012), Karnataka (Bapna & Kachroo, 2000; Aruna & Krishnappa, 2014), Kerala (Nair *et al*., 2005), Madhya Pradesh (Pande & Srivastava, 1952; Gautam & Thakur, 1981), Manippur (Singh *et al*., 2010), Meghalaya (Singh & Nath, 2007), Odisha (Dash & Saxena, 2009; Alam *et al.,* 2013; Mishra *et al*.,2016), Rajasthan (Bapna & Kachroo, 2000); Sikkim (Singh *et al.,* 2008), Tamil Nadu (Kashyap, 1929; Udar & Chandra, 1964; Alam & Srivastava, 2012; Daniels *et al*., 2018); Uttarakhand (Kashyap, 1929; Udar & Chandra, 1964; Singh & Singh, 2002; Singh & Singh, 2007, Nath *et al.,* 2010; Asthana & Sahu, 2013a, Sahu & Asthana, 2014), Uttar Pradesh (Bapna & Kachroo, 2000b; Singh, 2012).

Kerala: Idukki, Munnar, Vagavurrai (Udar & Jain, 1984; Rajeevan, 1990; Present collection), Wayanad Soojippara-(Nair *et al*., 2005a)

Specimen/s examined*:* India, Kerala, Idukki district, Mathikettan shola National Park, Karipara, 12.03.2014, (1660m), *Rajilesh V.K.* 10917; Aduvilanthankudi, 13.03.2014, (1600m), *Rajilesh V.K.* 10942 (MBGH); Wayanad, Soojipara, (887), Manju 87085a (CALI!).

TARGIONIACEAE Dumort.,

Anal. Fam. Pl. 68:70. 1829.

Plants pale green-greenish, prostrate, dorsiventral, fleshy, branches dichotomous, rarely with ventral innovations; mid rib prominent below; scale abundant, in two rows or rarely absent; pores prominent, air chambers empty or with assimilatory filaments, storage cells well developed.

Targionia L.,

Sp. Pl.2: 1136. 1753.

Targionia hypophylla L., Sp. PI. 1136. 1753; Kashyap, Liverw. W. Himal. 1: 57-58. 1929; Perold, Bothalia 23,2: 215-221.1993. *Bapna & Kachroo, Hepatic. India 2: 388. 2000;* Nair *et al.,* Bryo. Wayanad W. Ghats 37. 2005; Manju *et al*., Checklist Bryo. Kerala, Trop. Bryol Res. Rep. 7: 3. 2008; Chaudhary *et al*., Bryo. Fl. Gujrat. 23;. 2006; Chaudhary *et al*., Bryo. Fl. N. Konkan. 79-81. 2008; Singh & Nath, Hepat. Khas & Jaint Hills: East. Himal. 338. 2013; Sandhya Rani *et al*., Bryo. Andhra Pradesh. 58-61. 2014; Alam, Int. Jour. Envir. 4 (1): 63 -65. 2015; Singh *et al.,* Liverw. & Hornw. India 274. 2016; Daniels *et al.,* Bryo. Indira Gandhi N.P., Anam. Hill. 457. 2018. **(Plate 5.4)**

Plants greenish, simple, dichotomously branched, 7-11×3-4 mm, prostrate, obovate-linear oblong, margin entire, apex notched; mid rib prominent below; scales purple, in one row on either side of midrib, hyaline, triangular, purplish, delicate,

unappendaged; epidermal cells 4-6 angled, thin walled; epidermal pores elevated, elliptical-rounded, surrounded by 2-4 super imposed rings; air chambers single layered, containing green filaments; ventral storage cells well developed, irregular hexagonal, thin walled.

Habitat: Seen on land cuttings.

Distribution:

World: Africa, Afghanistan, America, Australia, Bhutan, China, Europe, India, Mexico and New Zealand.

India: Andhra Pradesh (Sandhya Rani *et al.,* 2014), Gujarat (Chaudhary *et al.,* 2006), Himachal Pradesh (Singh & Singh, 2009; Singh *et al*., 2015), Jammu & Kashmir (Langer & Tanwir, 2002); Karnataka (Schwarz & Frahm, 2013; Bapna & Kachroo 2000), Kerala (Udar & Jain, 1984; Nair *et al.,* 2005; Manju *et al.,* 2009b; Manju *et al.,* 2009a), Madhya Pradesh (Pande & Srivastava,1952; Nath *et al.,* 2015; Asthana & Nath, 2007), Maharashtra (Chaudhary *et al.,* 2008; Bagwan & Kore, 2012), Meghalaya (Singh & Nath, 2007), Orissa (Dash & Saxena, 2009; Alam *et al.,* 2013; Mishra *et al*., 2016), Rajasthan (Bapna, 1958; Alam *et al.,* 2011), Sikkim (Singh *et al.,* 2008), Tamil Nadu (Chopra, 1938; Alam & Srivastava, 2014), Uttarakhand (Udar & Gupta, 1981; Gaur & Nautiyal, 1981; Asthana & Sahu, 2013), West Bengal (Hattori, 1966).

Kerala: Idukki, Munnar, Peerumadu (Udar & Jain, 1984; Present collection), Wayanad, Soojippara, Chembra estate, Periya (Nair *et al.,* 2005), Thiruvananthapuram, Agasthyamalai BR, (Manju *et al.,* 2009b), Kannur, Aralam WLS (Manju *et al.,* 2009a)

Specimen/s examined*:* India, Kerala, Idukki, Mathikettan shola National Park, Aduvilanthankudi, 13.03.2014, 1600 m, *Rajilesh V.K.* 10950; Chundel, 28.11.2014, 1450 m, *Rajilesh V.K.* 11647b (MBGH); Wayanad, Chembra estate, (1055m), 11.10.2003, *Manju* 120251, CALI!).

DUMORTIERACEAE D. G. Long.,

Edinburgh J. Bot. 63(2–3): 260. 2006.

Plants dark green, large, flat, on wet rocks, dichotomously branched, margin undulate, apex notched, midrib prominent; rhizoids hyaline, smooth; scales on each side of the midrib near the apex, hyaline; air chambers absent; dorsal and ventral tissue not differentiated; gemma seen on dorsal side of the thallus at apex; capsule globose.

Dumortiera Nees in Reinw.*et al.,*

Nova Acta Acad.Nat.Cur.12:410.1824.

Dumortiera hirsuta (Sw) Nees, in Reinwardt, Blume & Nees, Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 12: 410.1824; Kashyap, Liverw. W. Himal. 1: 42-43. 1929; *Bapna & Kachroo, Hepatic. India 2: 440. 2000;* Manju *et al*., Checklist Bryo. Kerala, Trop. Bryol Res. Rep. 7: 4. 2008; Daniels & Daniel, Bryo. South. W. Ghats 276. 2013; Sandhya Rani *et al*., Bryo. Andhra Pradesh. 54-55. 2014; Daniels *et al.,* Bryo. Indira Gandhi N.P., Anam. Hill. 459. 2018; Singh *et al.,* Liverw. & Hornw. India : 78-79. 2016; *Marchantia hirsuta* Sw., Prodr, 145. 1788. *M. irrigua* Wilson, *in* Hooker, Brit. Fl. 2: 106. 1833. *Hygrophila irrigua* (Wilson) Taylor, *in* J. Mackay, Fl. Hibern. 2: 54. 1836. *Dumortiera irrigua* (Wilson) Nees. Naturgesch. Eur. Leberm. 4: 159. 1838. *D. hirsuta* var. *irrigua* (Wilson) Spruce, Trans. & Proc. Bot. Soc. Edinburgh 15: 566. 1885. *Hygrophila nepalensis* Taylor, Trans. Linn. Soc. 17: 392. 1835. *Dumortiera nepalenis* (Taylor) Nees. Naturgesch. Eur. Leberm, 4: 169. 1838. *D. hirsuta* var. *angustior* Gottsche, and fo. *depauperata* Gottsche, Lindenb. & Ness, Syn. Hepat. 544. 1846. *D. hirsuta* var. *intermedia* Gottsche, Lindenb. & Nees. Syn. Hepat. 544. 1846. *D. hirsuta* var. *latior* Gottsche, Lindenb & Nees, Syn. Hepat. 544. 1846. *D. hirsuta* var. *trichopus* Spuruce, Trans. & Proc. Bot. Soc. Edinburgh 15: 567. 1885. *D. hirsuta* var. *brasiliensis* Schiffn., in Schiffner & Arnell. Oesterr. Akad. Wiss., Math-Naturwiss. KI. Denkschr. 111:8. 1964. **(Plate 5.5)**

Plants dark green, large, overlapping patches on wet rocks, flat, repeatedly dichotomously branched at apex, 4-6×1-1.5cm, margin undulate, apex notched, midrib prominent; rhizoids hyaline, smooth; scales seen on each side of the midrib near the apex, hyaline; air chambers absent; dorsal and ventral tissue not differentiated, thin walled, irregular hexagonal; gemma seen on dorsal side of the thallus at apex; male receptacle disci form, terminal, stalked with bristle like hairs; female receptacle stalked at maturity; capsule globose.

Habitat: The plant seen on rocky patch and on roots of higher plants along the streams.

Distribution:

World: Africa, America, Bangladesh, Bhutan, China, Europe, India, Jamaica, Japan, Mexico, New Zealand, Nepal and Sri Lanka.

India: Andhra Pradesh (Sandhya Rani *et al.,* 2014), Goa (Phatak *et al.*, 2007), Assam (Barbhuiya & Singh, 2012), Jammu & Kashmir (Rashid *et al*.,2012), Karnataka (Schwarz & Frahm, 2013; Aruna & Krishnappa, 2014), Kerala (Nair *et al*., 2005; Nair *et al*., 2006; Manju *et al*., 2009; Madhusoodanan *et al*., 2007; Manju *et al*., 2009) Tamil Nadu (Daniels 2010, Daniels & Daniel 2013).

Kerala: Wayand, Chembra Hills (Nair *et al*., 2005b) Idukki, Chinnar WLS (Nair *et al*., 2006), Eravikulam NP (Madhusoodanan *et al*., 2007), Present collection, Kannur, Aralam WLS (Manju *et al*., 2009), Thiruvananthapuram Agasthyamalai BR, (Manju *et al*., 2009).

Specimen/s examined: India, Kerala, Idukki District, Mathikettan Shola National Park, Chundel, 09.04.2013, 1300 m, *Rajilesh V.K*. 9451; Check Post, 11.03.2014, 1200m, *Rajilesh V.K.* 9466; Njandar, 23.12.2015, 1400 m, *Rajilesh V.K.* 11690 (MBGH); Mathikettan Shola (1620m), 27.11.2014, *Rajilesh V.K.* 3926 (ZGC), Palakkad, Silent valley NP (980m), 18.03.2011, *Rajilesh V.K.* 5340 (ZGC),

FOSSOMBRONIALES Schljakov emend. Stotler & Crand. Stotl., Bot. Zhurn. (Moscow & Leningrad) 57(4): 500. 1972.

CALYCULARIACEAE He-Nygren,

Juslen, Ahonen, Glenny & Piippo, Cladistics 22: 27. 2006.

Plants dark greenish, translucent, prostrate, dorsiventral, deeply divided towards midrib; rhizoides light pinkish to colourless, numerous; midrib prominent, distinctly separated, more or less abruptly tapering into a 1-2 cells thick wing; ventral scales hyaline, purplish or purplish red, straight or recurved, tip unistratose; archegonia formed in dense clusters, protected by prostrate scales; archegonial scales elongated, hyaline; antheridia dorsal, formed in several rows along midrib and are subtended by lamelliform bracts, antheridia is sub sessile and globose.

Calycularia Mitt.,

J. Proc. Linn. Soc., Bot. 5: 122-123. 1861.

Calycularia crispula Mitt., J. Proc. Linn. Soc., Bot. 5: 122 1861; Manju *et al.*, Acta Botanica Hungarica 57 (3-4): 401-406. 2015; Manju & Rajesh, Bryoph. Kerala, Liverwort (1): 38. 2017. **(Plate 5.6)**

Plants dark greenish, on bark of trees, translucent, 1-3 cm long, 0.6-0.9 cm wide, prostrate, dorsiventral, flat, deeply divided towards midrib; rhizoides light pinkish to colourless, numerous; midrib prominent, distinctly separated, more or less abruptly tapering into a 1-2 cells thick wing, mid rib in cross section 8-20 cells high, unistratose, margin 35-60 cells rows wide, midrib cells in tranverse section rounded-hexagonal, in longitudinal section rectangular; cells in ventral epidermis of the midrib 22-40 µm wide, 30-40 µm long, weakly differ from inner cells; cells of ventral epidermis of the wing 36-58 µm wide, 44-78 µm long; dorsal cells above midrib 16-26 µm wide, 38-80 µm long, dorsal cells along midrib 32-58 µm wide, 50-90 µm long, dorsal cells of wings 48-60 µm wide, 50-70 µm long; cells of unistratose margins 34-50 µm wide,52-86 µm long; ventral scales hyaline, purplish or purplish red, straight or recurved, 400-500 µm long, 138-147 µm wide, base of ventral scale 4-6 cells broad, tip unistratose, oil bodies 6-34 per cell; archegonia formed in dense clusters, protected by prostrate scales; archegonial scales elongated,

hyaline, 750-950 μm; antheridia dorsal, formed in several rows along midrib and are subtended by lamelliform bracts, antheridia is subsessile and globose.

Habitat: Attached to bark of tree trunk.

Distribution:

World: Africa, Bhutan, China, Ethiopia, India, Myanmar, Nepal, North America, Taiwan and Thailand

India: Kerala (Present collection); Tamil Nadu (Manju *et al*., 2015; Daniels *et al*., 2014; Daniels *et al*., 2018).

Kerala: Idukki (Present collection)

Specimens examined: India, Kerala, Idukki district, Mathikettan shola National Park, Checkpost, 28.11.2012, 1200 m, *Rajilesh V. K.* 8240; Karipara, 12.04.2014, 1600 m, *Rajilesh V.K.* 10914; Mannankudi, 26.11.2014, 1540m, *Rajilesh V.K.* 11563; Kurisukavala, 28.11.2014, 1550 m, *Rajilesh V.K.* 11632; Njandar, 04.08.2015, 1400 m, 11672 (MBGH).

Note: Manju *et al*. (2015) reported this species as new record to Kerala. (Specimens collected from Mathikettan Shola and Valparai)

PALLAVICINIALES W. Frey & M. Stech., Nova Hedwigia 81: 64. 2005.

PALLAVICINIACEAE Mig.,

Krypt. Deutschl., Moose 423.1904.

Plants pale green, prostrate, ribbon like, dichotomously branched, midrib prominent; rhizoides brownish, unicellular, smooth walled, hyaline, arising from the midrib at the ventral side; wings transparent, margin undulate, apex obtuse; thallus cells quadrangular to hexagonal; antheridium encloses with antheridial scales arising from the midrib at the dorsal side of the thallus; antheridium globular in structure, shortly stalked and have single layered wall.

Pallavicinia Gray,

Nat. Arr. Brit. Pl. 1: 775. 1821.

Pallavicinia lyellii (Hook.) Gray, Nat. Arr. Brit. Pl. 1: 775.1821; Nair *et al.*, Bryoph. Wayanad, 42. 2005; Singh & Nath, Hepaticae. Khasi & Jaintia Hills, 300. 2007; Manju & Rajesh, Bryoph. Kerala, Liverwort (1): 51. 2017. **(Plate 5.7)**

Plants pale green, prostrate, ribbon like, dichotomously branched, 3-5×0.3-0.4 cm; rhizoides brownish, unicellular, smooth walled, hyaline, arising from the midrib at the ventral side; scales not clear; wings transparent, margin undulate, apex obtuse; midrib distinct, cells incrassate, 8-12 cells thick; storage cells quadrangular to hexagonal, 30-40×40-45 µm, gradually passing into a broad one rectangular cells towards wing; antheridium encloses with antheridial scales arising from the midrib at the dorsal side of the thallus; antheridium globular in structure, shortly stalked and have single layered wall.

Habitat: The plant seen on rock along the streams.

Distribution:

World: Africa, America, Brazil, China, Cuba, Europe, India, Indonesia, Japan, New Zealannd, Philippines, Russia, Singapore and Sri Lanka.

India: Andra Pradesh (Sandhya Rani *et al*.,2014), Assam (Srivastava, 1961; Barbhuiya & Singh, 2012), Karnataka (Pande & Srivastava,1953; Aruna & Krishnappa, 2014)), Kerala (Manju *et al.,* 2008a; 2009; Nair *et al*., 2005), Madhya Pradesh (Pande & Srivastava, 1953; Asthana & Nath, 2007; Sharma & Alam, 2011), Maharashtra (Lavate *et al*., 2015), Orissa (Mishra *et al*., 2016), Tamil Nadu (Alam & Srivastava, 2012; Daniels, 2010; Daniel, 2013),

Kerala: Idukki (Present collection), Kozhikode (Manju *et al*, 2008a), Thiruvananthapuram (Manju *et al.*, 2009b), Wayanad (Nair *et al.*, 2005a).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Chundel, 08.04.2013, (1450m), *Rajilesh V. K.* 9000; Checkpost, 25.11.2014, (1200 m), *Rajilesh V. K.*11526 (MBGH).

METZGERIALES Rosenv., Sporeplanterne. 278. 1913.

Key to the families

1a. Plants thin, dichotomously branched, with many hairs… .....**Metzgeriaceae**

1b. Plants thick, irregularly branched, hairs absent .. ..**Aneuraceae**

METZGERIACEAE H. Klinggr.,

Hoh.Crypt.Preuss. 10. 1858.

Plants whitish-pale green, prostrate, thallus small-large, delicate, thin, dichotomously branched, slightly convex top, apex obtuse with many hairs; hairs long, straight, hyaline, disposed singly at the margin of the wing and ventral surface of the midrib; cells polygonal, bulging, thin walled at wing; mid rib distinct, thick walled cells; gemmae absent.

Metzgeria Raddi,

Jungermanniogr. Etrusca. 34. 1818.

Metzgeria lindbergii Schiffn., Denkschr. Kaiserl. Akad. Wiss., Wien Math.-Naturwiss. Kl. 67: 182. 1898. *Metzgeria himalayensis* Kashyap, J. Bombay Nat. Hist. Soc. 26: 280 1917; Singh & Nath, Hepaticae. Khasi & Jaintia Hills 307. 2007. *M. saxbyi* Pearson Ann. Cryptog. Exot 4: 70. 1931. *M. conjugata* var. *japonica* S. Hatt. J. Hattori Bot. Lab.15: 80. 1955. *M. conjugata* subsp. *japonica* (S. Hatt.) Kuwah. J. Hattori Bot. Lab. 20: 135. 1958. *M. minuta* Kuwah. J. Hattori Bot. Lab.31: 166. f. 4: a–h. 1968. *M. assamica* S.C. Srivast. J. Indian Bot. Soc. 55: 194. f. 1–17. 1976. *M. minor* (Schiffn.) Kuwah. J. Jap. Bot.53: 269. 1978. **(Plate 5.8)**

Plants whitish-pale green, prostrate, thallus delicate, thin, dichotomously branched, slightly convex top, apex obtuse with many hairs; hairs long, straight, 87-

168 µm long, hyaline, disposed singly at the margin of the wing and ventral surface of the midrib; thallus marginal cells irregularly rectangular-pentagonal, 21-32×45-50 µm; median cells hexagonal, 33-36×44-50 µm; mid rib distinct, mid rib epidermal cells large, 11-14×19-28 µm, irregularly rounded, thin walled; inner cells 12-13 in numbers, 3-5 layers, 8-13×11-22 µm, thick walled; thallus wing cells polygonal, bulging, thin walled, 10-31×27-31 µm, 11-12 cells wide on each side of the midrib; gemmae absent

Habitat: Seen on stem bark along with other bryophytes like *Hypopterygium tamarisci* (Sw.) Brid. ex Muell*., Lejeunea tuberculosa* Steph. *and Ctenidium lychnites* (Mitt.) Broth.

Distribution:

World: China, Columbia, India, Japan and Sri Lanka.

India: Andra Pradesh (Singh & Nath, 2007 as *M. conjugata* subsp. *Japonica*), Arunachal Pradesh (Das & Singh, 2011; Dey & Singh, 2012), Himachal Pradesh (Singh *et al*., 2015), Manipur (Singh *et al.*, 2010), Sikkim (Dey & Singh, 2012), Uttarakhand (Srivastava & Udar, 1975 as *M. conjugata* subsp. *Japonica).*

Kerala: Idukki (Present collection)

Specimen/s examined: India, Kerala, Idukki, Mathikettan shola National Park, Mannankudi, 28.11.2012, (1700m), *Rajilesh V.K.* 8282b; Muthupara, 11.03.2014, (1550 m), *Rajilesh V.K.* 9484b; Mannankudi, 26.11.2014, (1600m), *Rajilesh V.K.* 11566a; (MBGH).

Note: In India this species is known by *Metzgeria himalayensis* Kashyap, collected from Eastern Himalayas and described by Kashyap in 1917. He & Jia (2019) synonymised this species under *M.lindbergii* Schiffn., which is reported by Schiffner in 1898. The present collection is a new record to Kerala.

ANEURACEAE H. Klinggr.,

Die Hoheren Cryptogamen Preussens 11. 1858.

Plants pale greenish-brownish green, prostrate, small-medium, delicate, thick, pinnately or irregularly branched, apices obtuse, margin smooth, entire; rhizoids rare; epidermal cells pentagonal slightly yellowish coloured, nontrigones; median cells polygonal, non trigones.

Riccardia Gray.,

Nat. Arr. Brit. Pl. 1: 683. 1821.

Plants greenish brown -yellowish brown, prostrate, small- medium, delicate or thick, irregularly or pinnately branched; branches short, fleshy, narrowed towards apex, apex obtuse, margin entire smooth; rhizoides rare, faint; c.s of main axis convex or biconvex, slightly plain above, 5-7 cells thick in the middle, become 1-2 cells wide and unistratose at the margins; epidermal cells pentagonal slightly yellowish coloured, nontrigones; median cells polygonal, non trigones.

Key to the species

1a. Plants small, less than 6mm, delicate, pinnately branched.... .....***R. tenuicostata***

1b. Plants medium, more than 18mm, robust, irregularly branched..... ..***R. levieri***

Riccardia levieri Schiffn., Osterr. Bot. Zeitschr. 49:130.1899; Singh & Nath, Hepaticae. Khasi & Jaintia Hills 313. 2007; Manju & Rajesh, Bryoph. Kerala, Liverwort (1): 53. 2017. **(Plate 5.9)**

Plants pale greenish-brownish green, prostrate, 18-22×1-1.1 mm, thick, fleshy, irregularly branched, apices obtuse, margin smooth, entire; rhizoids rare; c.s of main axis convex below, slightly plain above, 5-7 cells thick in the middle, become 1-2 cells wide and unistratose at the margins; epidermal cells pentagonal, 6-13×12-16 µm, slightly yellowish coloured, nontrigones; marginal cells 12-26×17-28 µm; median cells 19-34×20-36 µm, polygonal, non trigones.

Habitat*:* Seen on rocks near stream.

Distribution:

World: Bhutan and India.

India: Assam (Das & Sharma, 2016), Himachal Pradesh (Srivastava & Udar, 1976), Karnataka (Schwarz, 2013); Kerala (Madhusoodanan *et al*., 2007; Nair *et al*., 2005a); Madhya Pradesh (Pande & Srivastava, 1952; Asthana & Nath , 2007) Manipur (Singh *et al.*, 2010), Meghalaya (Singh & Nath, 2007), Orissa (Alam *et al*.,2013), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013; Daniels *et al*., 2018), Uttarakhand (Srivastava & Udar, 1976), West Bengal (Srivastava & Udar, 1976)

Kearla: Idukki (Present collection), Idukki (Madhusoodanan *et al*., 2007), Wayanad (Nair *et al*., 2005a).

Specimen/s examined: India, Kerala, Idukki, Mathikettan shola National Park, Company estate, 30.11.2012, (1600m), *Rajilesh V.K.* 8938b; Vellapara, 01.11.2017, (1650m), *Rajilesh V.K.*14277 (MBGH).

Riccardia tenuicostata Schiffn., Denkschr. Kaiserl. Akad. Wiss., Wien Math. Naturwiss. Kl. 67: 166 1898; Nair *et. al*., Bryoph.Wayanad, 44. 2005; Singh & Nath, Hepaticae. Khasi & Jaintia Hills 310. 2007; Manju & Rajesh. Bryoph. Kerala, Liverwort, (1): 55. 2017. *Aneura tenuicostata* (Schiffner) Stephani Sp. Hepat. 1: 245. 1899. **(Plate 5.10)**

Plants yellowish brown, small, delicate, 5-6×0.5-0.7 mm, pinnately branched; branches short, thick, fleshy, narrowed towards apex, apex obtuse, margin entire smooth; rhizoides rare, faint; main axis slightly biconvex; in cross section 6-7cells thick in the middle, wing multistratose, gradually becoming 1-2 cells wide towards margin; superficial cells polygonal, thin walled; marginal cells small, elongated-rectangular, 7-9×15-18 μm; median cells large, polygonal, thin walled, non trigonous.

Habitat: On wet rocks.

Distribution:

World: India, Indonesia and Singapore.

India: Assam (Das & Sharma, 2016), Himachal Pradesh (Singh & Singh, 2009), Kerala (Nair *et al*., 2005; Manju *et al*., 2009), Manipur (Singh *et al*., 2010), Meghalaya (Singh & Nath, 2007), Sikkim (Singh *et al*., 2008), Tamil Nadu (Srivastava & Udar, 1976; Daniels, 2010), Uttarakhand (Srivastava & Udar, 1976).

Kerala: Idukki (Present collection), Idukki (Rajeevan, 1990)

Specimen/s examined: India, Kerala, Idukki, Mathikettan shola National Park, Chundel, 08.04.2013, (1450m), *Rajilesh V.K.* 9408; Chundel, 26.04.2014, (1300m), *Rajilesh V. K.* 14208 (MBGH).

PORELLALES Schljakov., Bot. Zhurn. (Moscow & Leningrad) 57(4): 505. 1972.

Key to the families

1a. Plants medium; leaves ovate-oblong.. ..... **Porellaceae**

1b. Plants small; leaves rounded..... 2

2a. Leaves strongly concave; under leaves not prominent. .....**Radulacece**

2b. Leaves normal; under leaves prominent, bilobed .. .. **Lejeuneaceae**

PORELLACEAE Cavers,

New Phytol. 9(8/9): 292. 1910.

Plants yellowish green-brownish green, bipinnately or irregularly pinnately branched; leaves imbricate, ovate-oblong, base broad; leaf lobules oblong-elongated, large, broad base than apex, apex dentate or not, tip acuminate or not, entire margin; underleaf medium, ovate-triangular to lanceolate.

Porella L.,

Sp. Pl. 2:1106. 1753.

Plants yellowish green-brownish green, bipinnately or irregularly pinnately branched; leaves imbricate, ovate-oblong, 3-6 teeth at apex; base broad, marginal cells irregularly rectangular-pentagonal, median cells irregularly rounded, slightly trigones or non trigones; basal cells large, rounded-elongate, trigones; leaf lobules oblong-elongated, large, broad base than apex, apex dentate or not, tip acuminate or not, entire margin; underleaf medium, ovate-triangular to lanceolate, base broader than apex, acuminate tip, entire margin; sporogonium not seen.

Key to the species

1a. Leaves ovate-oblong; lobule margin entire, apex acuminate to rounded, entire margin .....……..……***P. acutifolia***

1b. Leaves broadly ovate; lobule margins incurved at base, 1-2 toothed at apex. .....….....…….....…… ..... ***P. campylophylla***

Porella acutifolia (Lehm. & Lindenb.) Trevis., Mem. Reale I st. Lombardo Sci., Ser. 3, Cl. Sci. Mat. 4: 408 1877; Nair *et al.,* Bryoph. Wayanad, 59. 2005; Singh & Nath, Hepaticae. Khasi & Jaintia Hills 170. 2007; Manju & Rajesh, Bryoph. Kerala, Liverwort (1): 82. 2017. *Madotheca acutifolia* Lehm. & Lindenb., Syn. Hepat. 266.1845. **(Plate 5.11)**

Plants yellowish green, dark brownish when dry, tufted on tree trunk; stem 7-10 cm long, bipinnately branched; leaves imbricate, ovate-oblong, 1.4-1.9×.07-0.9 mm, apex 1-2 strong teeth with 2-4 small teeth, base broad, marginal cells irregularly rectangular-pentagonal, 14-19×15-20 µm; median cells irregularly rounded, slightly trigones, 20-39×13-17 µm, basal cells large, trigones, 36-58×26-50 µm; leaf lobules oblong, large, 0.8-0.85×0.33-0.36 µm, broad base than apex, apex acuminate to rounded, entire margin; underleaf medium, ovate-triangular, 0.65-0.82×0.42-0.45 mm, apex 1-3 dentate, base broad than apex, entire margin.

Habitat: Seen on bark.

Distribution:

World: Japan, India and Sri Lanka.

India: Jammu & Kashmir (Rashid *et al*., 2012) Kerala (Nair *et al*., 2005a; Manju & Rajesh, 2017); Meghalaya (Singh & Nath, 2007), Tamil Nadu (Daniels, 2010; Verma *et al.,* 2013).

Kerala: Idukki (Nair *et al*., 2006; Present collection), Wayanad (Nair *et al*., 2005a).

Specimen/s examined: India, Kerala, Idukki, Mathikettan shola National Park, Shivanpara, 28.11.2012, (1500m), *Rajilesh V.K.* 8206; Njadar, 04.08.2015, (1400m), *Rajilesh V.K.* 11682b (MBGH).

Porella campylophylla (Lehm. & Lindenb.) Trevis., Mem. Reale I st. Lombardo Sci., Ser. 3, Cl. Sci. Mat. 4: 408 1877; Nair *et al*., Bryoph. Wayanad, 61. 2005; Singh & Nath, Hepaticae. Khasi & Jaintia Hills 172. 2007; Manju & Rajesh, Bryoph. Kerala, Liverwort. (1): 84. 2017. *Jungermannia campylophylla* Lehm. & Lindenb., Nov. Stirp. Pug. 6: 40. 1834. (**Plate 5.12**)

Plants brownish green, on tree trunk, 5-7cm long; stem irregularly pinnately branched; leaves imbricate, broadly ovate, obtuse at apex, 2.2-2.4 µm long, 1.4-1.5 µm wide near to base, 3-6 teeth at apex; teeth 3-5 cells high, 2-4 cells uniseriate, 2-3 cells wide at base; dorsal margin arched towards the base; ventral margin slightly incurved; marginal cells 20-33 × 12-21 µm; median cells 19-34×15-22 µm, irregularly rounded, non trigones; basal cells large, rounded-elongate, thin walled, 20-33×30-52 µm, trigones; leaf lobules oblong elongated, 1.3-1.5×0.5-0.55 mm, entire margin, acuminate tip with 1or 2 teeth at tip; underleaves transversely inserted, ovate-lanceolate, broad base, 0.9-1 mm long, 0.48-0.5 mm wide at base, acuminate tip, entire margin; sporogonium not seen.

Habitat: Seen on bark of trees.

Distribution:

World: India, Myanmar, Nepal and Vietnam,

India: Arunachal Pradesh (Shaheen &Srivastava, 1989), Jammu & Kashmir (Langer & Tanwir, 2002; Rashid *et al*., 2012), Himachal Pradesh (Kashyap & Chopra, 1932 as *Madotheca denticulata*), Karnataka (Aruna & Krishnappa, 2014), Kerala (Nair et al, 2006; Nair & Madhusoodanan, 2006; Manju & Rajesh,2011, 2017), Meghalaya (Singh and Nath, 2007), Sikkim (Hattori, 1966), Tamil Nadu (Shaheen &Srivastava, 1989; Daniles, 2010, 2013 Daniels *et al*., 2018), West Bengal (Shaheen & Srivastava, 1989).

Kerala: Idukki (Nair *et al*, 2006; Present collection), Kozhikode (Nair & Madhusoodanan, 2006), Palakkad, Parambikulam TR (Manju & Rajesh, 2011)

Specimen/s examined: India, Kerala, Idukki, Mathikettan shola National Park, 24.11.2014, Udumbupara, (1590m), *Rajilesh V.K.* 10980b; Checkpost, 25.11.2014, (1200m), *Rajilesh V.K.* 11535b (MBGH).

RADULACEAE Muell.,

Frib. Lebermoose 1: 404. 1909.

Plants green, yellowish-green to brownish green, firmily attached to the substratum, prostrate; stem bipinnate or irregularly pinnate, branching terminal; rhizoides rare, at base, brown; leaves, incubous, imbricate, ovate-obovate, concave, apex rounded, dorsal margin convex, ventral margin incurved at the end of lobule.

Radula Dumort.,

Comment. Bot. 112. 1822.

Radula javanica Gottsche, Syn. Hepat. 257, 1845; Bapna & Kachroo, Hepatic. India, 2:139, 2000; Nair *et al*, Bryophy. Wayanad, 78, 2005; Singh & Nath, Hepatic. Khasia & Jaintia Hills, 180, 2007; Manju & Rajesh, Bryophyt. Kerala, Liverwort (1):119, 2017. (**Plate 5.13**)

Plants yellowish green, epiphytic; 2.5-3.3 cm long, 2-2.4 mm wide including leaves, branching irregularly pinnate, branches obliquely spreading; rhizoides rare,

at base, brown; leaves lobes alternate, 0.9-1 mm long, 0.7-0.9 mm wide, imbricate, obliquely spreading, ovate-obovate, strongly concave, apex rounded, dorsal margin convex, ventral margin incurved at the end of lobule; leaf marginal cells thin walled, slightly trigonous,11-13 μm; median cells 15-19×17-22 μm, thin walled, trigonous, basal cells 15-21×22-30 μm, trigonous; lobules subrectangular, 1/3 the lobe length, 0.5 mm long, 0.3 mm wide, apex obtuse, margin entire; under leaves absent.

Habitat: Seen on bark.

Distribution:

World: China, India, Japan, Myanmar, Nepal, Sri Lanka, Thailand and Vietnam.

India: Karnataka (Schwarz, 2013), Kerala (Nair *et al*., 2005), Madhya Pradesh (Sharma & Alam, 2011), Meghalaya (Singh and Nath, 2007), Sikkim (Chopra, 1943), Tamil Nadu (Yamada, 1979 as *R. sandei*)

Kerala: Idukki (Present collection), Palakkad (Raja & Daniels, 2012 as *R. multiflora*), Wayanad (Nair *et al*., 2005a)

Specimen examined: India, Kerala, Idukki, Mathikettan shola National Park, Vellapara, 23.12.2015, (1650m), *Rajilesh V.K.* 11698 (MBGH).

LEJEUNEACEAE Cavers,

New Phytol. 9: 291. 1910.

Plants yellowish green-brownish, epiphytic, prostrate, branched; rhizoides clustered at underleaf bases or not; leaves incubously placed, slightly imbricate to imbricate, ovate, concave or not, apiculate or rounded apex, margin entire; leaf cells trigonous, large at base; marginal cells small, trigonous; median cells thin walled; leaf lobules with two teeth present; under leaves present at ventral side, apex bilobed.

Key to the species

Ia. Leaf lobule first tooth well developed..... ***Lejeunea***

1b. Leaf lobule second tooth well developed..... ***Cheilolejeunea***

Cheilolejeunea (Spruce) Steph.,

Bot. Gaz. 15: 284. 1890.

Cheilolejeunea serpentina (Mitt.) Mizut. J. Hattori Bot. Lab. 26: 171, 1963; Bapna & Kachroo, Hepatic. India, 2: 223, 2000; Nair *et al.*, Bryophy. Wayanad, 68, 2005; Singh & Nath, Hepatic. Khasi Jaintia Hills, 281, 2007. *Lejeunea serpentina* Mitt. J. Proc. Linn. Soc., Bot. 5: 112, 1861. *Cheilolejeunea principensis* Stephaniex Paris Rev. Bryol. 33: 38, 1906. *C. madagassa* Stephani Sp. Hepat. 5: 648, 1914. *Euosmolejeunea serpentina* (Mitt.) Stephani Sp. Hepat. 5: 590, 1914. (**Plate 5.14**)

Plant pale yellowish green, prostrate, pinnately branched; leaves imbricate more at the top of the branches, slightly at base, widely spreading, ovate, convex, apex rounded, margin entire, 0.5- 0.52 ×0.4- 0.5 mm; leaf marginal cells slightly thick walled, rounded to irregularly quadrangular, 12-22 ×9-4µm; medullary cells thick walled, irregularly hexagonal, trigonous, 21-30 ×20-23µm, basal cells 34-37 ×17-24µm; leaf lobules minute, constricted at apex, teeth double, first one indistinct, second one unicellular, small and sub-acute; under leaves distantly placed, wider than stem, orbicular, bilobed, 0.25× 0.25mm; lobes sub-acute, margin entire, 0.13 mm deep.

Habitat: Epiphytic on branches.

Distribution:

World: Africa, India, Philippines, Singapore, Sri Lanka and Thailand.

India: Assam (Singh & Barbhuiya, 2012), Kerala (Nair *et al*., 2005; Manju *et al*., 2008, 2009), Madhya Pradesh (Asthana *et al*., 1995; Sharma & Alam, 2011), Meghalaya (Singh & Nath, 2007), Sikkim (Mizutani, 1963), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013 Daniels *et al*., 2018).

Kerala: Idukki (Present collection), Kozhikode (Manju *et al*., 2008, Manju & Rajesh, 2014); Wayanad (Nair *et al*., 2005a).

Specimen examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Chundel, 26.04.2016, (1780m), *Rajilesh V.K.* 14214 (MBGH).

Lejeunea Lib.,

Ann. Gen. Sci. Phys. 6: 372. 1820.

Plants yellowish green-brownish, epiphytic, prostrate, branched; rhizoides clustered at underleaf bases or not; leaves incubously placed, slightly imbricate; leaf lobe ovate or sub orbicular, apex rounded or apiculate, margin entire; leaf cells trigonous, large at base; marginal cells small, trigonous; median cells thin walled; leaf lobules with first teeth well developed, second tooth indistinct; under leaves present at ventral side, apex bilobed or with more spines.

Key to the species

1a. Leaves distant ……..... ……**2**

1b.Leaves imbricate……..... ……**3**

2a. Leaves lobe tip apiculate, leaves lobule reduced .....…. .....***L. eifrigii***

2b. Leaves lobe tip rounded, leaves lobule not reduced…….....…....***L. cavifolia***

3a. Leaves lobe ovate – rectangular……..... ……..***L. wightii***

3b. Leaves lobe ovate – sub orbicular…… ..... ……**4**

4a. Leaves lobe clearly convex, sub ovate–orbicular…… .....……...…***L. obscura***

4b. Leaves lobe not convex, ovate……..... ……....***L. tuberculosa***

Lejeunea cavifolia (Ehrh.) Lindb., Acta Soc. Sci. Fenn. 10: 43. 1871; Singh & Nath, Hepaticae Khasi & Jaintia Hills 268. 2007. *Jungermannia cavifolia* Ehrh., Hannover. Mag. 4: 45. 1789. **(Plate 5.15)**

Plants greenish brown, on soil cutting, prostrate, branched, 10-15 mm long, 0.58-0.7 mm wide including leaves; stem 0.3 mm in diameter, 7 cells across; cortical

cells in 7 longitudinal rows of cells, 35-48×17-23 µm; medullary cells in 9-18 longitudinal row, smaller, irregularly rounded, 11-13 µm wide; leaves inccubously placed, loosely imbricate, sub ovate to sub orbicular, margin entire, apex rounded, 0.68-0.74×0.57-0.6 mm; leaf cells irregularly rounded, trigonous, 22-25×34-41 µm, large at base; marginal cells small, trigonous, 12-15×12-16 µm; median cells 18-21×21-27 µm, thin walled; lobules constricted at apex, first tooth 1 or 2 celled, second one obsolete, one celled; under leaves wider than stem, 0.29-0.32×0.25-0.28 mm, apex bilobed, lobes subacute; sinus 150 µm deep, cells 18-29×14-22 µm, irregularly pentagonal, trigonous.

Habitat: The plant epiphytic on logs and on rocks seen along with *Lejeunea eifrigii* Mizut., *and* some specimens found as epiphyllus.

Distribution:

World: America, China, Europe, India, Nepal, Russia and Siberia

India: Andra Pradesh (Sandhya Rani *et al*., 2014), Kerala (Manju *et al*., 2014), Meghalaya, (Singh & Nath, 2007), Nagaland (Bansal *et al.,* 2011), Tamil Nadu (Daniels, 2010); Uttarakhand (Mizutani, 1971)

Kerala: Idukki (Present collection), Palakkad (Manju *et al*., 2014).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Shivanpara, 28.11.2012, 1500m, *Rajilesh V.K.* 8254; Checkpost, 11.03.2014, 1200 m, *Rajilesh V.K.* 9468; Thakkalikavala, 25.11.2014, 1600 m, *Rajilesh V. K.* 11513 (MBGH).

Lejeunea eifrigii Mizut., J. Hattori Bot. Lab. 33: 244. 1970. *Taxilejeunea acutiloba* Eifrig, Ann. Bryol. 9: 94. f. 9. 1936. (**Plate 5.16**)

Plants light greenish- pale yellowish, on soil cutting, prostrate, 7-14 mm long, 0.6-0.9mm wide including leaves, branched; leaves distant, obliquely spreading; leaf lobe ovate, 0.3-0.5 mm long, 0.22-0.4 mm wide, apiculate apex, entire margin, dorsal margin arched, ventral margin straight- slightly arched; cells polygonal, 20-25×17-22 µm, slightly trigones at middle and tip; basal cells large, polygonal, 22-

40x18-23 μm; marginal cells rectangular, small; leaf lobule reduced, small, triangular-ovate, tooth not distinct; underleaves distant, wider than stem, sub orbicular- ovate, 0.18-0.25 ×0.2-25 mm, base cordate, bilobed; lobes lanceolate, acute tip; sinus medium, v-shaped; rhizoides present at the base of underleaves.

Habitat: The plant epiphytic on logs and on land cutting along with *Lejeunea cavifolia* (Ehrh.) Lindb.

Distribution:

World: Australia, China, Indonesia, Japan, Malaysia, New Caledonia, New Guinea, Philippines and Taiwan.

India: Eastern Himalaya & Sikkim (Dey & Singh, 2012).

Kerala: Idukki (Present collection); Thiruvananthapuram; Agasthyamalai BR, Athirumala (Pocs *et al*., 2007; Manju *et al*., 2009).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Shivanpara, 28.11.2012, (1500m), *Rajilesh V.K.* 8254; Checkpost, 11.03.2014, (1200m), *Rajilesh V.K.* 9468 (MBGH).

Lejeunea obscura Mitt. J. Proc. Linn. Soc., Bot.5:112.1861; Dey & Singh, Epiphyll. Livewort. Estrn. Hima. 259. 2012; Das & Sharma, *Arch. Bryol*.166.2013; *Hydolejeunea obscura* (Mitt.) Steph. Sp. Hepat. 5:565.1914. *Taxilejeunea obscura* (Mitt.) Eifrig. *Ann. Bryol*. 9: 93. 1936. **(Plate 5.17)**

Plants yellowish green, epiphytic, 0.8- 14mm long, branched; leaves imbricate, widely spreading; leaf lobe convex, sub ovate to orbicular, apex rounded, entire margin dorsal and ventral margin arched; leaves cells hexagonal- polygonal, trigones,15-33×15-22 μm at tip and middle; basal cells large, elongated-polygonal,28-48×24-35 μm; marginal cells irregular rectangular; leaf lobule small, triangular- ovate, bidentate; first tooth unicellular, second tooth obsolete; underleaf distant, 2-3 times as wide as the stem, bilobed to half of the underleaf length, margin entire; under leaf lobes ovate, acute tip; sinus narrow; rhizoids present at underleaves bases.

Habitat: This plant is epiphytic on tree trunk along with *Plagiochila arbuscula* (Brid. ex Lehm. & Lindenb.) Lindenb.

Distribution:

World: Bhutan, China, India, Indonesia, Nepal and Sri Lanka.

India: Andra Pradesh (Singh *et al*., 2015), Arunachal Pradesh (Dey & Singh, 2012), Assam (Das & Sharma, 2013), Manipur (Dey & Singh, 2012), Sikkim (Dey & Singh, 2012), Tamil Nadu (Daniels *et al*., 2018) and West Bengal (Dey & Singh, 2012).

Kerala: Idukki (Present collection).

Specimen examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Chagalakavala (1650m), 12.03.2014, *Rajilesh V. K.* 10925b (MBGH).

Note: This species is a new distributional record to Kerala.

Lejeunea tuberculosa Steph., Sp. Hepat. 5:790. 1915; Nair *et al*., Bryophy. Wayanad, 72. 2005; Singh & Nath, Hepaticae. Khasi & Jaintia Hills, 258. 2007. *Eulejeunea camerunensis* Steph. Sp. Hepat. 6:417. 1923. *E. microclada* Pearson Ann. Cryptog. Exot. 4 (2): 66. 1931. *Lejeunea camerunensis* (Steph.) E. W. Jones *J. Bryol*. 7: 33. 1972. **(Plate 5.18)**

Plants pale greenish-yellowish green, 12-16 mm long, 0.74-0.78 mm wide including leaves, irregularly branching; leaves slightly imbricate below, imbricate at tip, obliquely spreeding, lobes ovate, roundate, 0.48-0.51× 0.4-0.43mm, apex rounded, entire margin; antical margin slightly arched, postical margin incurved; marginal cells quandrangular, 12-14 ×16-20 µm, thin walled, median cells irregularly rounded to hexagonal, 19-23× 21-27µm, trigonous, thick walled, basal cells less trigonous, thin walled, 22-25×30-38 µm, irregularly hexagonal; leaf lobule constricted at tip, ovate, first tooth 1cell long, second tooth indistinct; underleaf distant, transversely inserted, orbicular- ovate, 0.20-0.21mm long, 0.24-0.25mm wide, bilobed, sinus 0.13-0.14 mm deep, lobes obtuse, 7 celled long; underleaf cells small, thin walled, nontrigonous, quadrangular.

Habitat: The plant is seen on bark along with *Ctenidium lychnites* (Mitt.) Broth., *Hypopterygium tamarisci* (Sw.) Brid. ex Muell. Hal. and *Metzgeria lindbergii* Schiffn.

Distribution:

World: Bhutan, India, Nepal and Philippines, Sri Lanka

India: Arunachal Pradesh (Dey & Singh, 2012), Assam (Barbhuiya & Singh, 2012) Kerala (Nair *et al*., 2005; 2012), Manipur (Singh *et al*., 2010), Meghalaya (Singh & Nath, 2007), Sikkim (Mizutani, 1971), Tamil Nadu (Daniels. 2010; Daniels & Daniel, 2013; Daniels *et al*., 2018), Uttarakhand (Mizutani, 1971), West Bengal (Mizutani, 1971).

Kerala: Idukki (Present collection), Wayanad (Nair *et al*., 2005; 2012).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Mannankudi (1600m), 26.11.2014, *Rajilesh V. K.*11566c (MBGH).

Lejeunea wightii Lindenb., Syn. Hepat. 379. 1845; Singh & Barbhuiya, *Arch. Bryol*. 149. 2012. **(Plate 5.19)**

Plants yellowish green-brownish green, branched, 7-15 mm long, 1.2 mm wide including leaves; leaves imbricate more at tip of the branches, oblique to wide-spreading, rectangular-ovate, apex rounded, entire margin, dorsal margin slightly curved, ventral margin straight, 0.6-0.62x0.52-0.55 mm; cells irregularly rounded, with distinct trigones, 20-27 μm; basal cells irregularly rounded–elongate, 20-22x43-45 μm; leaf lobule first tooth distinct; underleaves distant, imbricate at tip of the branches, orbicular, 2-lobed, transversely or sinuately inserted; rhizoides clustered at underleaf bases.

Habitat: The plant epiphytic on bark along with *Eurhynchium hians* (Hedw.) Sande Lac., *Homalia trichomanoides* (Hedw.) Schimp., *Homaliodendron flabellatum* (Sm.) M. Fleisch., and *Thuidium cymbifolium* (Dozy & Molk.) Dozy & Molk.

Distribution:

World: This species is endemic to India and Sri Lanka.

India: Assam (Singh & Barbhuiya, 2012), Sikkim (Hattori, 1966; Mitten, 1861), Tamil Nadu (Alam, 2012b; Daniels & Daniels, 2013; Daniels *et al*., 2018), Uttarakhand (Mizutani, 1963), West Bengal (Hattori, 1966).

Kerala: Idukki (present collection).

Specimens examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Vellapara, 27.11.2014, 1780 m, *Rajilesh V.K.* 11580a (MBGH).

JUNGERMANNIALES H. Klinggr., Hoh. Crypt. Preuss. 10.1858.

Key to the families

1a. Plants delicate, very small; leaves bilobed ..... **Cephaloziaceae**

1b. Plants normal, medium or large; leaves normal **2**

2a. Rhizoides present at the base of the stem or from rhizome..... **Plagiochilaceae**

2b. Rhizoides present throughout the ventral side of the stem **3**

3a. Leaf apex entire; underleaves not prominent, if present very small..... ..... **Jungermanniaceae**

3b. Leaf apex toothed; underleaves distinct **4**

4a. Leaf apex 3 toothed; underleaves broad, not bilobed ..... **Lepidoziaceae**

4b. Leaf apex 5-6 toothed or smooth; under leaf deeply bilobed with broad sinus..... ..... **Lophocoleaceae**

LEPIDOZIACAEAE Limpr.,

Krypt. Fl. Schlesien 1(2): 310. 1877.

Plants dark greenish to brownish green, forming interwoven mats, small, prostrate; stem pinnately branched; rhizoids on leafy branches from underleaf bases; leaves imbricate, sub opposite, widely spreading, oblong-ovate, apex 3 toothed; tooth triangular, small, 2 cells high, single cells at tip; sinus lunate; apical cells

irregularly pentagonal; median cells thick walled, slightly trigonous; basal cells irregularly rectangular, thick walled; underleaves distant, hyaline, appressed, connate with leaves at base, subquadrate, with several irregular triangular teeth.

Bazzania Gray.,

Nat. Arr. Brit. Pl. 1: 704. 1821.

Bazzania tridens (Reinw., Blume & Nees) Trevis., Mem. Reale I st. Lombardo Sci., Ser. 3, Cl. Sci. Mat. 4: 415 1877; Singh & Nath., Hepaticae. Khasi & Jaintia Hills 33. 2007; Manju & Rajesh, Bryoph. Kerala, Liverwort (1): 74. 2017. *Jungermannia tridens* Reinw., Blume & Nees Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 12: 228. 1825. *Bazzania sinensis* Gottsche ex Stephani, Hedwigia 25: 208. 1886. *B. albicans* Stephani, Hedwigia 32: 204. 1893. **(Plate 5.20)**

Plants dark greenish to brownish green, forming interwoven mats, small, prostrate, 1.5-2.5 cm long, 2.2-2.4 mm wide including leaves; stem pinnately branched, 0.1-0.2 mm in. diameter; rhizoids on leafy branches from underleaf bases; leaves imbricate, sub opposite, widely spreading, oblong-ovate, 1.08-1.48×0.57-0.6 mm at base, 3.8-4 mm wide at top; apex 3 toothed; tooth triangular, small, 2 cells high, single cells at tip; sinus lunate; marginal cells 8-13×10-16 µm; apical cells irregularly pentagonal, 11-25×12-18 µm; median cells 13-20×16-22 µm, thick walled, slightly trigonous; basal cells irregularly rectangular, thick walled, 13-16×20-34µm; underleaves distant, hyaline, appressed, connate with leaves at base, subquadrate, 0.35-0.38×0.42-0.45 mm, with several irregular triangular teeth; basal cells thick walled, greenish, quadrangular, 10-28 ×6-8 µm, median and top cells 7.5-19×6.5-8.5 µm. sporogonium not seen.

Habitat: Seen on bark, logs and rocks.

Distribution:

World: Bhutan, Borneo, China, India, Japan, Korea, Nepal, Sri Lanka and Thailand.

India: Andra Pradesh (Sandhya Rani *et al*., 2014), Assam (Singh & Barbhuiya, 2012), Kerala (Madhusoodanan *et al*., 2007; Manju *et al*., 2009b; Manjula *et al*.,

2013), Manipur (Singh *et al*., 2010), Meghalaya (Singh & Nath, 2007), Sikkim (Verma *et al*.,2013), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013), West Bengal (Sharma & Srivastava,1993; Verma & Srivastava, 2011;Verma *et al*.,2013).

Kerala: Idukki (Madhusoodanan *et al*., 2007, Present collection), Kozhikode (Nair & Madhusoodanan, 2006; Manjula *et al.,* 2013), Thiruvananthapuram (Manju *et al*., 2009b).

Specimen/s examined*:* India, Kerala, Idukki, Mathikettan shola National Park, Shivanpara, 28.11.2012, 1500 m, *Rajilesh V.K.* 8254, 8273; Mannankudi, 29.11.2012, 1800 m, *Rajilesh V.K.* 8911; Muthupara, 11.03.2014, 1500 m, *Rajilesh V.K.* 9490; Karipara, 28.11.2014, 1660 m*, Rajilesh V.K.* 11618 (MBGH).

LOPHOCOLEACEAE Muell. Frib. ex Vanden Berghen,

Fl. Gen.Belgique, Bryoph. 1(2): 208. 1956.

Plants yellowish or pale brownish green, prostrate, irregularly branched; rhizoids smooth, hyaline, clustered at the under leaf bases; leaves parallel to the stem, imbricate, widely spreading, succubous, oblong, quadrate-rectangular, apex as much wide as base, entire margin with 5-6 tooth at apex; under leaves distant, free, deeply bilobed; sporogonium not seen.

Key to the genus

1a. Plants very small, delicate ..... ***Chiloscyphus***

1b. Plants medium (more than 3 cm long), not delicate .... ***Heteroscyphus***

Chiloscyphus campanulatus Steph., Sp. Hepat. 3:208. 1907; Srivastava & Srivastava, Indian Geocaly, Hepat. Taxon. Study.44.2002; Das & Sharma, *Arch. Bryol*.166.2013. **(Plate 5.21)**

Plants whitish- pale greenish, very small, 4-8 mm long, 1. 2- 1.6 mm wide including leaves, delicate, laterally compressed, rarely branched; leaves imbricate,

alternate, flat, slightly oblique spreading; leaves lobes variable in shape, ovate-oblong, subquadrate-rectangulate, 0.6-0.9×0.6-0.8mm, margin entire, broad base narrowing towards apex; some leaves apex notched, truncate-rotundate; leaf cells hexagonal-irregularly rounded, trigones, 18-34x16-34µm at apex; middle cells irregularly rounded tri-radiate trigones, 18-40x17-38 µm; basal cells large, 20-48x20-46 µm; marginal cells slightly quadrate; underleaves distant, small, 0.15-0.4 mm long, 0.2-0.33 mm wide, oblong, bifid; lobes triangular- lanceolate, 8-10 cells long, 2-5 cells width at base, one cell width at tip; additional one tooth present each side of the lobes.

Habitat: Epiphytic on logs.

Distribution:

World: Endemic to India.

India: Assam (Das & Sharma, 2013), Jammu & Kashmir (Srivastava & Srivastava, 2002), Madhya Pradesh (Sharma & Alam, 2011), Tamil Nadu (Sreebha *et al*., 2015; Daniels *et al*., 2018), Uttarakhand (Srivastava & Srivastava, 2002).

Kerala: Idukki (Present collection).

Note: New record to Kerala.

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Mannankudi (1850m), 29.11.2012 *Rajilesh V.K.* (MBGH).

Note: New distributional record to Kerala.

Heteroscyphus Schiffn.,

Oesterr. Bot.Z. 60: 171. 1910.

Plants yellowish-pale brownish green, prostrate, irregularly branched; rhizoids many, smooth, hyaline, clustered at the under leaf bases; leaves parallel to the stem, opposite, imbricate, widely spreading, succubous, ovate-oblong, quadrate-

rectangular, apex as much wide as base, entire margin with 5-6 tooth at apex or smooth; marginal cells irregularly pentagonal, thick walled; median cells hexagonal, thick walled; basal cells hexagonal, thick walled; under leaves small or large, distant or closely imbricate, free, wider than stem, deeply bilobed, apex bifid to form tooth like projections or not; sporogonium not seen.

Key to the species

1a. Leaves apex thoothed; underleaf small, deeply bilobed with broad sinus .... ***H. argutus***

1b. Leaves apex smooth; underleaf large, apex bifid into form a tooth .... ***H. perfoliatus***

Heteroscyphus argutus (Reinw., Blume & Nees) Schiffn., Oesterr. Bot. Z. 60: 172. 1910; Nair *et al*., Bryophy. Wayanad, 48. 2005; Singh & Nath, Hepaticae. Khasi & Jaintia Hills 77. 2007; Manju & Rajesh, Bryophy. Kerala, Liverwort (1):62. 2017. *Jungermannia arguta* Reinw., Nees & Blume, Nova Acta Phys. Med. Acad. Caes. Leop. Carol. Nat. Cur. 12: 206. 1825. *Chiloscyphus argutus* (Reinw., Nees & Blume) Nees, Syn. Hepat. 183. 1845. **(Plate 5.22)**

Plants pale brownish green, prostrate, firmly attached to bark, irregularly branched, 4-5 cm long and 2 mm wide including leaves; stem 0.27×0.1 mm in. diameter, 10- 12 cell across; cortical cells 14-16×17-23 µm; medullary cells 13-16×18-2 µm, thick walled, irregularly rounded; rhizoids smooth, hyaline, clustered at the under leaf bases; leaves parallel to the stem, imbricate, widely spreading, succubous, oblong, quadrate- rectangular, 1.2-1.38 × 1-1.2 mm, apex as much wide as base, entire margin with 5-6 tooth at apex; leaf teeth 3-6 cells long, uniseriate, 2 cells wide at base; marginal cells irregularly pentagonal, thick walled, 14-21×17-20 µm; median cells hexagonal, thick walled, 20-48×22-42µm; basal cells hexagonal, thick walled, 22-37×36-43 µm; oil bodies many, rounded, bead like; under leaves distant, free, 0.13×0.14 mm, deeply bilobed with broad sinus, 102 µm in. high; lobes 5-6 in. number, lanceolate, 2-3 cell wide at base, uniseriate at tip; sporogonium not seen.

Habitat: The plant is firmly attached to the bark.

Distribution:

World: Borneo, Brazil, China, India, Japan, Myanmar, New Zealand, Philippines, Sri Lanka, Sumatra, Taiwan and Vietnam.

India: Andra Pradesh (Sandya Rani *et al*., 2014), Arunachal Pradesh (Majumdar & Singh, 2015), Assam (Singh & Barbhuiya, 2012; Barbhuiya & Singh, 2012)); Verma et al., 2012; Das & Sharma, 2013), Himachal Pradesh (Srivastava & Srivastava, 2002), Jammu & Kashmir (Langer & Tanwir, 2002), Karnataka (Srivastava & Srivastava, 2002), Kerala ((Srivastava & Srivastava, 2002; Nair *et al*, 2005a, 2006; Manjula, 2013; Rajesh & Manju, 2014), Manipur (Srivastava & Srivastava, 2002), Madhya Pradesh (Srivastava & Srivastava, 2002; Sharma & Alam, 2011), Meghalaya (Srivastava & Srivastava, 2002; Singh & Nath, 2007), Orissa (Alam *et al*., 2013; Mishra *et al*., 2016), Sikkim (Srivastava & Srivastava, 2002), Tamil Nadu (Alam & Srivastava, 2009; Daniels, 2010; Verma *et al.,*2013; Daniels *et al*., 2018), Uttarakhand (Srivastava & Srivastava, 2002; Asthana & Sahu, 2013), West Bengal (Srivastava & Srivastava, 2002).

Kerala: Idukki (Present collection; Srivastava & Srivastava, 2002; Nair *et al*, 2006; Manjula et al., 2013), Kannur (Manju *et al.*, 2009b), Kozhikode (Manju *et al*., 2008a), Wayanad (Nair *et al.*, 2005a).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Checkpost, 25.11.2014, 1200 m, *Rajilesh V.K.* 11533; Vellapara, 27.11.2014, 1650 m, *Rajilesh V.K.* 11607 (MBGH).

Heteroscyphus perfoliatus (Mont.) Schiffner, Oesterr. Bot. Z. 60: 171. 1910; Nair *et al.*, Bryoph. Wayanad, 50. 2005; Singh & Nath, Hepaticae. Khasi & Jaintia Hills 77. 2007. *Lophocolea perfoliata* Mont., Ann. Sci. Nat., Bot. 17: 12. 1842. *Chiloscyphus perfoliatus* (Mont.) Nees, Syn. Hepat. 172.1845. **(Plate 5. 23)**

Plants yellowish-pale green, epiphyte on tree trunk, appressed to the stem, 3-4 cm long, 2-2.5 mm wide including leaves, laterally branched; stem cylindrical,

0.18-0.22 mm in. diameter, 10-12 cells across; cortical cells thick walled, pale yellowish; medullary cells colourless, thin walled; rhizoides many, hyaline, long, arising from the underleaf bases; leaves opposite, succubous, closely imbricate, ovate-oblong, 1.6-2×1.2-1.4 mm, broad base, entire margin, smooth, apex obtuse; cells thin walled, trigones; 25-46×20-44 µm at base, 22-40×23-42 µm at middle, 16-33×18-33 µm at apex; under leaves prominent, large, wider than stem, closely imbricate, reniform, wider than long, apex bifid to form tooth like projections, tooth 4-5 cells long, 3-4 cells wide at base.

Habitat: Seen on stem bark along with *Pterobryopsis frondosa* (Mitt.) M. Fleisch.

Distribution:

World: India, Nepal and Sri Lanka.

India: Kerala (Srivastava & Srivastava, 2002; Nair *et al*., 2005a; Manjula *et al*., 2013), Meghalaya (Singh and Nath, 2007), Tamil Nadu (Daniels, 2010; Verma *et al.,* 2013), West Bengal (Chopra, 1938b as *Chlioscyphus Perfoliatus)*

Kerala: Idukki (Present collection, Madhusoodanan *et al*., 2007; Manjula *et al*., 2013), Wayanad (Nair *et al*., 2005a).

Specimen/s examined: India, Kerala, Idukki, Mathikettan shola National Park, Mannankudi, 29.11.2012, (1800m), *Rajilesh V.K.* 8918b; Vellapara, 01.11.2017, (1780 m), *Rajilesh V.K.* 14281(MBGH).

PLAGIOCHILACEAE Muell. Frib.,

Leberm. Eur. 877. 1956.

Plants yellowish green- brownish green, creeping, slightly glossy, small-large, dichotomously or irregularly-lateral branched; rhizoids arise from rhizomes or on to base of the stem; stem brownish, stem cells differentiated; leaves ovate to sub rectangular, oblong-ovate or triangular-oval, apex irregularly dentate; ventral margin spinose-dentate; dorsal margin almost straight.

Plagiochila (Dumort.) Dumort.,

Recueil Observ.Jungerm.14. 1835.

Plants yellowish green-brownish green, creeping, slightly glossy, small-large, dichotomously or irregularly-lateral branched; stem brownish, stem cells differentiated, hexagonal; cortical cells brownish-yellowish brown, thick walled, 2 or 3 layered; medullary cells thin walled, smooth, colourless or whitish; rhizoids arise from rhizomes or on to base of the stem; leaves ovate to sub rectangular, oblong-ovate or triangular-oval, apex irregularly dentate, ventral margin spinose-dentate; dorsal margin almost straight; middle cells polygonal or irregularly rounded; basal cells irregularly hexagonal-polymorphic, slightly thick walled, large; sporophyte unknown.

Key to the species

1a. Plants medium; leaves contiguous . ..... ***P. arbuscula***

1b. Plants small; leaves imbricate **2**

2a. Leaves broadly triangular-ovate; leaf cells trigones .... ***P. sciophila***

2b. Leaves ovate-sub-rectangular; leaf cells minutely trigones ..... ***P. fruticosa***

Plagiochila arbuscula (Brid. ex Lehm. & Lindenb.) Lindenb., Sp. Hepat. 1:23.1839; Manju & Rajesh, Bryophy. Kerala, Liverwort (1): 66. 2017. **(Plate 5.24)**

Plants yellowish green to brownish green, epiphytic on bark, arising from creeping rhizome, 7-13 cm long, 4-5 mm wide including leaves, dichotomously branched, branches more at terminal; stem 245-302 µm in diameter, cortex 3 cell layers, thick walled, 8-11×16-22 µm, yellowish brown colour; medullary cells thin walled, 12-25×20-33 µm, smooth, colourless; rhizoids on rhizomes; leaves contiguous, oblong-ovate, 1.6-1.8×0.9-1.2 mm, apex irregularly dentate, with 2-3 larger teeth, ventral margin spinose-dentate; dorsal margin almost straight, entire; teeth 5-7 per leaf, 1-2 uniseriate row, 2-3 cells wide at base, terminal cells acute; leaf apical and median cells 17-20×20-33 µm, less trigones, irregularly polymonial; basal cells trigones, thick walled, 15-25×30-42 µm; sporophyte unknown.

Habitat: Seen on tree trunk, hanging from creeping rhizomes along with *Lejeunea obscura* Mitt.

Distribution:

World: China, India, Sri Lanka and Southeast Asia.

India: Kerala (Nair *et al*., 2005a).

Kerala: Idukki (Present Collection), Wayanad (Nair *et al*., 2005a).

Specimen/s examined: India: Kerala, Idukki, Mathikettan shola National Park, Shivanpara, 28.11.2012, 1500 m, *Rajilesh V.K.* 8245; Karipara, 12.03.2014, 1600 m, *Rajilesh V.K.* 10915b; Chagalakavala, 12.03.2014, 1500 m, *Rajilesh V.K.* 10925a; Udumbupara, 24.11.2014, 1500 m, *Rajilesh V.K.* 10976 (MBGH).

Plagiochila fruticosa Mitt., J. Proc. Linn. Soc., Bot. 5: 94, 1861; M. L.So, Systematic Botany Monographs, V.60, *Plagiochila* in China 66. 2001; Nair *et al.,* Bryoph. Wayanad, 53. 2005; Singh & Nath, Hepaticae. Khasi & Jaintia Hills 151. 2007; Manju & Rajesh, Bryoph. Kerala, Liverwort (1):69. 2017 **(Plate 5.25)**

Plants brownish green, creeping, glossy, 7-8 cm long; stem brownish, 300µ m wide, cells differentiated, hexagonal; cortical cells brownish, thick walled, 2 layered, 5-10× 10-15 µm; medullary cells thin walled, 12-15×15-25 µm; leaves slightly imbricate, ovate to sub rectangular, 1-1.5×0.75-0.82 mm; ventral margin straight, entire, recurved at base, 3-5 teeth per leaf, teeth 2-3 cells high, base 2 celled, tip 1 celled; leaf cells minutely trigonous, quadrangular at margin, 13-16×13-20 µm; middle cells polygonal, 18-22×17-28 µm; basal cells irregularly hexagonal, slightly thick walled, large, 16-23×20-37 µm.

Habitat: Epiphytic on bark of the stem.

Distribution:

World: Bhutan, China, Japan, India, Philippines, Sri Lanka and Thailand

India: Karnataka (Rawat & Srivastava, 2007; Schwarz, 2013); Kerala (Nair *et al*., 2005a; Nair & Madhusoodanan, 2006; Rawat & Srivastava, 2007; Manju *et al*., 2009b); Meghalaya (Singh & Nath, 2007); Sikkim (Hattori,1966), Tamil Nadu (Rawat & Srivastava, 2007; Verma *et al*, 2013).

Kerala: Idukki (Present collection; Rawat & Srivastava, 2007), Kozhikode (Nair & Madhusoodanan, 2006), Thiruvananthapuram (Manju *et al*., 2009b), Wayanad (Nair *et al.,* 2005a).

Specimen/s examined*:* India: Kerala, Idukki, Mathikettan shola National Park, Chundel, 09.04.2013, 1200 m, *Rajilesh V.K.* 9433; Aduvilanthankudi, 13.03.2014, 1650 m, *Rajilesh V K* 10938; Udumbupara, 1500 m, 24.11.2014, *Rajilesh V.K.* 10975; Vellapara, 13.03.2014, 1650 m, *Rajilesh V K* 11692; Njandar, 04.08.2015, 1400 m, *Rajilesh V.K.* 11673(MBGH).

Plagiochila sciophila Nees ex Lindenb. Sp. Hepat. 24: 100. 1840; Singh & Nath, Hepaticae. Khasi & Jaintia Hills 145. 2007. *P. euryphyllon* Carl ex Herzog. Hedwigia. 78:232. f. 8. 1938. *P. Japonica* subsp. *ciliigera* R. M. Schust. Amer. Midl. Naturalist.62:354.1959. *P. acanthophylla* var. *ciliigera* (R. M. Schust.) Inoue. J. Hattori Bot. Lab. 25: 100.1962. *P acanthophylla* subsp. *japonica* (Sande Lac.) Inoue. J. Hattori Bot. Lab. 25: 100. 1962. *P acanthophylla* subsp. *ciliigera* (R. M. Schust.) R.M. Schust. Hepat. Anthocerotae N. Amer. 4: 435.1980. **(Plate 5. 26)**

Plants pale brownish green, slightly glossy, tuft on bark and on rocks; stem 6-8.5 cm long, 3-4 mm wide including leaves; branches rare, (if present) irregularly-lateral; stem brownish, 300-315 µm in. diameter, cortex yellowish brown, thick walled, 3-4 layered, cells 13-18×9-12 µm; medullary cells thin walled, larger, whitish brown, 12-14 layers, 17-25×15-20 µm; rhizoids on base of the stem; leaves imbricate, broadly triangular-ovate, 2-2.2 mm×1.8-2 mm; postical margin extend up to half of the stem, somewhat straight, entire, 2-3 teeth near at apex; antical margin broad at base, irregularly dentate, 16-18 spines, apex broadly rounded; teeth 5-7cells long, 3-4 cells uniseriate, 2-4 cells wide at base, teeth cells enlarged, 22-40×10-15 µm; leaves basal cells polymorphic, thick walled, trigonous, 35-45×20-35 µm; median cells somewhat irregularly rounded, thick walled, trigonous; apical cells

polymorphic, thick walled, trigonous,18-20×16-18 μm; marginal cells somewhat rectangular, thick walled, 20-24×16-18 μm; sporophyte unknown.

Habitat: Seen on rock in association with *Homaliodendron flabellatum* (Sm.) M. Fleisch.

Distribution:

World: India, Nepal, Sri Lanka and Vietnam

India: : Arunachal Pradesh (Dey & Singh, 2012), Himachal Pradesh (Singh & Singh, 2019) Kerala (Nair *et al.,* 2005b; Rawat & Srivastava, 2007), Manipur (Singh *et al*., 2010), Meghalaya (Rawat & Srivastava, 2007; Singh & Nath, 2007), Sikkim (Rawat & Srivastava, 2007; Dey & Singh,2012); Tamil Nadu (Rawat & Srivastava, 2007; Daniels, 2010; Verma et al., 2013; Daniels & Daniel, 2013), Uttarakhand (Srivastava & Dixit, 1996; Rawat & Srivastava, 2007; West Bengal (Rawat & Srivastava, 2007).

Kerala: Idukki (Rawat & Srivastava, 2007; Present Collection) Wayanad (Nair *et al.,* 2005b)

Specimen/s examined: India, Kerala, Idukki, Mathikettan shola National Park, Mannankudi, 29.11.2012, 1800 m, *Rajilesh V.K.* 8298; Mannankudi, 29.11.2012, 1850 m, *Rajilesh V.K.* 8909; Vellapara, 27.11.2014, 1600 m, *Rajilesh V.K.* 11588b (MBGH).

Note: Rajilesh *et al*. (2018) wrongly identified this species as *Plagiochila magna* Inoue and reported as new record to Peninsular India. Nair *et al*., (2005b) already reported this species from Kerala. *P. sciophila* shows wide range of morphological variations depending upon the microhabitat.

CEPHALOZIACEAE Mig.

Krypt. Fl. Deutschl.,Moose. 465.1904.

Cephaloziella kiaeri (Austin) S. Arnell, Bot. Not. 319. 1952; Nair *et al.,* Bryoph. Wayanad, 55. 2005. *Jungermannia kiaeri* Austin, Bull. Torrey Bot. Club 6:18. 1875. *Cephalozia andreana* Steph., Sp. Hepat. 6: 434. 1924. *Cephaloziella willisana* (Steph.) Kitagawa, J. Hattori Bot. Lab. 32: 295.1939. **(Plate 5.27)**

Plants pale greenish, prostrate, delicate, 10- 13 mm long, branched; rhizoides few at base of the stem; leaves distant, contiguous, small, bilobed, lobes sub equal, 150-190×135- 145 µm, leaf cells irregularly rectangular, small, thin walled, 9-15×7-9 µm, basal cells slightly larger, 19-21×8- 10 µm, quadrangular, underleaves absent.

Habitat*:* Seen on soil along with *Campylopus involutus* (Muell. Hal.) A. Jaeger.

Distribution:

World: China, India, and Sri Lanka.

India: Karnataka (Schwarz & Frahm, 2013), Kerala (Udar & Kumar, 1985; Nair *et al*., 2005a; Manju *et al.*, 2009a), Meghalaya (Singh & Nath, 2007 as. *C.willisana),* Tamil Nadu (Udar & Kumar, 1985; Nair *et al*., 2005a; Daniels & Daniel, 2013; Daniels *et al*., 2018).

Kerala: Idukki (Udar & Kumar, 1985; Present collection); Palakkad (Udar & Kumar, 1985); Thiruvananthapuram (Manju *et al.,*2009b as *C. willisana*); Wayanad (Udar & Kumar, 1985; Nair *et al*., 2005a).

Specimen examined: India, Kerala, Idukki, Mathikettan shola National Park, Mannankudi, 29.11.2012. (1800m), *Rajilesh V.K.* 8903 (MBGH).

JUNGERMANNIACEAE Rchb.,

Bot. Damen. 256. 1828.

Plants pale yellowish green-brownish green, prostrate, branched; stem cells thin walled and hyaline; rhizoids many, purple-pink to colourless, scattered at the

ventral side or restricted to the leaf bases; leaves obliquely inserted, imbricate or contiguous, alternate or not, reniform-ovate, sub quadrate or ovate-ligulae, apex rounded, margin entire; under leaves not prominent, if present very small, triangular or not; sporophyte not seen.

Jungermannia L.,

Sp.Pl. 2: 1131–1136. 1753.

Plants pale yellowish green-brownish green, prostrate, simple, and branched; stem cells thin walled and hyaline; rhizoids many, purple-pink to colourless, scattered at the ventral side or restricted to the leaf bases; leaves imbricate, alternate, ovate-sub quadrate or ovate-ligulae, apex rounded, margin entire, obliquely inserted; leaf marginal cells rectangular or quadrangular, less trigonous, middle cells irregularly rounded or polygonal, non trigonous, thick walled, basal cells polygonal, minute trigonous, thin walled.

Key to the species

1a. Plants more than 2 cm long, branched; rhizoids scattered along the stem, purple-pink **2**

1b. Plants less than 1cm long, simple; rhizoids restricted to leaf base, colourless..... ..... ***J.comata***

2a. Leaves distant to contiguous, clearly alternate ..... ***J. shinii***

2b. Leaves closed to imbricate slightly alternate ..... . ***J. rubripunctata***

Jungermannia comata Nees., Enum. Pl. Crypt. Jav. 78. 1830; Singh & Nath, Hepaticae. Khasi & Jaintia Hills. 97. 2007. **(Plate 5.28)**

Plants pale green to brownish green, tufted on logs, prostrate, simple, small, 6-8 mm long, 1.8-2 mm wide including leaves; stem 0.2-0.26 mm in diameter,11-12 cells across; cortical cells thin walled, 18-20×17-38 μm; medullary cells 13-30×18-32 μm, thin walled, irregularly hexagonal; rhizoids pale purple-colourless, large, along the stem, mostly restricted to leaf bases; leaves imbricate, obliquely inserted, ovate-ligulate, 1.2-1.3×0.8-0.85 mm, apex rounded, margin entire; marginal leaf cells rectangular, 36-43×11-15 μm at basal part of leaf, which reduce to small, 20-

23×12-19 µm, rectangular-pentagonal at top; median cells 26-39×13-24 µm, trigonous, cells irregularly rounded, thin walled; basal cells less trigonous, thin walled, 18-20×36-46 µm.

Habitat: Seen on logs.

Distribution:

World: China, Japan, India, Indonesia, Philippines, Sumatra, Taiwan and Thailand.

India: Assam (Singh & Barbhuiya, 2012), Meghalaya (Singh & Nath, 2007), Nagaland (Vana, 1972), Sikkim (Amakawa, 1970), West Bengal (Amakawa, 1970).

Kerala: Idukki (Present collection).

Specimen/s examined: India, Kerala, Idukki, Mathikettan shola National Park, Njandar, 04.08.2015. 1400 m, *Rajilesh V.K.* 11679; Vellapara, 01.11.2017, 1780 m, *Rajilesh V.K.* 14275 (MBGH).

Note: This species is new distributional record to Peninsular India.

Jungermannia rubripunctata (S. Hatt.) Amak., J. Hattori Bot. Lab. 22: 38. 1960; Singh & Nath, Hepaticae. Khasi & Jaintia Hills. 99. 2007; Manju & Rajesh, Bryoph. Kerala, Liverwort. (1):76. 2017. *Plectocolea rubripunctata* S. Hatt., J. Hattori Bot. Lab. 3: 41. f. 36, 1948. **(Plate 5.29)**

Plants pale yellowish green-brownish green, mat form on soil cutting, prostrate, branched. 2-2.2 cm long and 1.2-1.5 mm wide including leaves; stem 0.2 mm wide, 8 cells across; cells thin walled and hyaline; cortical cells 10-15×15-18 µm; medullary cells 20-25×20-30 µm; rhizoids many, pink-purple, scattered at the ventral side; leaves imbricate, slightly alternate, ovate-sub quadrate, apex rounded, margin entire, 0.64-0.75×0.51-0.6 mm, obliquely inserted; leaf marginal cells quadrangular, less trigonous, 19-32×28-32 µm, middle cells polygonal, non trigonous, thick walled 21-25×22-33 µm, basal cells polygonal, minute trigonous, 18-34×40-49 µm, thin walled.

Habitat: Seen on vertical land cuttings.

Distribution:

World: China, Japan, India and Nepal.

India: Kerala (Manju & Rajesh, 2017), Meghalaya (Singh & Nath, 2007), West Bengal (Udar & Kumar, 1981)**.**

Kerala: Idukki (Present colletion); (Manju & Rajesh, 2017).

Specimen examined: India, Kerala, Idukki, Mathikettan shola National Park, Checkpost, 25.11.2014, 1200 m, *Rajilesh V.K.*11531 (MBGH).

Jungermannia shinii Amakaw, J. Hattorri Bot. Lab. 33: 156.f.27.1970; Singh & Nath, Hepaticae. Khasi & Jaintia Hills 99. 2007; Manju & Rajesh, Bryoph. Kerala, Liverwort (1):76. 2017. *Plectocolea shinii* (Amakawa) Polish bot. J. 58(1): 132. 2013. *Solenostoma shinii* (Amakawa) T. Katag. & Furuki. Hattoria 9: 92. 2018. **(Plate 5.30)**

Plants yellowish to brownish green in colour, seen as patches, prostrate, apex sub erect; stem sparsely branched, 2.5 cm long, 2 mm wide including leaves; rhizoids seen along the ventral side of the stem, purple in colour; leaves contiguous, clearly alternate, inserted obliquely, reniform to ovate, apex almost rounded, margin entire, 1×1 mm; leaf cells containing many rounded chloroplast, which are placed near the cell wall; marginal cells quadrangular, 34-36×21 μm; middle cells quadrangular to hexagonal, 53–57×29-38 μm; basal cells almost quadrangular, 75-79×24-35 μm; sporophyte not seen.

Habitat: Seen on vertical and cuttings in association with *Marchantia linearis* Lehm. & Lindenb.

Distribution:

World: India and Japan.

India: Andra Pradesh (Sandhya Rani *et al*., 2014 as *J. truncata*), Kerala (Manju *et al*., 2008; Manju & Rajesh, 2017), Meghalaya (Singh and Nath, 2007).

Kerala: Idukki (Present collection). Kerala (Manju *et al*., 2008; Manju & Rajesh, 2017)

Specimen examined: India, Kerala, Idukki, Mathikettan shola National Park, Vellapara, 01.11.2017, (1850 m), *Rajilesh V.K.* 14288 (MBGH).

ANTHOCEROTOPHYTA Rothm.ex Stotler & Crand. Stotler.,

Bryologist 80 (3): 425. 1977.

The plant body is thalloid form, flattened, lobed; rhizoides hyaline, unicellular; thallus without internal tissue differentiation, pyrenoid present in each cells; capsule horn like, erect.

ANTHOCEROTALES Limpr. Krypt. Fl. Schlesien 1(2): 345. 1877.

ANTHOCEROTACEAE Dumort.,

Anal. Fam. Pl. 68-69. 1829.

Thallus usually spongy, posses numerous schizogenous cavities in 1-3 layers; antheridia numerous, club shaped in antheridial chamber, with 4 tired cells in the jacket layer; epidermal layer of capsule wall stomatiferous; spores brown to dark; pseudoelators 1-5 celled, short, thin walled or long, vermiform, thick walled bearing a central dark continuous lumen.

Anthoceros L.,

Sp. Pl. 2: 1139- 1140. 1753.

Anthoceros crispulus (Mont.) Douin, *Rev. Bryol*. 32:27. 1905; Pande & Bharadwaj, J. Indian Bot. Soc. 28:5. 1949; Nair *et al.*, Bryoph. Wayanad. 80. 2005. *Anthoceros punctatus* var. *crispulus* Mont., Hist. Nat. Îles Canaries 4: 195.1840. **(Plate 5.31)**

Thallus dark green, rosettes, 1.4-1.6 cm wide; rhizoides hyaline, smooth walled; epidermal cells elongated rectangular, thin walled, containing chloroplast and pyrenoides; storage cells large, irregularly hexagonal, 45-65× 45-55µm, thin walled; mucilage chambers present, 1-2 layered; seta 4 cm long; capsule bivalved, erect; elaters 280-320 µm long; spore dark brown, rounded, spinulate, 35-40 µm wide.

Habitat: Terrestrial on soil.

Distribution:

World: America, Europe, India, Japan, Korea, Malaysia and Sri Lanka.

India: Andra Pradesh (Sandhya Rani *et al*., 2014), Arunachal Pradesh (Asthana & Srivastava, 1991), Bihar (Bapna & Kachroo, 2000), Karnataka (Asthana & Srivastava, 1991; Aruna & Krishnappa, 2014)), Kerala (Rajeevan, 1990; Asthana & Srivastava, 1991; Easa, 2003; Manju *et al*., 2005a), Maharashtra (Asthana & Srivastava, 1991; Chaudhary *et al*., 2008), Tamil Nadu (Asthana & Srivastava, 1991; Daniels, 2010), Uttar Pradesh (Asthana & Srivastava, 1991; Singh, 2012), Uttarakhand (Asthana & Srivastava, 1991).

Kerala: Idukki (Present collection, Rajeevan, 1990; Asthana & Srivastava, 1991), Palakkad (Easa, 2003), Wayanad (Nair *et al*., 2005a).

Specimen examined: India, Kerala, Idukki, Mathikettan shola National Park, Vellapara, 01.11.2017, (1780m), *Rajilesh V.K.* 14276 (MBGH).

BRYOPHYTA Schimp.,

Handb. Paleophyt.1. 1879.

Plants foliose, leaves usually many ranked, spirally arranged, rarely distichous, costate or ecostate, laminar cells isodiametric to linearly elongated; seta short or long; capsules vary in shape with mouth, operculam and peristome teeth. Mosses are the most diversified group of Bryophytes. Gametophyte is either erect or prostrate, branched or not, midrib prominent, single or double, rhizoids multicellular and branched; sporophyte differentiated in to foot, seta and capsule.

POLYTRICHALES Cavers, New Phytol. 10(1–2): 31. 1911.

POLYTRICHACEAE Schwagr.,

Sp. Musc. Frond. 1. 1830.

Plants greenish, slender, simple, unbranched; stem with central strand; leaves concave, lanceolate, broad at base, apex acute, margin entire at extreme base, dentate towards to the apex; costa strong, wide, clear at base; leaves cells

rectangular–rounded, incrassate; seta erect, long; capsule erect, peristome with 32 teeth, operculam rostrate, calytra hairy, covering capsule.

Pogonatum P. Beauv.,

Mag. Encycl. 9(19): 329. 1804.

Pogonatum microstomum (R.Br. ex Schwagr.) Brid., Bryol. Univ. 2: 745 1827; Gangulee, Moss. E. India 1(1). 143. 1969; Nair *et al*., Bryoph.Wayanad, 94. 2005. *Polytrichum clavatum* Dozy & Molk., Pl. Jungh. 3: 326. 1854. *Pogonatum paucidens* Besch., Rev. Bryol. 18:89.1891.. *P. macrocarpon* Broth., Symb. Sin. 4: 135 1929. *P. submicrostomum* Broth., Symb. Sin. 4: 134 1929. *P. mirabile* Horik., Bot. Mag. (Tokyo) 49: 671. 26 1935. *P. subclavatum* Dixon, Ann. Bryol. 12: 56 1939. *P. microstomum* var. *ciliatum* W. X. Xu & R.L. Xiong, Acta Bot. Yunnan. 6:183. f. 8: 15–18 1984. **(Plate 5.32)**

Plants dark greenish, lax tuft on soil cutting, robust; stems simple, rarely innovating, 5-7×0.7-1.6 mm, covered with large leaves upper, tomentose below; leaves rigid, erect-spreading, slightly incurved when dry, lanceolate, 8-10×1.3-1.8 mm; base wide, ovate, slightly sheathing, 1.3 mm long, 2.3 mm wide; apex sharply pointed, acute; margin sharply toothed nearly to the wide base of lamina; costa single, reddish brown, strongly toothed on back above; leaves cells rectangular, 47-60×15-18 µm at base, becoming narrower towards margin; irregularly quadrate, 12-24×14-20 µm, incrassate at middle and tip; lamellae numerous, covering most of the ventral region, 3-5cells high, end cells thin walled, larger, divided to base into flask-shaped forks, thick walled sclerides cells below. seta erect, 2-3 cm long, yellowish brown; capsule erect, greenish, reddish brown when old, 5-6 mm long, 2 mm in diameter; peristome normal, 32 in number; spores rounded, pale greenish, 12 µm in diameter.

Habitat: The plant seen on land cuttings.

Distribution:

World: Bhutan, China, Formosa, India, Philippines, Sri Lanka and Tonkin.

India: Arunachal Pradesh (Rawat *et al*., 2017), Karnataka (Aruna & Krishnappa, 2014), Kerala (Nair *et al*., 2005a; Madhusoodanan *et al*., 2007), Odisha (Mishra *et al*., 2016),Uttarakhand (Asthana & Sahu, 2013), West Bengal (Gangulee, 1969).

Kerala: Idukki (Present Collection, Madhusoodanan *et al*., 2007), Wayanad (Nair *et al*., 2005a).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Shivanpara, 28.11.2012, 1500 m, *Rajilesh V. K.* 8205, 8210, 8243; Njandar, 04.08.2015, 1400 m, *Rajilesh V.K.* 11675 (MBGH).

DICRANALES M. Fleisch., Hedwigia 61(4): 392. 1920.

Key to the families

1a. Leaves with distinct sheathing lamina; alar absent..... **Fissidentaceae**

1a. Leaves without sheathing lamina; alar present or indistinct..... 2

2a. Costa strong, wide..... .....**Leucobryaceae**

2b. Costa normal, narrow..... 3

3a. Plants large; leaves medium; alar distinct..... ....**Dicranaceae**

3b. Plants small; leaves small; alar indistinct..... .....**Ditrichaceae**

FISSIDENTACEAE Schimp.,

Coroll. Bryol. Eur. 20. 1856.

Plants yellowish-green; leaves distichous, vertically placed, oblong, ovate-lanceolate, complanate; characteristic sheathing or vaginent lamina present; sheathing laminae unequal and open; costa single, reached to the apex; cells quadrate-hexagonal, distinct, multipapillate.

Fissidens Hedw.,

Sp. Musc. Frond. 152. 1801.

Plants yellowish-green, small to large; leaves distichous, oblong or narrowely lanceolate- ovate lanceolate, vertically placed, 14-20 pairs, complanate,

small-large; sheathing or vaginent lamina present; sheathing laminae unequal and open; costa single, reached to the apex; cells quadrate-hexagonal, incrassate, distinct, multipapillate, cells with pellucid (resembling semilimbidium) present or absent.

Key to the Species

1a. Plants large, more than 2 cm long .... ***F. anomalus***

1b. Plants small, less than 2 cm long **2**

2a. Leaves narrowely lanceolate ..... ***F.crispulus*** var. ***crispulus***

2b. Leaves ovate-lanceolate **3**

3a. Leaves with 18-20 pairs; leaves large, more than 1.8 mm……. …….. .. .. ***F. involutus*** subsp. ***curvatoinvolutus***

3b. Leaves with 14-16 pairs; leaves small, less than 0.8 mm…..... ***F. pellucidus***

Fissidens anomalus Mont., Ann. Sci. Nat., Bot., ser. 2, 17: 252 1842; Gangulee, Moss. E. India 1(2). 555. 1971. *F. neckeroides* Griff., Calcutta J. Nat. Hist. 2: 504 1842. *F. cryptotheca* Dozy & Molk., Pl. Jungh. 314. 1854. *F. schiffneri* Baumgartner & Dixon, Ann. Naturhist.Mus. Wien 59: 67. 1953 **(Plate 5.33)**

Plants greenish, robust, tufted on bark; stem 2-3.5 cm long, 6 mm broad; leaves curled, crumpled when dry, oblong-lingulate, 2.9-3.5×0.6-0.9 mm; dorsal lamina narrowing down to a rounded base at point of insertion, apical portion symmetric, narrower than base, irregularly toothed at margin; sheathing laminae unequal and open, terminating below margin with 3 or 4 rows of elongate, incrassate, pellucid cells resembling a semilimbidium; semilimbidium absent; costa single, reached to the apex; cells quadrate-hexagonal, distinct, multipapillate; apical and median ones 9-13×7-9 µm, irregularly rounded*;* basal ones slightly large rounded, 1317×11-14 µm; sporophyte not seen.

Habitat: Epiphytic on bark.

Distribution:

World: Burma, India, Indonesia, Nepal, Philippines, Sri Lanka, Thailand and Vietnam.

India: Karnataka (Schwarz, 2014), Kerala (Nair & Madhusoodanan, 2001; 2006), Meghalaya (Asthana & Srivastava 2015), Tamil Nadu (Daniels & Daniel, 2013).

Kerala: Idukki (Nair & Madhusoodanan, 2001; Present Collection), Kozhikode (Nair & Madhusoodanan, 2006).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Kadayirippu, 25.11.2014, 1500m, *Rajilesh V.K.* 10997; Mannakudi, 26.11.2014, 1600 m, *Rajilesh V.K.* 11559; Vellapara, 27.11.2014, 1780 m, *Rajilesh V.K.* 11586; (MBGH).

Fissidens crispulus Brid. Musc. Rec. Suppl. 4: 187, 1819 (1818).var ***crispulus*** Brid., Musc. Rec suppl. 4:187.1819; Nair *et al*., Bryoph.Wayanad, 105. 2005. *Fissidens bryoides* var. *crispulus* (Brid.) Wijk & Margad., Taxon 8:1. 1959. F. tamarindifolius (Turn.) Brid. var. *crispulus* (Brid.)Brid., Bryol. Univ.2:686.1827. *F. zippelianus* Dozy & Molk. Syst. Verz.29.1854. *F. sylvaticus* (auct. non Griff.) Dix., Hong Kong Nat. Suppl. 2: 8. 1933. *F. pepuensis* P.C.Chen, Sunyatsenia (2): 189, 31.1941. *F. sylvaticus* var. *zippelianus* (Doxy & Molk.) Gangulee, Moss. E. India 2:537. 1971. **(Plate 5.34)**

Plants pale greenish- yellowish green, simple, 1-1.5 ×0.2- 0.22 cm; leaves narrowly lanceolate, apex acuminate, margin crenulated above by upturned marginal cells, entire below; dorsal lamina narrowing down to flat base at the point of insertion; sheathing lamina unequal and open, tip terminating slightly below margin level; semilimbidium absent; costa yellowish green, percurrent; leaf cells quadrangular to hexagonal, mamillose, incrassate, 10-11 ×10 μm, extreme basal cells rectangular.

Habitat: The plant seen on land cuttings.

Distribution:

World: China, India and Malaysia.

India: Karnataka (Schwarz, 2013); Kerala (Nair *et al*., 2005), West Bengal (Rawat *et al.,* 2016).

Kerala: Idukki (Present Collection); Kozhikode, Wayanad (Nair *et al*., 2005).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Vellapara, 27.11.2014, (1780m), *Rajilesh V.K.* 11611b (MBGH).

Fissidens involutus Wilson ex Mitt. subsp. ***curvato-involutus*** Gangulee. Gangulee, Moss. E. India 1(2). 548. 1971. *Fissidens curvatoinvolutus* Dixon, Notes Roy. Bot. Gard. Edinburgh 19: 279, 1938. **(Plate 5.35)**

Plants yellowish green, simple; stem brownish, rhizomatous, 1.5 cm long, 0.3 cm wide including leaves; leaves 18- 20 pairs, curled when dry, ovate-lanceolate, apex curved, acuminate tip, margin crenulated by projection of marginal cells, 1.8- 2 × 0.5-0.6 mm; dorsal lamina straight to down and rounded base; sheathing lamina unequal, open; semilimbidium absent; costa yellowish, percurrent; leaf cells quadrangular, thick walled, incrassate, mamillose, 10-15 ×11-12 µm.

Habitat: The plant seen on land cuttings.

Distribution:

World: Burma, India, Nepal, Thailand and Vietnam.

India: Gujarat (Chaudhary *et al*., 2006), Kerala (Madhusoodanan *et al*., 2007, Manju *et al*., 2008); Madhya Pradesh (Gangulee, 1971, Nath *et al*., 2007), Odisha (Gangulee, 1971), Rajasthan (Alam *et al*., 2014; Rawat *et al*., 2015), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013).

Kerala: Idukki (Present Collection, Madhusoodanan *et al*., 2007).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Mannankudi, 26.11.2014,1650m, *Rajilesh V.K.* 11543 (MBGH).

Fissidens pellucidus Hornsch. Linnaea 15:146.1841; Manju *et al*., Tropical Bryol. Res. Rep. 7:12.2008. *Conomitrium asterodontium* Muell. Hal. Syn Musc. Frond. 2:

527. 1851. *Fissidens subcrenatus* Schimp. Syn. Musc. Frond. 2: 531. 1851. *F. laxus* Sull. & Lesq. Proc. Amer. Acad. Arts 4: 276. 1859. *F. rufulus* Sull. Proc. Amer. Acad. Arts. 5: 275. 1861. *F. flexinervis* Mitt. J. Linn.Soc., Bot.12.588.1869. *F. wrightii* A Jaeger Enum. Fissident.12.1869. *Conomitrium wrightii* (A. Jaeger) Muell. Hal. Linnaea 39: 364. 1875. *Fissidens grandiretis* Renauld & Cardot Prodr. Fl. Bryol. Madagascar 115. 1898. *F. pyrenocystis* Cardot Rev. Bryol.37: 121. 1910. *F. erikssonii* E. B. Bartram Acta Horti Gothob. 18: 270. 1950. *F. cremersii* Bizot & Onr. Rev. Bryol. Lichenol. 42: 846. 1976. **(Plate 5.36)**

Plants greenish, small, tufted on rocks; stem yellowish brown, simple, 4-6× 0.3-0.6 mm long; rhizoides few, reddish, smooth; leaves 14-16 pairs, small, ovate-lanceolate, 0.6-0.72× 0.18-0.2mm, acute tip, margin crenulate; dorsal lamina straight to down rounded at base of insertion; sheathing lamina unequal, open, small, reaching less than half the length of apical leaf; limbidium absent; costa prominent, percurrent, brownish; laminal cells guttulate, irregularly rectangular, thick walled, smooth, 10-12× 10-13 µm.

Habitat*:* Seen on rocks.

Distribution:

World: Belize, Bolivia, Brazil, Caribbean, Chile, China, Colombia, Costa rica, Fiji, French, Indonesia, India, Japan, Java, Malaysia, Myanmar, Nepal, Philippines, Singapore, Sri Lanka, Thailand, Vietnam and Venezuela.

India: Karnataka (Schwarz, 2013); Kerala (Nair *et al*., 2008b), Meghalaya (Asthana & Srivastava, 2015).

Kerala: Idukki (Present Collection); Kerala (Nair *et al*., 2008b)

Specimen examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Mannankudi, 26.11.2014, (1650m), *Rajilesh V.K*. 11547 (MBGH).

DITRICHACEAE Limpr.,

Laubm., Deutschl.1: 482. 1887.

Plants small, tufted, with short, erect stems; leaves narrow, lanceolate, margin entire or slightly toothed near to apex; costa single, percurrent; cells smooth, thin walled, linear-rectangular; alar cells not differentiated.

Garckea Muell.,

Hal. Bot.Zeitung (Berlin) 3: 865. 1845.

Garckea flexuosa (Griff.) Margad. & Nork., J. Bryol. 7: 440. 1973; Gangulee, Moss. E. India 1(2). 185. 1969; Nair *et al*., Bryoph. Wayanad, 95. 2005. *Dicranum phascoides* Hook., Bot. Misc. 1: 39. 21 1829. *Grimmia. comosa* Dozy & Molk., Ann. Sci. Nat., Bot., ser. 3, 2: 304 1844. *Garckea* phascoides Muell. Hal. Bot. Zeitung (Berlin) 3: 865.1845. *G. bescherellei* Muell. Hal. ex Besch. Ann. Sci. Nat., Bot., ser. 6, 9: 339. 1880. **(Plate 5.37)**

Plants pale greenish, caespitose, 0.7 - 1.2 cm high. stems erect, simple, thin; leaves comose at apex, lax below, erect-spreading to appressed, flexuose when dry, narrow, 1.2-2×0.4-0.6 mm, lanceolate, acuminate, margin smooth, recurved; costa single, ending below the apex; cells prosenchymatous, thin-walled, elongated-rectangular, hyaline, smooth, cells 40-120×4-10 µm; rectangular, brownish at base; sporophyte not seen.

Habitat*:* On logs.

Distribution:

World: Andaman Islands, Australia, Bhutan, Japan, India, Indonesia, Malaysia, Myanmar, Nepal, New Guinea, Philippines, Sri Lanka and Thailand.

India: Andhra Pradesh (Sandhya Rani *et al*., 2014), Karnataka (Schwarz, 2013; Schwarz & Frahm, 2013; Aruna & Krishnappa, 2014)); Kerala (Rajeevan, 1990); Meghalaya (Gangulee, 1969), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013;

Daniels *et al*., 2018), Tripura (Gangulee, 1969), West Bengal (Gangulee, 1969; Rawat *et al.,* 2016).

Kerala: Idukki (Rajeevan, 2010; Nair & Madhusoodanan, 2001; Madhusoodanan *et al*., 2017; Present Collection), Kozhikode (Manju & Rajesh, 2014), Wayanad (Nair *et al*., 2005a).

Specimen examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Mannankudi, 29.11.2012, 1600 m, *Rajilesh V.K*. 8915 (MBGH).

Note: It is a very common species distributed in low and high altitude areas of Kerala.

DICRANACEAE Schimp.,

Corol. Bryol.Eur. 11. 1856.

Plant erect, slender or robust, caespitose, branched; stem without central strand; leaves spreading, falcate, narrow, lanceolate, apex subulate, margin entire, broad at base; costa percurrent; leaves cells short to long quadrate, papillose present; alar cells distinct; seta and capsule brownish.

Leucoloma Brid.,

Bryol. Univ. 2: 218. 1827.

Leucoloma amoene-virens Mitt., J.Proc. Linn. Soc., Bot., Suppl.1:13.1859. Gangulee, Moss. E. India 1(2). 409.1971; Nair *et .al*., Bryoph. Wayanad, 99.2005. *Dicranum amoenevirens* (Mitt.) Muell. Hal. Linnaea 36: 11.1869. *Poecilophyllum amoenevirens* (Mitt.) Mitt. J. Linn. Soc., Bot.13: 297. 1873. **(Plate 5.38)**

Plants yellowish green, caespitose on bark; 2-3 cm long; stem branched, densely covered with falcate leaves; leaves dense, erect-spreading, falcate, flexuose when dry, lanceolate, 2.2-4×0.4-0.42 mm, gradually narrowing from a wider elliptical sheathing base, subulate, tip pointed, margin entire except extreme tip, where faintly toothed; costa narrow, single, pale yellowish-yellowish, 33 µm wide at

base, reach up to the tip; apical cells rhomboid,18-22×3-4 µm; median one quadrate-rounded, 5-8×4-5 µm, incrassate, papillate; basal one elongate-rectangular, 12-30×5-7 µm, smooth; marginal hyaline cells 4-5 layer at base, reduced to 3-4 above, 80-120×3-4 µm; alar cells distinct, orange-brown, broad rectangular, 55-78×37-42 µm; sporophyte not seen.

Habitat: The plant seen on bark.

Distribution:

World: India and Sri Lanka.

India: Karnataka (Schwarz, 2013); Kerala (Nair *et al*., 2005a), Madhya Pradesh (Nath *et al*., 2012), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013; Daniels *et al*., 2018).

Kerala: Idukki (Present collection), Kozhikode (Manju *et al*., 2008a), Thiruvanthapuram (Manju *et al*., 2009a), Wayanad (Nair *et al*., 2005a)

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Mannankudi, 29.11.2012, 1650 m, *Rajilesh V.K.* 8917; Muthupara, 11.03.2014, *Rajilesh V.K.* 1500 m, 9485, 9493; Aduvilanthankudi, 13.03.2014, 1600 m, *Rajilesh V.K.* 10959 (MBGH).

LEUCOBRYACEAE Schimp. Coroll. Bryol. Eur. 19.1856.

Plants yellowish green to whitish green, branched or unbranched, medium to large; leaves small or large, erect or erectopatent-falcate, lanceolate, acuminate tip, margin incurved to form subulate or apiculate apex; costa single, strong, wide, occurring more or less than half of the leaf at base, reached to the tip; leaf cells differentiated or not, lamina cells rectangular to irregular rhomboid, incrassate or not, basal cells large, brownish.

Key to the genera

1a. Plants whitish green, leaves large; upto 1.2 cm, leaves cells differentiated to chlorocysts and leucocysts ..... ***Leucobryum***

1b. Plants yellowish green, leaves small; upto 7 mm long, leaves cells not diffentiated as above..... ***Campylopus***

Campylopus

Brid. Muscol.Recent.Suppl. 4: 71. 1819.

Plants yellowish green to dark greenish, dichotomously branched, medium to large; leaves small or large, erect or erectopatent-falcate, lanceolate, acuminate tip, margin incurved to form subulate, stem leaves shows rhizoides growing from base; costa single, strong, wide, occurring more or less than half of the leaf at base, reached to the tip; lamina cells rectangular to irregular rhomboid, incrassate or not, basal cells large, brownish.

1a. Leaves more than 5 mm long; costa occurring more than 2/3 of the leaf at base ....***C. involutum***

1b. Leaves less than 5mm long; costa occurring less than 2/3 of the leaf at base..... .....***C. flexuosus***

Campylopus flexuosus (Hedw.) Brid., Muscol. Recent. Suppl. 4: 71. 1819; Gangulee, Moss. E. India 1 (2). 292. 1969; Nair *et al*., Bryoph. Wayanad, 98.2005. *Dicranum flexuosum* Hedw. Sp. Musc. Frond. 145. 38 f. 1–4. 1801. *Campylopus heterophyllus* Mitt., J. Linn. Soc .Bot.12:77.1869. *C. scabricuspis* Mitt., St. Helena 358. 1875. *C. boivinianus* Besch., Ann. Sci. Nat., Bot., ser. 6, 9: 320. 1880. *C. brachymastyx* Muell., Hal. ex Besch.Ann. Sci. Nat., Bot., ser. 6, 9: 324. 1880. *C. melaphanus* Stirt., Ann. Scott. Nat. Hist. 12 (46):110.1903. *C. crenulatus* Stirt., Trans. Bot. Soc. Edinburgh 26:244.1914. *C. alleizettii* Ther. & P. de la Varde, Ann. Cryptog. Exot. 1: 279. 1. 1928. *C. hondurensis* E.B. Bartram, Publ. Field Mus. Nat.

Hist., Bot. Ser. 4: 351. 17A. 1929. *C. homomallus* J. F. Leroy & Ther., Bull. Jard. Bot. Etat Brux. 18: 162 (12). 1947. **(Plate 5.39)**

Plants dark greenish, mat form on wet rocks; stem dark brownish, erect, 5-9 cm long, tomentose, dichotomously branched; leaves erect to erectopatent, crowded in a comal tufts, flexuose when dry, 5.5-6×0.8-0.9 mm, lanceolate-subulate, margin slightly incurved, serrated to the tip; costa single, strong, occurring less than half of the leaf at base, reached to the tip; cells rectangular, 35-54×10-12 µm at base; upper cells shorter, 31-36×7-9 µm, irregular rhomboid, incrassate, shorter towards margin; alar cells brownish, large, hexagonal-bulging, 40-52×22-26 µm; sporophyte not seen.

Habitat: The plant seen as thick mat on wet rocks.

Distribution:

World: Algeria, China, East Nepal, India, Madagascar, New Zealand and Siberia.

India: Karnataka (Aruna & Krishnappa, 2014); Kerala (Nair *et al*., 2005a; 2007; Manju *et al.,* 2009a) Madhya Pradesh (Gupta *et al*., 2016), Tamil Nadu (Daniels *et al*., 2018).

Kerala: Idukki (Present Collection, Nair *et al.*, 2007), Thiruvanthapuram (Manju *et al*., 2009a), Wayanad (Nair *et al*., 2005a).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Aduvilanthankudi, 13.03.2014, 1650 m, *Rajilesh V.K.* 10964; Mannankudi, 26.11.2014, 1800 m, *Rajilesh V.K.* 11558; Njandar, 04.08.2015, 1400 m, *Rajilesh V.K.* 11665, 11667 (MBGH).

Campylopus involutus (Muell. Hal.) A. Jaeger, Ber. Thatigk. St. Gall. Natur. Ges. 1870-71: 418. 1872; Gangulee, Moss. E. India 1(2). 307.1971. *Dicranum involutum* Muell. Hal. Bot. Zeitung (Berlin) 11:34.1853. *Dicranum erythrognaphalon* Muell. Hal., Bot. Zeitung Berlin11: 37. 1853. *Dicranum nietneri* Muell. Hal., Linnaea 36: 35. 1869. *Campylopus erythrognaphalus* (Muell. Hal.) A. Jaeger, Ber. Thatigk. St. Gallischen Naturwiss. Ges.1: 143. 1872. *Campylopus nietneri* (Muell. Hal.) A.

Jaeger, Ber. Thatigk. St. Gallischen Naturwiss. Ges.1: 136. 1872. *Campylopus tenuinervis* M. Fleisch., Musci Buitenzorg.1: 120. 1904. *Campylopus roinei* Cardot & P. de la Varde, Rev. Bryol.49: 37. pl. 1: f 5. 1922. **(Plate 5.40)**

Plants yellowish green, caespitose on logs; stem erect, tomentose, dichotomously branched, 3-5 cm long; leaves erectopatent-falcate, 4-5×0.7-0.8 mm, lanceolate, acuminate tip, margin incurved to form subulate, extreme tip slightly denticulate, stem leaves shows rhizoids growing from base; costa single, strong, occurring more than half of the leaf at base, reached to the tip, costa in c.s. undulated on back, 1-2 layer of sclerides cells; alar cells reddish brown, 42-49×19-33 µm, quadrate-rectangular; basal lamina cells wide rectangular, 33-75×22-27 µm near to costa, becoming shorter above, narrower and hyaline near margin; upper lamina cells irregular rhomboid, incrassate,16-22×10-12 µm; leaves c.s. shows inner one layer of large, bulging, 46-53×23-31 µm, hyaline cells, 1-2 layer of small, sclerides cells; seta erect, straight when dry, cygneous when moist, 6 mm long, brownish; capsule brownish, ovate-cylindrical; peristome teeth reddish brown, 360-390 µm long, split into two from middle, papillose, hyaline above; spores rounded, 15 µm in. diameter, greenish brown, smooth.

Habitat: The plant seen on logs and soil along with *cephaloziella kiaeri* (Austin) S. Arnell.

Distribution:

World: India and Malasia.

India: Kerala (Manju *et al*., 2008b), West Bengal (Gangulee, 1971).

Kerala: Idukki (Present Collection), Thiruvananthapuram (Manju *et al*., 2008b).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Shivanpara, 1550 m, *Rajilesh V.K.* 8244, 8266; Mannankudi, 1800 m, *Rajilesh V.K.* 8903 (MBGH).

Leucobryum Hampe,

Linnaea 13: 42. 1839.

Leucobryum javense (Brid.) Mitt., J. Proc. Linn. Soc., Bot., Suppl.1:25 1859; Gangulee, Moss. E. India 1(2). 426. 1971. *Sphagnum javense* Brid. Bot. Zeitung Regensburg 1(13): 200. 1802. *Leucobryum falcatum* Muell., Hal.Syn. Musc. Frond. 1:79. 1848. *L. teysmannianum* Dozy & Molk., Bryol. Jav. 1: 17. 1855. *L. laticaule* Muell., Hal. Hedwigia 36: 331. 1897. *L. spinidorsum* Muell., Hal. Hedwigia 36: 331 1897. *L. strictifolium* Broth., Oefvers. Forh. Finska Vetensk. Soc. 40: 159. 1898. *L. uncinatum* M. Fleisch., Musci Buitenzorg 1:149.1904. *L. cineraceum* Cardot & Ther., Diagn. Esp. Var. Nouv. Mouss. 8:1.1910. *L. confusum* Ther., Bull. Soc. Bot. Geneve 13: 224. 1921. *L. cyathifolium* Dixon, J. Linn. Soc., Bot. 45: 499. 1922. *L. novae-guineae* E. B. Bartram, Svensk Bot. Tidskr. 47(3): 397 1953. **(Plate 5.41)**

Plants whitish green, tufted on logs; stem 2-3 cm long, crowded with falcate leaves; leaves lanceolate, gradually narrowing in to a canaliculated and apiculate at apex, broad and concave at base, 8-12×1.7-1.9 mm; costa broad, scabrous on back above, smooth below; margin serrated near to tip; in cross section of leaf shows one layer of 4 angled chlorocysts between 2 rows of leucocysts above, becoming 3-4 layered at base; leucocysts rectangular, 70-80×36-60 µm; leaves cells rectangular, 70-96×25-35 µm, hyaline at base near to costa, becoming elongate, narrower, 100-132×7-8 µm at margin; alar cells brownish, rectangular; sporophyte not seen.

Habitat: The plant seen on logs.

Distribution:

World: Borneo, India, Indonesia, Japan, Nepal, New Guinea, Philippines and Vietnam.

India: Tamil Nadu (Daniels & Daniel, 2013).

Kerala: Idukki (Present Collection).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Checkpost, 28.11.2012, 1200 m, *Rajilesh V.K.* 8241; Shivanpara, 28.11.2012,

1500 m, *Rajilesh V.K.* 8268; Chundel, 04.08.2015, 1500 m, *Rajilesh V.K.* 11652, 11663(MBGH).

Note: The present collection is a new record for Kerala.

POTTIALES M. Fleisch. Hedwigia 61: 392. 1920.

POTTIACEAE Hampe,

Bot. Zeitung (Berlin) 11(18): 329. 1853.

Plants yellowish green, erect, slender, densely tufted, simple, leaves erect-spreading, linear-lanceolate, costa single, brownish, reached to the tip, cells papillose or hyaline, elongated-rectangular, yellowish, hyaline.

Hymenostomum R. Br.,

Trans. Linn.Soc. London 12(2): 572. 1818.

Hymenostomum edentulum (Mitt.) Besch., Bull. Soc. Bot. France 34: 95 1887; Gangulee, Moss. E. India 1(2). 673.1971.*Weissia edentula* Mitt.J. Proc. Linn. Soc., Bot., Suppl.1: 27. 1859. *Gymnostomum pancherianum* Besch.,Ann. Sci. Nat., Bot., ser. 5. 18: 188. 1873.*Hymenostomum pancherianum* (Besch.) A. Jaeger, Ber. Thatigk. St. Gallischen Naturwiss. Ges. 1877–78: 366. (Gen. Sp. Musc. 2: 630). 1880. **(Plate 5.42)**

Plants yellowish green, brownish when dry, on wet rocks; stem simple, brownish,7-10 mm long, densely covered with leaves; leaves erect- spreading, curled, sheathing-keeled, linear-lanceolate, 2.8-3.2×0.3-0.35 mm, acute apex, margin entire upto middle, broken or crenulated by papillae at apex; costa single, brownish, reached to the tip; leaf basal cells elongated-rectangular, yellowish, hyaline, 70-98×13-21 µm, gradually shorter to rectangular, 23-44×9-13 µm at middle; rounded-quadrate, 8-14×9-13 µm, papillose, slightly thich walled, yellowish at apex; sporophyte not observed.

Habitat: The plant seen on wet rock.

Distribution:

World: China, India, Indonesia, New Caledonia, North Vietnam, Philippines, Sri Lanka and Taiwan.

India: Karnataka (Aruna & Krishnappa, 2014), Kerala (Manju and Rajesh, (2010), Maharashtra (Magdum *et al*., 2017), Odisha (Mishra *et al*., 2016).

Kerala: Idukki (Present Collection), Kannur (Manju *et al*., 2010).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Aduvilanthankudi, 13.03.2014, 1600m, *Rajilesh V.K.* 10949b; Company estate, 30.11.2014, 1600m, *Rajilesh V.K.* 8934 (MBGH).

BRYALES Limpr., Krypt.-Fl. Schlesien 1(1): 55. 1876.

Key to the families

1a. Leaves large, apex rounded, notched at tip with short apiculus, margin denticulate throughout ..... **Mniaceae**

1b. Leaves small, apex acuminate- aristate, margin denticulate to apex..... **Bryaceae**

BRYACEAE Schwagr.,

Sp. Musc. Frond. 5(2): 47. 1830.

Plants variable in colour, yellowish green, brownish, silvery white; stem tufted, terrestrial, erect, robust, 2-3 subfloral innovations; leaves small or medium. erectopatent, appressed to stem when dry, oblong-spathulate or oblong-ovate, small to long, acuminate to form aristate tip; costa strong, single, reached to the tip or excurrent to form a short or long arista; leave cells thin walled, hexagonal or rhomboid at apex, hyaline or not; hexagonal-rhomboid at middle; rectangular at base; cells with distinct border along the margin or not; seta apical, erect, 2-3.5cm long, yellowish or reddish brown; capsule erect, obovate or ovate-cylindrical.

Key to the genera

1a. Capsule erect ....***Brachymenium***

1b. Capsue horizontal-pendulous **2**

2a. Plants medium; leaves ovate-oblong ....***Bryum***

2b. Plants large; leaves oblong-spathuate .... ***Rhodobryum***

Brachymenium Schwagr.,

Sp. Musc. Frond., Suppl. (1,2): 131–134, pl. 135. 1824.

Plants greenish to yellowish green, brownish below; stem erect, robust, 2-3 subfloral innovations; leaves erectopatent, appressed to stem when dry, oblong-spathulate, small to long (1.2-4.4) acuminate to form aristate tip; margin entire, revolute from base to above the middle of leaf, minutely dentate above; costa strong, single, excurrent to form a short arista, reddish at base, yellowish above; leaves cells thin walled, rhomboid at apex; hexagonal-rhomboid at middle; rectangular μm at base; cells with distinct border along the margin or not; seta apical, erect, 2-3.5 cm long, yellowish or reddish brown; capsule erect, obovate, cylindrical, 3-5.5 mm long.

Key to the species

1a. Leaves longer, more than 3 mm, margin distinct yellowish cells border; capsule long (5.5mm); seta upto 3.5mm long .... ***B. nepalense***

1b. Leaves shorter, less than 2mm, margin not clearly distinct border; capsule short (up to 4mm); seta upto 2.5 mm long .... ***B. ochianum***

Brachymenium nepalense Hook., Sp. Musc. Frond., Suppl. 2 2: 131. Pl .135 1824; Gangulee, Moss. E. India 2(4). 937. 1974. *Bryum hookeri* Spreng., Syst. Veg. 4(1): 212.1827. *Brachymenium contortum* Griff., Calcutta J. Nat. Hist. 3: 56 1843. *Bryum brevicaule* Hampe ex Muell., Hal. Syn. Musc. Frond. 1: 323 1848. *Brachymenium brevicaule* (Hampe ex Muell. Hal.) Mitt. & Wilson, Hooker's J. Bot. Kew Gard. Misc.9:330.1857. *B. clavulum* Mitt., Trans. Linn. Soc. London, Bot. 3: 165 1891. *B.*

subflexifolium Renauld & Cardot, Bull. Soc. Roy. Bot. Belgique 33(2): 122 1895. *B. ischyroneuron* Cardot, Rev. Bryol. 28: 114 1901. *B. microcarpum* Broth., Reise Ostafr., Syst. Arbeit. 3: 57. 8 f. 9. 1908. *B. submicrocarpum* Broth., Reise Ostafr., Syst. Arbeit. 3: 57. 9 f. 10 1908. *B. parvulum* Broth., Symb. Sin. 4: 54 1929. *Bryum alolense* Dixon, J. Bot. 80: 8 1942. (**Plate 5.43**)

Plants greenish, gregarious to densely caespitose on rocks; stem robust, erect, 2-2.5 cm long, with subfloral innovations; leaves erectopatent, imbricate, slightly twisted when dry, oblong-spathulate, 3.2-4.4×1-1.2 mm, acuminate, aristate, margin entire, revolute except at tip where dentate, flat; costa strong, single, reddish, excurrent to form long arista; leaves cells slightly thick walled, rhomboid-hexagonal, 37-60×13-15 µm at apex; hexagonal, 38-49×16-18 µm at middle; rectangular, 55-80×28-32 µm at base, thick walled; extreme basal cells red, rectangular; 2-4 layer of narrow-elongated, 120-142×5-5.7 µm, yellowish cells form distinct border along the margin; seta apical, reddish brown, erect, 3-3.5 cm long; capsule erect, greenish when young, brownish at maturity, 5.5 mm long with the short tapering apophysis, 2 mm in. diameter, ovate-cylindrical.

Habitat: The plant seen on wet rocks.

Distribution:

World: Borneo, Burma, Central Africa, China, India, Indonesia, Japan, Vietnam, Philippines, Sumatra, Sri Lanka,Taiwan and Thailand .

India: Karnataka (Schwarz & Frahm, 2013), Kerala (Nair *et al*., 2005a; Manju *et al*., 2014), Maharastra (Magdum *et al*., 2017) Tamil Nadu (Daniels *et al*., 2018).

Kerala: Idukki (Present Collection), Palakkad (Manju *et al*., 2014), Wayanad (Nair *et al*., 2005a).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Mannakudi, 28.11.2012, (1600m), *Rajilesh V.K.* 8274; Kurusukavala, 28.11.2014, (1550m), *Rajilesh V.K.* 11630 (MBGH).

Brachymenium ochianum Gangulee, Moss. E. India 2(4). 934.1974. (**Plate 5.44**)

Plants yellowish green, brownish below; stem erect, 1-1.3 cm long, 2-3 subfloral innovations, densely aggregated with large leaves above, tomentose below; upper leaves large, comal tufted, erectopatent, appressed to stem when dry, oblong-spathulate, 1.2-1.4×0.5-0.64 mm, acuminate tip; margin entire, revolute from base to above the middle of leaf, minutely dentate above; costa strong, single, excurrent to form a short arista, reddish at base, yellowish above; leaves cells thin walled, rhomboid, 54-64×8-9 µm at apex; hexagonal-rhomboid, 30-40×14-19 µm at middle; rectangular, 22-40×9-11 µm at base; 2-3 layer of narrow elongated, 72-155×8-13 µm cells borded leaf margin from tip to above middle, reduced to 2 rectangular layer with 26-32×14-16 µm at base; seta apical, erect, 2-2.5 cm long, yellowish brown; capsule erect, obovate, cylindrical, 3-4 mm long, 1.2 mm in diameter at the top; peristome normal, small; spore rounded, papillose, 35-40 in diameter, yellowish green.

Habitat: The plant seen on stem bark.

Distribution:

World: Bhutan, India and Taiwan.

India: Kerala (Manju *et al.,* 2008b); Manipur (Gangulee, 1974), Sikkim (Gangulee, 1974), and West Bengal (Gangulee, 1974).

Kerala: Idukki (Present Collection); Kerala (Manju *et al.,* 2008b).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Vattapara, 28.11.2014, (1620m), *Rajilesh V.K.* 11641; Njandar, 04.08.2015, (1500m), *RajileshV.K* 11684b (MBGH).

Bryum Hedw.,

Sp. Musc. Frond. 178–187, pl. 42, f. 8–12; pl. 43–44. 1801.

Plants silvery white or greenish, glossy or not, loosely to densely tufted on wet rocks, log; stem robust to erect, short, julaceous, branched by 2 subfloral

innovations; leaves small or medium, appressed, imbricate, erectopatent, broadly ovate, oblong-ovate, slightly concave, acuminate tip, margin flat, entire.costa single, form arista in top leaves, reached to the tip in below leaves or excurrent; leaves cells sometimes clearly differentiated into hyaline at top or not; upper cells hexagonal-rhomboid, colourless; lower cells rectangular; seta apical, reddish brown, erect; capsule horizontal-pendulous, ovate-cylindrical, brownish; peristome normal.

Key to the species

1a. Plants silvery; leaves small, cells clearly differentiated into hyaline at top ....***B. argenteum***

1b. Plants not silvery; leaves large, with distict border, cells not differentiated at top.. ..... ***B. wightii***

Bryum argenteum Hedw., Sp. Musc. Frond. 181-182. 1801; Gangulee, Moss. E. India 2(4). 970. 1976; Nair *et al.*, Bryoph. Wayanad, 126. 2005. *B. argenteum* var. *majus* Schwagr., Sp. Musc. Frond., Suppl. 1 2: 88 1816. *B. argenteum* var. *lanatum* (P. Beauv.) Hampe., Linnaea 13: 44 1839. *B. candidum* Muell., Hal. Nuovo Giorn. Bot. Ital. 4: 18 1872. *B.argyrotrichum* Muell., Hal. Linnaea 39: 385 1875. *B. argyreum* Muell., Hal. Linnaea 43: 380 1882. *B. compactulum* Muell., Hal. Linnaea 43: 383 1882. *B. arenae* Muell., Hal. Flora 68: 402. 1885. *B. argenteum* var. *costaricense* Renauld & Cardot, Bull. Soc. Roy. Bot. Belgique 31(1): 167. 1893. *B. apophysatum* Muell., Hal. Nuovo Giorn. Bot. Ital., n.s., 3:24.1897. *B. amblyolepis* Cardot., Rev. Bryol. 27:1900; *Bryum viviparum* Głow., Carinthia II 27: 114. 1904. *B. argenteum* var. *brachycarpum* Cardot, Rev. Bryol. 36: 112. 1909. *B. tricolor* Cardot., Rev. Bryol.38: 34. 1911. *B. argenteum* var. proliferum Sim., Trans. Roy. Soc. South Africa 15: 328. 328. 1926. *B. argenteum* var. *viride* Sim., Trans. Roy. Soc. South Africa 15: 328. 328. 1926. *Brachymenium argenteoides* Dixon, Notes Roy. Bot. Gard. Edinburgh 19(95): 289. 1938. **(Plate 5.45)**

Plants silvery white, glossy, densely tufted on wet rocks; stem erect, short, julaceous, 0.9-1.8 cm, branched by 2 subfloral innovations; leaves appressed,

imbricate, erectopatent, broadly ovate, 0.9-1×0.5-0.55 mm, slightly concave, acuminate tip, aristate in top leaves, margin flat, entire; costa single, form arista in top leaves, reached to the tip in below leaves; leaves cells clearly differentiated into hyaline cells in the upper half of the leaf and chlorophyllose cells below; upper hyaline cells hexagonal-rhomboid, 45-55×13-15 µm, colourless; lower cells rectangular, 23-25×13-15 µm, yellowish green; seta apical, reddish brown, erect, 2cm long, arcuate at tip; capsule horizontal-pendulous, ovate-cylindrical, brownish, 2 mm long, 1 mm in diameter; peristome normal, double, outer peristome teeth brownish yellow, 395 µm long, 91 µm wide at base, lanceolate, tip hyaline, papillose; inner peristome prominent, hyaline, ciliate at tip.

Habitat: The plant seen on wet rock.

Distribution:

World: Africa, Australia, China, Europe, India, Indonesia, Japan, Korea, New Zealand, Philippines, Siberia, Sri Lanka and Vietnam

India: Arunachal Pradesh (Gangulee, 1976), Gujarat (Chaudhary *et al*., 2006), Karnataka (Schwarz, 2013; Aruna & Krishnappa, 2014)), Maharashtra (Magdum *et al*., 2017), Meghalaya (Gangulee, 1976), Rajasthan (Alam *et al*., 2014), Odisha (Mishra *et al*., 2016), Sikkim (Gangulee, 1976), TamilNadu (Daniels, 2010; Daniels & Daniel, 2013; Daniels *et al*., 2018),West Bengal (Gangulee, 1976).

Kerala: Idukki (Present Collection, Madhusoodanan *et al*., 2007, Nair *et al*., 2006), Wayanad (Nair *et al.*, 2005a).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Kadayiruppu, 25.11.2014, 1550 m, *Rajilesh V.K.* 10990, 10992; Mannankudi, 26.11.2014, 1600 m, 11569; Vattapara, 28.11.2014, 1620 m, 11634, 11638 (MBGH).

Bryum wightii Mitt. J. Proc. Linn. Soc. Bot., Suppl. 1: 74. 1859; Gangulee, Moss. E. India 2(4): 983. 1974; Nair *et al*., Bryoph. Wayanad, 130. 2005. *B. srilankenese* Mohamed, J. Bryol. 12: 25. f. 2 1982. *B. formosum* Mitt. J. Bot. 38:

329. 413. 1900. *B. bohnhofii* Muell. Hal. ex Broth. Nat. Pflanzenfam. I (3): 598 1904. **(Plate 5. 46)**

Plants yellowish green, brownish below, densely tufted on wet rocks; stem erect, reddish, 1.5- 2.3 cm long, branched by 3-4 subfloral innovations, tomentose; leaves large, ovate-oblong, 4 -5 mm × 1-2 mm, concave, acuminate; margin entire, reflexed below, minutely serrate at apex; costa strong, brownish, excurrent in to form short arista; leave cells slightly thick walled, rhomboid, 50-60×10-12 µm at apex, thin walled, rectangular, 70-100 × 18-25 µm at base, 2-3 layer of narrow elongated, pale yellowish, 70-130×8-12 µm cells boarded at leaf margin.

Habitat: The plant seen on wet rock and soil.

Distribution:

World: India, Nepal and Sri Lanka.

India: Karnataka (Schwarz & Frahm, 2013; Aruna & Krishnappa, 2014), Kerala (Nair *et al*, 2001); Maharashtra (Chaudhary *et al*., 2008; Magdum *et al*., 2017), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013; Daniels *et al*., 2018).

Kerala: Idukki (Present collection), Wayanad (Nair *et al*, 2005a).

Specimen examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Checkpost, 29.11.2012, (1200 m), *Rajilesh V.K.* 8219 (MBGH).

Rhodobryum (Schimp.) Limpr.,

Laubm. Deutschl., 2(20): 444. 1892.

Rhodobryum roseum (Hedw.) Limpr. Laubm. Deutschl. 2(20): 445. 1892; Gangulee, Moss. E. India 2(4). 1016. 1976. *Mnium roseum* Hedw. Sp. Musc. Frond. 194 1801. *Mnium proliferum* Leyss. ex With. Syst. Arr. Brit. Pl. (ed. 4) 3: 789 1801. *Mnium spathulatum* Hornsch., Linnaea 15:135.1841. *Bryum leucothrix* Muell. Hal. Hedwigia 38: 69 1899. **(Plate 5.47)**

Plants greenish, loose tuft with small creeping subterranean stolons growing on logs and rocks; stem robust, erect, 1.5-2.2 cm long, branched by about 2 subfloral innovations, 7-9 mm long; leaves smaller, sparse, scale like, distantly placed, appressed below, large, prominent, clustered green leaves at top, erectopatent, curled when dry, carinate, oblong-spathulate, apiculate, 4-4.3×0.92-1.3 mm; costa single, strong, excurrent, in cross section of costa shows group of stereides; leaf cells hexagonal-rhomboid, thin walled, 58-64×19-20 μm at middle; 71-75×18-20 μm at tip; rectangular, 62-85×18-21 μm at base; 3-4 rows of narrow, elongated, 135-170×6-7 μm, yellowish cells form a prominent border; seta apical, erect, strong, 2.5-3 cm long; capsule horizontal, brown, oblong-cylindrical, 4.5-5 mm long, 1.2 mm in. diameter; peristome normal, small.

Habitat: The plant seen on extreme base of tree trunk and on rocky patch near strem.

Distribution:

World: America, China, Central and South Africa, Europe, India, Japan, Mexico, Siberia, Sri Lanka,Taiwan and Vietnam.

India: Kerala (Madhusoodanan *et al*., 2007; Manju *et al*., 2008b), West Bengal (Gangulee, 1976).

Kerala: Idukki (Present collection; Madhusoodanan *et al*., 2007).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Chundel, 09,04.2013, 1460 m, *Rajilesh V.K.* 9457; Udumbupara, 24.11.2014, 1500 m, *Rajilesh V.K.* 10977; Kadayirippu, 23.11.2014, 1500 m, *Rajilesh V.K.* 10995 (MBGH).

MNIACEAE Schwagr.,

Sp. Musco.Frond. 5(2): 25. 1830.

Plants pale-dark greenish, forming loose mats, fertile stem erect, with terminal large leaves forming a rosette; sterile branches usually prostrate; leaves on erect branch more crowded at apex, curled when dry, large, oblong-ovate margin flat, strongly bordered with 2-3 layer of cells, denticulate from base; costa single, strong, brown, ends in an apiculus; cells incrassate, hexagonal-irregularly rounded-rectangular sporophyte on erect branch; seta strong, erect, long; capsule horizontal.

Plagiomnium T.J.Kop**.,**

Ann. Bot. Fenn. 5 (2): 145-147. 1968.

Plagiomnium rhynchophorum (Hook.) T.J. Kop., Hikobia 6: 57. 1971. *Mnium rhynchophorum* Hook. Icon. Pl.1:pl.20, f. 3. 1836. *M. rostratum* var. *javanicum* Nees., Bryol. Brit. 255. 1855; *M. chloroloma* Muell. Hal., Linnaea 43: 360. 1882. *M. ligulatum* Muell. Hal. Nuovo Giorn. Bot. Ital., n.s. 4: 12. 1897. *M. marginatulum* Muell. Hal. Gen. Musc. Frond. 134. 1900. *M. rostratum* var. *ligulatum* Herzog., Biblioth. Bot. 87: 88. 1916. *M. carolinianum* L.E. Anderson, Bryologist 57(3): 177, f. 1–19. 1954. *M. incertum* Dixon ex Foreau., J. Bombay Nat. Hist. Soc. 58: 27. 1961. *Plagiomnium carolinianum* (L.E.Anderson) T. J. Kop., Ann. Bot. Fenn. 14(1): 6. 1977. *P. rhynchophorum* var. *carolinianum* (L.E.Anderson) T. J. Kop., Ann. Bot. Fenn.18: 110. 1981. **(Plate 5.48**).

Plants pale green-dark green, creeping mat on log, rock, soil; main stem erect, 2-4 cm long, lateral stoloniferous base are prostrate; leaves on erect branch more crowded at apex, spreading, curled when dry, large, oblong-ovate, 5-7×1.5-2.5 mm, apex rounded, notched at tip with short apiculus, margin flat, strongly bordered with 2-3 layer of cells, denticulate from base; costa single, strong, yellowish-brown, ends in an apiculus; cells incrassate, collenchymatous, hexagonal-irregularly rounded, 20-33×15-23 µm at apex and middle, basal cells rectangular, 45-90×14-16 µm; margin bordered with 2-3 layer of narrow, elongated, 100-135×6-8 µm; spine cells small, 22-27×11-15 µm; sporophyte on erect branch; seta strong, erect, long, 2-

2.2 cm long, reddish brown; capsule horizontal, pale greenish when young, greenish brown at mature, ovoid, cylindrical, 4-5×1.2-1.5 mm; operculam rostrate, 1.7 mm long, curved, beak yellowish brown; peristome normal, double, 530-620×125-130 µm; spore rounded, greenish, 22 µm in diameter.

Habitat: The plant seen on logs, rocks and on land cuttings near strem along with *Thuidium cymbifolium* (Dozy & Molk.) Dozy & Molk. and *Rhodobryum roseum*(Hedw.) Limpr.

Distribution:

World: China, India, Indonesia, Japan, Korea, Myanmar, Nepal, New Guinea, New Zealand, Pakisthan, Philippines, Sri Lanka and Taiwan.

India: Arunachal Pradesh, Assam (Gangulee, 1976), Kerala (Nair & Madhusoodanan, 2001), Manipur, Meghalaya, Nagaland (Gangulee, 1976), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013 as *Plagiomnium rostratum*).

Kerala: Idukki (Present collection), Wayanad (Nair *et al*., 2005a as *Mnium rostratum*).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Shivanpara, 28.11.2012, 1400 m, *Rajilesh V.K.* 8203, 8261; Checkpost, 29.11.2012, 1200 m, *Rajilesh V.K.* 8284; Vellapara, 27.11.2014, 1780 m, *Rajilesh V.K.* 11602; Changalakavala, 12.03.2014, 1400m, *Rajilesh V.K.* 10924; Aaduvilanthankudi, 13.03.2014, 1600 m, 10950, 10962 (MBGH).

Note: This species was earlier reported as *Mnium rostratum* Schrad. from Kerala.

BARTRAMIALES M. Menzel, J. Hattori Bot. Lab. 71: 242. 1992.

BARTRAMIACEAE Schwagr.,

Sp. Musc. Frond., 5(2): 90. 1830.

Plants yellowish-brownish green, densely tufted, usually robust; leaves lanceolate, acuminate, dentate or serrate; costa single, percurrent or excurrent; cells narrow, rectangular, papillose or mamillose.

Philonotis Brid.,

Bryol. Univ. 2: 15–28, pl. 6, f. 5. 1827.

Plants yellowish green or brownish green, tufted on rocks; stem erect, soft, delicate, unbranched or whorl of subfloral innovations; leaves erectopatent, appressed or spreading, lanceolate, gradually narrowed into a long filiform point or blunt-acute apex; margin serrated from middle; costa single, prominent, reached to the tip; cells papillose or smooth; basal cells elongated or quadrate rectangular; narrow, elongated rectangular or rhomboid-hexagonal at tip and middle, mamillose at upper ends.

Key to the species

1a. Plants with a whorl of subfloral innovations at tip .... ***P. thwaitesii***

1b. Plants usually erect, unbranched 2

2a. Leaves lanceolate, gradually narrowed into a long filiform point at apex ....***P.mollis***

2b. Leaves shortly lanceolate, apex blunt to acute .. .. ***P. hastata***

Philonotis hastata (Duby) Wijk & Margad., Taxon 8:74 1959; Gangulee, Moss. E. India 2(4). 1127. 1974; Nair *et al*., Bryoph. Wayanad, 137. 2005. *Hypnum hastatum* Duby, Syst. Verz. 132. 1846. *Bartramia tahitensis* Muell., Hal. Bot.Zeitung (Berlin) 17: 220. 1859. *Philonotis heterophylla* Mitt., J. Proc. Linn. Soc., Bot., Suppl. 1: 61. 1859. *P. asperifolia* Mitt., J. Linn. Soc., Bot.10:185.1868. *Bartramia obtusifolia* Mitt., Fl. Vit. 381. 1873. *B. amblyoblasta* Muell., Hal. Linnaea 38: 631. 1874. *B. tenuicula* Hampe Linnaea 8: 210 1874. *B. comorensis* Muell. Hal. Linnaea 40: 245.

1876. *Philonotis tenuicula* (Hampe) Besch. Ann. Sci. Nat., Bot., ser. 6, 10:245.1880. *Bartramia elongatula* Muell., Hal. Linnaea 43: 415. 1882. *Philonotis jardinii* (Besch) Paris, Index Bryol. 923. 1897. *Bartramia curvifolia* (Besch.) Muell., Hal. Gen. Musc. Frond. 338. 1900. **(Plate 5.49 a-f)**

Plants pale greenish, slender, radiculose at base, on rock; stem erect, 1.5-2 cm long; leaves erectopatent, appressed to stem when dry, small, 0.8-0.9×0.18-0.2 mm, lanceolate, shortly acuminate, acute-blunt tip, margin slightly reflexed, denticulate at tip; costa single, prominent, reached to the tip, papillose at back; leave cells lax, thin walled, mamillae at the anterior end, rhomboid to hexagonal, 40-50×12-14 µm at tip and middle, 17-28×15-18, quadrate-rectangular at base margin, pale yellowish coloured at extreme basal cells.

Habitat: The plant is tufted on rock.

Distribution:

World: Africa, Australia, Bolivia, Borneo, Chile, India, Indonesia, Japan, Philippines, Sri Lanka, South America, Taiwan and Venezuela.

India: Andhra Pradesh (Sandhya Rani *et al*., 2014), Assam (Gangulee, 1974), Gujarat (Chaudhary *et al*., 2006), Karnataka (Schwarz, 2013; Aruna & Krishnappa, 2014), Kerala (Nair *et al*, 2005a; Manju *et al.,* 2009b; Rajesh & Manju, 2014), Maharashtra (Chaudhary *et al*., 2008; Magdum *et al*., 2017), Orissa (Mishra *et al*., 2016), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013; Daniels *et al*., 2018), West Bengal (Gangulee, 1974; Rawat *et al.,* 2016) .

Kerala: Idukki (Present collection), Kannur (Manju *et al.,* 2009b), Kozhikode (Rajesh & Manju, 2014); Wayanad (Nair *et al*, 2005a).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Shivanpara, 28.11.2012, 1500 m*, Rajilesh V.K.* 8201b; Chundel, 28.11.2014, 1460 m, *Rajilesh V.K.* 11647(MBGH).

Philonotis mollis (Dozy & Molk.) Mitt., J. Proc. Linn. Soc., Bot., Suppl. 1: 60. 1859; Gangulee, Moss. E. India 2 (4). 1120. 1974; Nair *et al.,* Bryoph.Wayanad,

137. 2005. *Bartramia mollis* Dozy & Molk., Ann. Sci. Nat. Bot., ser. 3, 2:300. 1844. *B. secunda* Dozy & Molk., Pl. Jungh. 3:332.1854. *Philonotis mollis* var. *simplicicaulis* Zanten, Nova Guinea, Bot. 16: 10(16): 293. pl. 25: f. 1 1964. **(Plate 5.49 g-l)**

Plants yellowish green, loose tuft on rocks; stem soft, delicate, 1.5-2 cm long, unbranched, erect; leaves erectopatent below; spreading, lax above, lanceolate, gradually narrowed into a long filiform point, 1.7-2.2×0.3-0.4 mm, margin serrated from middle; costa single, prominent, reached to the tip; extreme basal cells lax, rectangular, smooth; basal cells elongated rectangular, 35-50×15-20 μm, narrow, elongated rectangular, 36-43×4-6 μm at tip and middle, mamillose at upper ends; sporophyte not seen.

Habitat: The plant is tufted on rock.

Distribution:

World: Andaman Island, Borneo, India, Indonesia, Japan, Madagascar, Philippines, Sri Lanka and Sumatra.

India: Andhra Pradesh (Sandhya Rani *et al*., 2014), Karnataka (Schwarz & Frahm, 2013), Maharashtra (Chaudhary *et al*., 2008; Magdum *et al*., 2017), Orissa (Mishra *et al*., 2016), Rajasthan (Alam *et al*., 2014), Tamil Nadu (Daniels & Daniel, 2013), Uttar Pradesh (Sahu & Asthana, 2015) West Bengal (Rawat *et al.,* 2016).

Kerala: Idukki (Present collection); Wayanad (Nair *et al*., 2005a).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Karipara, 12.03.2014, (1660m), *Rajilesh V.K.* 9499; Company estate, 30.11.2012, (1600m), *RajileshV. K.* 8950 (MBGH).

Philonotis thwaitesii Mitt., J. Proc. Linn. Soc., Bot., Suppl.1:60.1859; Gangulee, Moss. E. India 2(4). 1121. 1974; Nair *et al.,* Bryoph. Wayanad, 138. 2005. *Philonotis revoluta* Bosch & Sande, Lac. Bryol. Jav. 1: 158. 128. 1861. *P. socia* Mitt. J. Proc. Linn. Soc., Bot. 8: 151. 1864. *P. sumatrana* Dixon, Ann. Bryol.

5:32.1932. *P. appressifolia* Dixon, Hong Kong Naturalist, Suppl. 2: 18 1933. (**Plate 5. 50**)

Plants yellowish green to brownish tufted on rock, robust; stem erect, 0.8-1 cm long, with a whorl of subfloral innovations; leaves dense, whorled, erect, appressed, more appressed when dry, lanceolate, 0.97-1.2 × 0.22-0.27 mm, apex acuminate-acute, margin faintly denticulate from middle; costa single, reached at the tip; elongate-rectangular, 30-70 × 10-12 µm at middle and tip, mamillose at tops; basal cells rectangular, 35-50 × 12-16 µm; extreme basal cells quadrate-rectangular, 19-22 × 11-15µm; sporophyte on top; seta erect, brownish, 1-1.5 cm long; capsule erect, brown, sub globose, 2-2.5 mm long, 2.2 mm in. diameter, furrowed when dry.

Habitat: The plant is tufted on rock.

Distribution:

World: Bolivia, China, Colombia, India, Japan, Korea, New Guinea and Taiwan.

India: Andhra Pradesh (Sandhya Rani *et al*., 2014), Karnataka (Schwarz, 2013; Schwarz & Frahm, 2013), Kerala (Nair *et al*., 2005a), Orissa (Mishra *et al*., 2016), Rajasthan (Alam *et al*., 2014), Sikkim (Alam *et al*., 2014), Tamil Nadu (Daniels & Daniel, 2013; Daniels *et al*., 2018).

Kerala: Idukki (Present collection), Wayanad (Nair *et al*., 2005a).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Checkpost, 28.11.2012, (1200m), *Rajilesh V.K.* 8216; Changalakavala, 12.03.2014, (1550m), *Rajilesh V.K.* 10935b (MBGH).

Notes: It is a very common species in the high altitude shola forests.

ORTHOTRICHALES Dixon., Man. Bryol. 409. 1932.

ORTHOTRICHACEAE Arn.,

Disp. Meth.Mosses 13. 1825.

Plants dark greenish-brownish, dense tufts on logs or stem; stem long, creeping, sometimes erect; leaves dense, appressed or curled when dry, linear –

lanceolate, apex acute, margin entire; costa single, strong; cells at upper rounded, papillose, basal cells elongate; capsule erect, smooth.

Macromitrium Brid.,

Muscol. Recent. Suppl. 4: 132. 1819.

Macromitrium sulcatum (Hook.) Brid., Bryol. Univ. 1: 319. 1826; Gangulee, Moss. E. India 2 (5). 1181. 976; Nair et al., Bryoph. Wayanad, 141. 2005. *Schlotheimia sulcata* Hook., Musci Exot. 2:156. 1819. *Macromitrium belangeri* Muell. Hal., Bot. Zeitung Berlin 20: 374. 1862. *M. neelgheriense* Muell., Hal. Syn. Musc. Frond. 1:737.1849. *M. ceylanicum* Mitt., J.Proc. Linn. Soc., Bot., Suppl. 1: 52.1859. *M. ramentosum* Thwaites & Mitt., J. Linn. Soc., Bot. 13: 301. 1873. *M. seriatum* Paris & Broth., Rev. Bryol.34: 95. 1907. *M. trollii* Dixon., Repert. Spec. Nov. Regni Veg. 38: 104. 1935. **(Plate 5. 51)**

Plants greenish above brownish below, dense tufts on tree trunk or log, robust; main stem prostrate, 2 cm long, secondary branches erect, 1-2 cm long; leaves dense, imbricate, appressed and hook like curled when dry, erect-erectopatent, linear-lanceolate, 1.3-1.6×0.2-0.35mm, apex acute, margin entire; costa single, strong, reached to the tip; leaf cells at apex incrassate, 11-15×6-7µm, quadrate- rounded; middle cells thick walled, ovate-rounded, 5-6 µm wide, papillate; cells elongated, linear, 17-21×4-5µm near to costa; basal cells elongate, 20-30 µm, with large tubercular papilla each; extreme basal cells elongate, 20-22-10-11µm, surrounded by thin walled hexagonal cells, sometimes hyaline; sporophyte apical; seta erect, short, 5-7mm long, brownish; capsule erect, cylindrical, oblong-ovoid, sulcate, 2.5-3.5mm long, 0.8mm in. diameter; calyptra campanulate, sulcate; operculam conic, rostrate, 1.25mm high; peristome teeth exostome only,180-200µm high, brownish white; spores rounded, papillose,15-22 µm in diameter, yellowish green.

Habitat: The plant is tufted on log and bark.

Distribution:

World: Borneo, Burma, India, Philippines and Thailand.

India: Karnataka (Aruna & Krishnappa, 2014), Kerala (Nair *et al*., 2005a; Nair *et al.*, 2006; Manju *et al.*, 2008a; Manju *et al.*, 2009a), Maharashtra (Chaudhary *et al*., 2008; Magdum *et al*., 2017), Orissa (Mishra *et al*., 2016), Tamil Nadu (Daniels & Daniel, 2013).

Kerala: Idukki (Present Collection, Nair *et al.*, 2006), Kozhikode (Manju *et al.*, 2008a), Thiruvanathapuram (Manju *et al.*, 2009a), Wayanad (Nair *et al*., 2005a).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Checkpost, 28.11.2012 (1200m), *Rajilesh V.K.* 8265; Vattapara, 28.11.2014, (1620 m), *Rajilesh V.K.* 11637(MBGH).

RHIZOGONIALES Goffinet & W. R. Buck,

Monogr. Syst. Bot. Missouri Bot. Gard. 98: 235. 2004.

RHIZOGONIACEAE Broth.,

Nat. Pflanzenfam. 1(3): 614. 1904.

Plants pale greenish-brownish green, tufted on log or bark, robust, with erect or flexuose shoots, tomentose below; leaves lax, erect-spreading, spirally arranged, flexuose, linear-lanceolate, acuminate, margin thick, double spinose; costa single, strong, reached to the tip, brownish, spinose on back above; leaf cells incrassate; sporophyte on main stem; seta long; capsule inclined, brown.

Pyrrhobryum Mitt.,

J. Linn. Soc., Bot.10:174-175.1868.

Pyrrhobryum spiniforme (Hedw.) Mitt., J. Linn. Soc., Bot. 10: 174. 1868; Nair *et al*., Bryoph. Wayanad, 133. 2005. *Hypnum spiniforme* Hedw., Sp. Musc. Frond. 236–237. 1801. *Rhizogonium spiniforme* (Hedw.) Bruch in Krauss, Flora 29:134. 1846; Gangulee, Moss. E. India 2(4).1068. 1974. *Mnium spiniforme* (Hedw.) Muell.

Hal., Syn. Musc. Frond. 1: 175. 1848. *Rhizogonium spiniferum* Brid. ex Hampe, Linnaea 22: 583. 1849. *R. pervilleanum* Besch., Ann. Sci. Nat., Bot., ser. 6, 10: 242. 1880. *R. boninense* Z. Iwats., Bull. Natl. Sci. Mus. 12: 298. 1969. **(Plate 5. 52)**

Plants pale greenish-brownish green, tufted on log or bark; stem brown, tomentose below, erect-flexuose, 1.8-2.7cm long, branched from base; leaves lax, erect-spreading, spirally arranged, flexuose, incurved at apex when dry, lower smaller, upper larger, 3.5-7×0.38-0.5 mm, linear-lanceolate, acuminate, margin thick, double spinose; costa single, strong, reached to the tip, brownish, spinose on back above; leaf cells incrassate, smooth; rounded quadrate-hexagonal, 11-14 µm wide at middle and tip; quadrate-rectangular, 12-22×5-8 µm at base; sporophyte on main stem; seta long, 4.8-5.2 cm, brown, erect-flexuose; capsule inclined, brown, slightly oblong-ovate, 3.6-4.2 mm long, 2 mm in diameter; peristome double, large; inner peristome 0.82 mm, outer peristome 0.77 mm long.

Habitat: The plant is tufted on logs and bark.

Distribution:

World: Australia, Borneo, Central & South Africa, Central & South America, China, India, Indonesia, Japan, Korea, New Zealand, North Vietnam, Philippines, Sri Lanka, Sumatra, and Taiwan.

India: Kerala (Nair *et al.*, 2005a), Tamil Nadu (Daniels & Daniel, 2013; Daniels *et al*., 2018),

Kerala: Idukki (Present collection; Nair *et al*., 2006), Wayanad (Nair *et al.*, 2005a).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Mannakudi, 28.11.2012, (1600m), *Rajilesh V.K.* 8277; Shivanpara, 28.11.2012, (1500m), *Rajilesh V.K.* 8223, 8254; Company estate, 30.11.2012, (1650m), *Rajilesh V.K.* 8930; Muthupara, 11.03.2014, (1500m), *Rajilesh V.K.* 9488; Karipara, 12.03.2014, (1650m), *Rajilesh V.K.* 10903; Vellapara, 23.12.2015, (1650m), *Rajilesh V.K.* 11687b (MBGH).

HYPNODENDRALES N. E. Bell, A.E. Newton & D. Quandt.,

Bryologist 110: 554. 2007.

RACOPILACEAE Kindb.,

Bot. Centralbl. 76(3): 85. 1898.

Plants pale yellowish green, glossy, tufted on bark or soil; main stem prostrate, rhizomatous; leaves dimorphic, in three rows, two lateral and one dorsal; lateral leaves spreading, larger, oblong-ovate, long aristate, margin denticulate from middle to tip; costa single, excurrent; dorsal leaves appressed to the stem, smaller, drooping, ovate, long aristate, margin denticulate at tip, costa single, strong, excurrent; leaf cells chlorophyllose, rectangular or quadrate-hexagonal; sporophyte on main stem; seta erect; capsule erect, cylindrical, brownish.

Racopilum P. Beauv.,

Prodr. Aetheogam 36–37, 87. 1805.

Racopilum orthocarpum Wilson ex Mitt., J. Proc. Linn. Soc., Bot., Suppl. 2: 136. 1859; Gangulee, Moss. E. India 2(5). 1199. 1976; Nair *et al*., Bryoph. Wayanad, 143. 2005. *R. siamense* Dixon, J. Siam Soc., Nat. Hist. Suppl. 9: 34. 1932. **(Plate 5.53)**

Plants pale yellowish green, glossy, tufted on bark or soil; main stem creeping, rhizomatous; branches short, 1.5-2 cm long, prostrate, complanate; leaves dimorphic, in three rows, two lateral and one dorsal; lateral leaves spreading, larger, 1.3-1.7×0.48-0.7 mm, oblong-ovate, long aristate, margin denticulate from middle to tip; costa single, excurrent; dorsal leaves appressed to the stem, smaller, 0.9-1×0.3-0.34 mm, drooping, ovate, long aristate, margin denticulate at tip, costa single, strong, excurrent; leaf cells chlorophyllose, basal cells irregularly rectangular,19-24×6-10 µm; quadrate-hexagonal, 11-20×10-12 µm at middle, elongated rhomboid, 36-41×6.5-7.5 µm at tip; sporophyte on main stem near the branches; seta erect, 1.2-1.5cm long, brownish; capsule erect, cylindrical, brownish, slightly curved, lightly furrowed when dry.

Habitat: This plant is growing as tuft on rocks, logs and on soil.

Distribution:

World: India, Myanmar, Nepal, Sri Lanka, Southeast Asia and Vietnam,

India: Kerala (Nair *et al.*, 2005a), Madhya Pradesh (Nath *et al*., 2007), Orissa (Mishra *et al*., 2016), Tamil Nadu (Daniels & Daniel, 2013; Daniels *et al*., 2018).

Kerala: Idukki (Present collection) Wayanad (Nair *et al.*, 2005a).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Udumbupara, 24.11.2014, 1500 m, *Rajilesh V.K.* 10975b; Thakkalikavala, 25.11.2014, 1500 m, *Rajilesh V.K.* 11502; Vellapara, 27.11.2014, 1780 m, *Rajilesh V.K.* 11611; Chundel, 28.11.2014, 1460 m, *Rajilesh V.K.* 11645(MBGH).

Note: This species is rare in Kerala.

HOOKERIALES M. Fleisch., Hedwigia 61: 397. 1920.

Key to the families

1a. Costa double, reached just beyond the middle.. ..... **Hookeriaceae**

1b. Costa single, very short or reached to the tip... 2

2a. Leaves asymmetrical, ovate; amphigastria present. ..... . **Hypopterygiaceae**

2b. Leaves symmetrical, linear-lanceolate; amphigastria absent ..... **Daltoniaceae**

HYPOPTERYGIACEAE Mitt.,

J. Proc.Soc., Bot. 1: 147. 1859.

Plants caespitose, highly branched, densely tomentose, secondary branches erect, dendroid, Leaves 3 rowed with 2 lateral and 1 ventral rows, complanate; lateral leaves asymmetric slightly concave, ovate, short-acuminate to acuminate, margin entire below, bordered all around by 2 rows of linear, elongate, hyaline cells, short-acuminate to apiculate tooth at apex; costa single, percurrent; cells rhomboid-

hexagonal; ventral leaves (amphigastria) cordate to orbicular, sharply apiculate at apex, margin boarded by 2 linear, elongated, hyaline cells; costa single, excurrent or percurrent, faint, cells rhomboid-hexagonal; sporophytes laterally on main stems; seta orange-brown, smooth; capsule inclined, brownish.

Keyto the genus

1a. Amphigastria ovate-acumimate; costa very short .....***Cyathophorella***

1b. Amphigastria cordate-orbicular; costa reach above the middle . ..***Hypopterygium***

Cyathophorella M. Fleisch.,

Musci Buitenzorg 3: 1088. 1908.

Cyathophorella adiantum (Griff.) M. Fleisch., Musci Buitenzorg 3: 1094. 1908; Gangulee, Moss. E. India 2(6). 1533. 1977. *Neckera adiantum* Griff., Icon. Pl. Asiat. pl. 85 f. 2. 1849. *Cyathophorum griffithii* Wilson. J. Proc. Linn. Soc., Bot., Suppl. 1(2): 147. 1859. *Cyathophorum kurzeanum* Hampe ex Paris., Index Bryol. Suppl.107. 1900. *Cyathophorella adianthoides* Broth., Philipp. J. Sci. 8: 84. 1913. *Cyathophorella kurzeana* M. Fleisch., Hedwigia 63: 212. 1922. **(Plate 5.54)**

Plants dull green, lax tufts; primary stems creeping, rhizomatous, tomentose; secondary stem simple, unbranched, 3-4 cm long, distantly foliate, tips caudate; lateral leaves in two rows, asymmetrical, 3-4×1.8-2.2 mm, widely spreading, smaller toward base and tip, ovate, acuminate, margin highly toothed except at base; costa single, short, bifurcate; basal marginal cell rectangular, 50-90×20-24 μm, middle cell smooth, oval-hexagonal, 60-70×20-22 μm; apical cells 50-80×7-10 μm; margin bordered by two or three layered elongated cells, yellowish; amphigastria smaller, symmetrical, in one row, parallel with stem, ovate.-acuminate, elongated tip, 2.5-3.5×1.2-1.8 mm, costa very short, faint; cells similar to lateral leaves.

Habitat: This plant is seen on tree trunk of shola forests and semi evergreen forests.

Distribution:

World: Bhutan, India, Nepal and Philippines.

India: Kerala (Manju *et al*., 2008b); Sikkim, West Bengal Gangulee (1977).

Kerala: Idukki (Present Collection). Kerala (Manju *et al*., 2008b).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Udumbupara, 24.11.2014, 1590 m, *Rajilesh V.K.* 10980; Chundel, 24.12.2015, 1250m, *Rajilesh V.K.* 14204 (MBGH).

Hypopterygium Brid.,

Bryol.Univ, 2: 709-718.1827.

Plants pale green, caespitose, highly branched, densely tomentose, secondary branches erect, dendroid; leaves 3 rowed with 2 lateral and 1 ventral rows, complanate; lateral leaves asymmetric slightly concave, ovate, short-acuminate to acuminate, margin entire below, bordered all around by 2 rows of linear, elongate, hyaline cells, short-acuminate to apiculate tooth at apex; costa single, percurrent; cells rhomboid-hexagonal, thin-walled; under leaves cordate to orbicular, sharply apiculate at apex, margin boarded by 2 linear, elongated, hyaline cells, apiculate to distantly faint toothed above; costa single, excurrent or percurrent, faint, cells rhomboid-hexagonal; sporophytes laterally on main stems, perichaetia smaller, erect, narrower than leaves; seta orange-brown, smooth; capsule inclined, brownish, ovoid-oblong; peristome normal.

Key to the species

1a. Leaves acuminate; underleaves costa percurrent .....***H. tamarisci***

1b. Leaves short acuminate; underleaves costa excurrent . ..... ***H. flavolimbatum***

Hypopterygium flavolimbatum Muell., Hal. Syn. Musc. Frond. 2: 10 1851; Gangulee, Moss. E. India 2 (6). 1545. 1977. *H. tibetanum* Mitt., J. Proc. Linn. Soc., Bot., Suppl. 2: 148. 1859. *H. aristatum* Bosch & Sande., Lac. Bryol. Jav. 2: 12.141. 1861. *H. japonicum* Mitt., J. Linn. Soc., Bot. 8: 155. 1865. *H. apiculatum* Thwaites

& Mitt., J. Linn. Soc., Bot. 13: 309. 1873. *H. fauriei* Besch., Ann. Sci. Nat., Bot., ser. 7, 17: 391. 1893. *H. canadense* Kindb., Rev. Bryol. 26:46. 1899. *H. fauriei* sub sp. *solmsianum* Kindb., Hedwigia 40: 286. 1901. *H. delicatulum* Broth., Leafl. Philipp. Bot. 2: 656. 1909. *H. formosanum* Nog.Trans. Nat. Hist. Soc. Taiwan 26(148): 40. 3 f. 9–13. 1936. *H. acuminatum* Dixon, Trav. Bryol. 1[13]: 15 1942. *H. sasaokae* Dixon, Trav. Bryol. 1[13]: 15 1942. *H.vietnamicum* Pocs, Rev. Bryol. Lichenol. 34: 806. pl. 3. 1966. **(Plate 5.55)**.

Plants pale green, 2-3 cm long caespitose, stems creeping, highly branched, secondary branches erect, dendroid, 1- 2 cm long; leaves 3 rowed with 2 lateral and 1 ventral rows, complanate; lateral leaves asymmetric, 0.8-1.2-×0.5-0.6 mm, ovate, acuminate, margin entire below, bordered all around by 2 rows of linear, elongated, 75-130×4-9µm, hyaline cells, apiculate to tooth at apex; costa single, 2 celled width, reach above the mid leaf; cells rhomboid-hexagonal, 25-30×12-15 µm, thin- walled; under leaves cordate to orbicular,0.6-0.8 × 0.4-0.6 mm, sharply apiculate at apex, margin boarded by 2 linear, elongated, hyaline cells, apiculate to distantly faint toothed above; costa single, excurrent; cells rhomboid-hexogonal, 25-30×11-15 µm, 28-40×10-17µm at lower cells; sporophyte not seen.

Habitat: The plant is seen on tree trunk of shola forest and evergreen forests.

Distribution:

World: China, India, Indo- Malayan region, Indonesia and New Guinea.

India: Kerala (Nair *et al*, 2005a; Manju *et al.,* 2014); Tamil Nadu (Daniels & Daniel, 2013), West Bengal (Gangulee, 1977).

Kerala: Idukki (Present Collection), Wayanad (Nair *et al*, 2005a).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Company estate, 30.11.2012, 1600 m, *Rajilesh V.K.* 8940; Karipara, 12.03.2014, 1650 m, *Rajilesh V.K.* 10905; Njandar, 04.08.2015, 1400 m, *Rajilesh V.K.* 11674; Vellapara, 23.12.2015, 1650 m, *Rajilesh V.K.* 11687 (MBGH).

Hypopterygium tamarisci (Sw.) Brid. ex Muell. Hal. Syn. Musc. Frond. 2: 8 1850; Nair *et al*., Bryophy. Wayanad, 177. 2005. *Hypnum scutellatum* Taylor, London J. Bot. 6: 338 1847. *Hypopterygium brasiliense* Sull. Proc. Amer. Acad. Arts 3: 184 1854. *H. rigidulum* Mitt., J. Linn. Soc., Bot. 12: 329. 1869. *H. pygmaeum* Muell. Hal., Linnaea 40: 256. 1876. *H. falcatum* Muell. Hal., Flora 69: 514. 1886. *H. rotundo-stipulatum* Muell. Hal., Hedwigia 36: 106. 1897. *H. kaernbachii* Broth. Fl. Schutzgeb. Sudsee 104. 1900. *H. jungermanioides* Muell. Hal. ex Kindb., Hedwigia 40: 294 1901. *H. mildbraedii* Broth. Wiss. Erg. Deut. Zentr.-Afr. Exped., Bot.2:167.1910. *H. usambaricum* Broth., Denkschr. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl. 88: 736. 1913. *H. atrotheca* Dixon J. Bot. 66: 350 1928. **(Plate 5.56)**

Plants pale green, caespitose, 2-4 cm long; stems creeping, highly branched, densely tomentose, secondary branches erect, dendroid, 2 cm long. Leaves 3 rowed with 2 lateral and 1 ventral rows, complanate; lateral leaves asymmetric, 1.2-1.9×0.6-0.8 mm, slightly concave, ovate, short-acuminate, margin entire below, bordered all around by 2 rows of linear, elongated, 50-125×7-8.5 µm, hyaline cells, short-acuminate tooth at apex; costa single, percurrent, 2 celled width, reach above the midleaf; cells rhomboid-hexagonal, 25-35×11-13 µm, thin- walled; under leaves cordate to orbicular, 0.7-0.9×0.6-0.8 mm, sharply apiculate at apex, margin boarded by 2 linear, elongated, hyaline cells, apiculate to distantly faint toothed above; costa single, faint, extends to middle part; cells rhomboid-hexogonal, 20-30×10-12, 35-50×15-20 µm at lower cells; sporophytes laterally on main stems, perichaetia smaller, erect, narrower than leaves; seta long, 1.2cm high, orange-brown, smooth; capsule inclined, brownish, ovoid-oblong; peristome normal, 0.45 mm high, 16 nos.

Habitat: This plant is growing as tuft on rocks and tree trunk along with other bryophytes such as *Ctenidium lychnites, Lejeunea tuberculosa and Metzgeria lindbergii.* in shola forest and semi evergreen forests.

Distribution:

World: Argentina, Bolivia, Brazil, Columbia, India, Indonesia, Mexico, Peru, Philippines, Sri Lanka, Sumatra and West Indies.

India: Kerala (Nair *et al.*, 2005a; Nair *et al*., 2006; Madhusoodanan *et al*., 2007), Karnataka (Schwarz & Frahm, 2013; Tamil Nadu (Daniels & Daniel, 2013; Daniels *et al*., 2018).

Kerala: Idukki (Present collection, Madhusoodanan *et al*., 2007; Nair *et al*., 2006), Wayanad (Nair *et al.*, 2005a).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Mannankudi, 28.11.2012, 1850 m, *Rajilesh V.K.* 8277; Karipara, 12.03.2014, 1660 m, *Rajilesh V.K.* 10904; Checkpost, 25.11.2014, 1250 m, 11511, 11529; Mannankudi, 26.11.2014, 1650m, *Rajilesh V.K.* 11566d; Vellapara, 23.12.2015, 1650 m, Karipara, 12.03.2014, 1660 m, *Rajilesh V.K.* 10904, 11695 (MBGH).

DALTONIACEAE Schimp.,

Syn. Musc. Eur. 478. 1860.

Plants dull green, yellowish green, golden yellowish to golden brown, sometimes glossy; primary stems creeping, rhizomatous, tomentose or not; secondary stems simple, erect, unbranched, distantly or densely foliate; leaves whorled or in two rows as complanate, erectopatent or not, symmetric or asymmetric, oblong-ovate to linear-lanceolate, acuminate tip margin entire or toothed; costa single, bifurcate or not, short or ending below the leaf tip; leaves cells smooth, oval-rhomboid to oval-hexagonal, amphigastria present or not perichaetial leaves small, scale like, ecostate; seta erect, smooth, brownish, capsule erect or sub erect, ovate, operculam conic; peristome double.

Daltonia Hook. & Taylor.,

Muscol. Brit. 80–81, pl. 3 1818.

Daltonia marginata Griff., Calcutta J. Nat. Hist. 3: 270. 1843; Gangulee, Moss. E. India 2 (6). 1472. 1977. *D. flexifolia* Mitt., J. Proc. Linn. Soc., Bot., Suppl. 2: 146. 1859. (**Plate 5.57**)

Plants yellowish green, golden yellowish to golden brown when dry, glossy, small tufted; primary stem creeping, short; secondary stem erect, unbranched, 8-12 mm long, densly foliate; leaves whorled, erectopatent, 2.7-3.5×0.3-0.4 mm, linear-lanceolate, rounded base, acuminate tip, entire margin, recurved; costa prominent, single, ending below the leaf tip, leaves cells smooth, oval-rhomboid at tip and middle, 30-33×7-9 µm, basal cells rectangular-rhomboid, 50-62×7-8 µm, extreme basal cells brownish yellow, oblong to linear, 55-60×15-20 µm; perichaetial leaves small, scale like, ecostate; seta erect, smooth, brownish, 7-12 mm long; capsule erect, ovate, 2.2 mm long, 1mm diameter; operculam conic; peristome double, normal with exostome teeth narrowly lanceolate, papillose; endostome lightly papillose, widely lanceolate, segments linear.

Habitat: This plant is seen on bark of many forest trees in the shola forest.

Distribution:

World: India and Nepal.

India: Kerala (Present Collection).

Kerala: Idukki (Present Collection).

Specimen/s examined*:* India, Kerala, Idukki District.,Mathikettan Shola National Park, Chundel, 08.04.2013, 1450m, *Rajilesh V.K.* 9418b; Vellapara, 27.11.2014, 1780 m, *Rajilesh V. K.* 11612 (MBGH).

Notes: It is a rare species in the study area.The present collection is a new record for Peninsular India.

HOOKERIACEAE Schimp.,

Coroll. Bryol. Eur. 101. 1856.

Plants yellowish green or reddish, caespitose, glossy when dry, stems creeping, branched, secondary branches prostrate; leaves dense, spreading in several rows, heterophyllous; lower leaves small, ovate, acute tip, margin dentate at tip or

slightly dentate; costa double, percurrent, less than half of leaf or more, divergent;cells rectangular-irregular rhomboid; upper leaves, oblong-ovate, distinctly toothed at margin; costa double, percurrent, reach above the midleaf, divergent;cell rectangular; sporophytes laterally on main stems; seta long, brownish; capsule horizontal, brownish.

Hookeriopsis (Besch.) A.Jaeger,

Ber. Thatigk. St. Gallischen Naturwiss. Ges. 1875–76: 358. 1877.

Plants yellowish green or reddish, glossy when dry, caespitose, 5-10 cm long; stems creeping, branched, secondary branches prostrate. Leaves dense, spreading in several rows, complanate, heterophyllous; lower leaves small, ovate, acute tip, margin dentate at tip or slightly dentate; costa double, percurrent, less than half of leaf or more, divergent; basal cells, rectangular, narrower towards margin; median cells, elongated, irregular rhomboid; apical cells, elongated, irregular rhomboid; upper leaves, oblong-ovate, distinctly toothed at margin; costa double, percurrent, reach above the midleaf, divergent; basal cell, rectangular. Sporophytes laterally on main stems, perichaetia smaller, erect, narrower than leaves; seta long, brownish, strong, smooth, bent or not; capsule horizontal, brownish; peristome double, spores rounded, 8-12µm in diameter.

Key to the species

1a. Plants reddish-yellowish green; lower leaf costa above the mid leaf .... ……***H. utacamundiana***

1b. Plants yellowish green; lower leaves costa below the mid leaf ..... ***H. secunda***

Hookeriopsis secunda (Griff.) Broth., *Nat. Pflanzenfam. I (3): 942. 1907*; Gangulee, Moss. E. India 2(6). 1515. 1977. *Hookeria secunda* Griff. in Cal. J. Nat. Hist., 3: 280. 1843. **(Plate 5.58)**

Plants yellowish green, glossy when dry, caespitose, 5-10 cm long; stems creeping, branched, secondary branches 2-3 cm long, prostrate; leaves dense, spreading in several rows, complanate, heterophyllous; lower leaves small, 1.3-1.5×0.8-0.9 mm, ovate, acute tip, margin lightly dentate at tip; costa double,

percurrent, less than half of leaf, divergent; basal cells 30-50×15-17µm, rectangular, narrower towards margin; median cells 25-45×12-15µm, elongated, irregular rhomboid; apical cells 25-40×14-15 µm, elongated, irregular rhomboid; upper leaves 1.8×1 mm, oblong-ovate, distinctly toothed at margin; costa double, percurrent, reach above the midleaf, divergent; basal cell 30-35×16-18 µm, rectangular; median cells 65-80×12-14 µm; apical cells 30-40×12-14 µm. sporophyte laterally on main stems, perichaetia smaller, erect, narrower than leaves; seta long, 2 cm high, brownish, strong, smooth; capsule 1.5-1.7×0.6-0.8 mm in. diameter, horizontal, brownish, cylindrical-urn shaped; peristome double, 0.35 mm high, 3nos; spores rounded, 8-12 µm in. diameter.

Habitat: This plant is seen as thick patches on rock in the shola forest.

Distribution:

World: India and Sri Lanka.

India: Kerala (Daniels & Brijithlat, 2012), Meghalaya (Gangulee, 1976).

Kerala: Idukki (Present Collection); Thiruvananthapuram, Neyyar WLS, (Daniels & Brijithlat, 2012).

***Specimen examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Company estate, 30.11.2012, 1650 m, *Rajilesh V.K.* 8929 (MBGH).

Hookeriopsis utacamundiana (Mont.) Broth., in Nat.P fl., 1(3): 942. 1907; Gangulee, Moss. E. India 2(6). 1513. 1977. *Hookeria utacamundiana* Mont., Ann. Sci. Nat. 2, 17: 247. 1842. *H. secunda* Griff., Calcutta J. Nat. Hist. 3: 280. 1843. *H. pappeana* Hampe Icon.Musc. 2. 1844. *H. lindenbergii* Hampe, Linnaea 20: 85. 1847. *Lepidopilum sumatranum* Bosch & Sande, Lac. Bryol. Jav. 2: 42. 165. 1862. *Hookeriopsis geminidens* Broth., Philipp. J. Sci. 5: 156. 1910. *H. yakushimensis* Toyama, Acta Phytotaxa Geobot.6: 102. 2. 1937. **(Plate 5.59)**

Plants reddish-yellowish green, glossy when dry, caespitose, 5-8 cm long; stems creeping, branched, secondary branches 1-2 cm long, prostrate. Leaves dense, spreading in several rows, complanate, 1.2-2×0.6-0.9 mm, oblong-ovate, sharply

acute tip, margin sharply dentate at upper part; costa double, percurrent, more than half of leaf, divergent; leaf cell thin walled rectangular 45-55×20-22 µm at base; stem attachment cells are brownish; median cells 80-100×11-13 µm, elongated, elliptic- rhomboid; apical cells 50-60×11-13 µm, elongated, irregular rhomboid; sporophytes laterally on main stems; seta long, 2.2 cm high, brownish, strong, smooth, bent tip; capsule 1.2-1.4×0.4-0.5 mm in diameter, horizontal, brownish, cylindrical; peristome double, 0.4 mm high, 32nos.

Habitat: This plant is seen as thick patches on roots of trees in the shola forest.

Distribution:

World: India, Indonesia, Sri Lanka and Vietnam

India: Karnataka (Schwarz, 2013); Tamil nadu (Verma *et al.,* 2011) and West Bengal (Gangulee, 1977).

Kerala: Idukki (Present Collection).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Mannankudi, 29.11.2012, 1800 m, *Rajilesh V.K.* 8300; Vattapara, 07.04.2013, 1650 m, *Rajilesh V.K.* 8975 (MBGH).

Note: The present collection is a new record to Kerala.

HYPNALES W. R. Buck & Vitt Taxon 35: 33. 1986.

Key to the families

1a. Leaves symmetric **2**

1a. Leaves asymmetric . ..... **Neckeraceae**

2a. Leaves broad, base cordate or auriculate .....**Pterobryaceae**

2b. Leaves not broad, base not cordate **3**

3a. Alar cells differentiated, coloured or hyaline . ..... **Sematophyllaceae**

3b. Alar cells not clearly differentiated **4**

4a. Costa single, reached above the middle **5**

4b Costa double, faint or absent **9**

5a**.** Leaf cells obscure, cell with papillate **6**

5b. Leaf cells normal, cells with out papillate **8**

6a. Plants bi or tri pinnately branched, leaf small; margin crenulated throughout..... **Thuidiaceae**

6b. Plants pinnately branched, leaf large; margin not crenulated **7**

7a. Leaf cells differentiated from costa to margin; capsule hidden ..... **Cryphaeaceae**

7b Leaf cells not differentiated; capsule not hidden ..... **Meteoriaceae**

8a. Plants julaceous, leaf cells incrassate .... **Regmatodontaceae**

8b. Plants normal, leaf cells not incrassate ..... **Brachytheciaceae**

9a. Leaf margin smooth, apex short apiculus ..... **Leskeaceae**

9b. Leaf margin slightly dentate, apex acute or acuminate **10**

10a. Leaf mostly falcate ..... **Hypnaceae**

10b. Leaf not falcate **11**

11a. Leaf margin slightly crenulated below, dentate above **12**

11b. Leaf margin dentate throughout ..... **Hylocomiaceae**

12a. Capsule erect ..... **Entodontaceae**

12b. Capsule horizontal to drooping ..... **Pylaisiadelphaceae**

LESKEACEAE Schimp.,

Coroll. Bryol. Eur.109.1856.

Plants pale greenish, caespitose; stem prostrate, pinnately branched; branches long, filamentous; leaves dense, erectopatent, imbricate, ovate, slightly concave, apex short apiculus, margin smooth; costa double, faint; leaf cells elongated rectangular- rhomboid; sporophyte unknown.

Leptopterigynandrum Muell.,

Hal. Hedwigia 36(2): 114. 1897.

Leptopterigynandrum decolor (Mitt.) M. Fleisch., Musci Buitenzorg 4: 1703. 1923. *Stereodon decolor* Mitt., J. Proc. Linn. Soc., Bot., Suppl. 1: 92. 1859. *Pterigynandrum decolor* (Mitt.) Broth., Nat. P flanzenfam. I (3): 892 1907; Gangulee, Moss. E. India 3(8). 1765. 1980. **(Plate 5. 60)**

Plants pale greenish, caespitose; stem prostrate, pinnately branched; branches long, filamentous; leaves dense, erectopatent, ovate, slightly concave, 1.2-1.4×0.7-0.8 mm, apex short apiculus, margin smooth; costa double, faint, reaching ¼ of leaf length; leaf cells chlorophyllous, elongated rectangular, slightly pitted, 54-60×6-8 μm near to costa, irregular quadrate 10-18×18-20 μm near to basel margin, elongated rhomboid, 32-40×4.5-5.5 μm at middle and tip; sporophyte unknown.

Habitat: Plants seen as thick mat on rocks.

Distribution:

World: China and India.

India: Kerala (Present Collection), Sikkim (Ellis *et al.,* 2014).

Kerala: Idukki (Present Collection).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Chundel, 28.11.2014, 1430 m, *Rajilesh V.K.* 11647b (MBGH).

Note: This taxon is a new distributional record to Peninsular India.

THUIDIACEAE Schimp.,

Syn. Musc. Eur. 493. 1860.

Plants pale greenish-yellowish green, caespitose or mat form on log; stem prostrate, irregularly bi or tri pinnately branched; paraphyllia present or absent; leaves dense, erectopatent, rounded ovate or ovate-lanceolate, slightly concave, apex short apiculus, margin crenulated, some genus stem leaves and branch leaves

distinct, stem leaves ovate-lanceolate triangular, apex long, subulate; branch leaves erectopatent or erect-spreading, ovate-triangular or acuminate, acute apex, margin crenulated throughout; costa single or double, faint or prominent, short to excurrent to form aristate; leaf cells chlorophyllous; elongated rectangular, slightly pitted, irregular quadrate, elongated rhomboid, at middle and tip; cells with papillae on one or both sides sometimes to form stellate head on top by union of several head of papillae; sporophyte unknown.

Key to the genera

1a. Leaf apex long acuminate; cells with single papillae on one or both side.....***Thuidium***

1b. Leaf apex acute; cells with several small head of papillae form stellate head on top .....***Pelekium***

Pelekium Mitt.**,**

J.Linn.Soc. Bot. 10: 176. 1868.

Pelekium velatum Mitt., J. Linn. Soc., Bot. 10: 176. pl. 6: f. c 1868; Gangulee, Moss. E. India 3(7).1615. 1978. *Lorentzia longirostris* Hampe, Nuovo Giorn. Bot. Ital. 4: 288. 1872. *Pelekium fissicalyx* Muell., Hal. Bot. Jahrb. Syst. 5: 87. 1883. *Thuidium fissicalyx* (Muell. Hal.) Paris, Index Bryol. 1280. 1898. *Pelekium lonchopodum* Muell. Hal., Biblioth. Bot.13: 7. 1889. *Thuidium bandaicum* Muell. Hal., Bull. Soc. Roy. Bot. Belgique 41(1): 89. 1906. *Pelekium calcicola* M. Fleisch., Musci Buitenzorg 4: 1511. f. 240. 1923. **(Plate 5.61)**

Plants pale green- yellowish green, mat form on log; main stem creeping, bi or tri pinnately branched; leaves erect-spreading, ovate-acuminate, acute tip, slightly cordate base, 0.55-0.58×0.32-0.34 mm, margin crenulated; costa single, strong, ending below the tip, leaves cells papillose, union of several small head of papillae form stellate head on top; leaf cells quadrate-hexagonal, 8-11 μm wide at tip and

middle; rectangular-rhomboid, 20-25×6-7 at base near the costa, gradually smaller, rhomboid to margin; sporophyte not observed.

Habitat: This plant firmly attached to the bark and logs in the shola forest.

Distribution:

World: Borneo, Burma, India, Indonesia, Philippines, Singapore, Sumatra and Thailand.

India: Karnataka (Schwarz, 2013); Kerala (Manju *et al*., 2008b).

Kerala: Idukki (Present Collection).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Shivanpara, 28.11.2012, 1550m, *Rajilesh V.K.* 8253, 8258; Chundel, 08.04.2013, 1200 m, *Rajilesh V.K.* 9403, 9407; Karipara, 12.03.2014, 1660 m, 10913; Aduvilanthankudi, 13.03.2014, 1600m, *Rajilesh V.K.* 10946; Kurishukavala, 28.11.2014, 1600 m, *Rajilesh V.K.* 11627; Vellapara, 27.11.2014, 1600 m, *Rajilesh V.K.* 11591, Njandar, 04.08.2015, 1400 m, *Rajilesh V.K.* 11641(MBGH).

Thuidium Schimp.,

Bryol. Eur. 5: 157, (fasc. 49–51. Mon. 1.) 1852.

Plants pale greenish -yellowish green, brownish when old, mat form on log and rocks, main stem creeping, irregularly bi or tri pinnately branched; paraphyllia dense on stem and leaf, branched, filiform; stem leaves erectopatent or erect spreading, ovate- lanceolate triangular, slightly plicate or not, apex long, subulate or acuminate; costa excurrent to form long subulate tip; branch leaves erectopatent or erect-spreading, ovate-triangular, acute apex, margin crenulated throughout; costa single, reached above the mid leaf; cells with papillae on one or both sides, stem leaves cells irregular rectangular; branch leaves cells quadrate-irregular rhomboid or hexagonal rhomboid.

Key to the species

1a. Stem leaves more than 2mm long; costa excurrent to form long arista .... ***T. cymbifolium***

1b. Stem leaves less than 0.6 mm long; costa reached upto top ..... ***T. pristocalyx***

Thuidium cymbifolium (Dozy & Molk.) Dozy & Molk., Bryol. Jav. 2:115. 221. 1865. Gangulee, Moss. E. India 3 (7).1646.1978. *Hypnum cymbifolium* Dozy & Molk, Ann. Sci. Nat., Bot., ser. 3, 2:306. 1844. *H. blepharophyllum* Muell., Hal. Bot. Zeitung (Berlin) 12:573. 1854. *H. casuarinum* Muell., Hal. Linnaea 38:569. 1874. *H. nanodelicatulum* Hampe, Linnaea 40:323. 1876. *Thuidium amblystegioides* Muell. Hal., Rev. Bryol. 3: 4. 1876. *H. plumulosiforme* Hampe, Linnaea 40:324. 1876. *Thuidium casuarinum* (Muell. Hal.) A. Jaeger, Ber. Thatigk. St. Gallischen Naturwiss. Ges. 1876 77:265.1878. *Tamariscella cymbifoliola* Muell., Hal. Flora 82: 476. 1896. *Thuidium lauterbachii* Broth., Fl. Schutzgeb. Sudsee 102. 1900. *T. longissimum* Herzog, Hedwigia 49: 125. 1909. *T. viridiforme* Cardot, Bull. Soc.Bot. Geneve 3: 284. 1911. *T. cymbifolium* var. *prostratum* M. Fleisch., Musci Buitenzorg 4: 1532. 241. 1923. *T. dodabettense* M. Fleisch., Hedwigia 69: 94. 1929. *T. cymbifolium* var. *robustum* Dixon, Ann.Bryol.12: 54.1939. *T. paraviride* Sakurai Bot., Mag. (Tokyo) 57: 350. 11. 1943 **(Plate 5.62**)

Plants yellowish green, mat form on log and rocks, brownish when old; main stem creeping, irregularly bi or tri pinnately branched; paraphyllia dense on stem and leaf, branched, filiform; stem leaves erectopatent, ovate-lanceolate triangular, 2.2-2.6×0.7-0.8mm, slightly plicate, apex long, subulate, excurrent costa formed to long arista, crenulate margin; branch leaves erectopatent, short, 0.3-0.35×1.7-2.2 mm, ovate-triangular, acute apex, margin crenulated throughout; costa single, reached above the mid leaf; stem leaves cells irregular rectangular, 22-25×5-7 µm at base, cells with single papillae on both side; extreme basal cells 22-23×10-12 µm, yellowish brown coloured; irregular rhomboid, 22-24×7-8 µm at middle and tip;

branch leaves cells quadrate-irregular rhomboid, 10-11×12-14 μm, cells with single papillae on both side; sporophyte not seen.

Habitat: This plant is seen on bark and rocks in the shola forest. Plants seen along with *Homalia trichomanoides* (Hedw.) Schimp., *Lejeunea wightii, Homaliodendron flabellatum* (Sm.) M. Fleisch. and *Eurhynchium hians* (Hedw.) Sande Lac.

Distribution:

World: Australia, Bhutan, Burma, China, India, Indonesia, Japan, Korea, Nepal, Philippines, Sri Lanka, Sumatra, Taiwan, Thailand and Vietnam

India: Karnataka (Schwarz, 2013; Schwarz & Frahm, 2013), Kerala (Manju *et al*., 2008b), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013; Daniels *et al*., 2018), Uttarakhand (Alam, 2013), Uttar Pradesh (Saxena *et al*., 2009)

Kerala: Idukki (Present collection), Kerala (Manju *et al*., 2008b).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Mannankudi, 29.11.2012, 1700m, *Rajilesh V.K.* 8922, 8924; Vellapara, 27.11.2014, 1780m, *Rajilesh V.K.* 11557, 11580b, 11582; Shivanpara, 28.11.2012, 1500 m, *Rajilesh V.K.*8254; Njandar, 25.04.2016, 1400m, *Rajilesh V.K.* 14206 (MBGH).

Thuidium pristocalyx (Muell. Hal.) A. Jaeger, Ber. Thatigk. St. Gallischen Naturwiss. Ges. 1876–77: 257. 1878; Nair *et al*., Bryoph. Wayanad, 178. 2005. *Hypnum pristocalyx* Muell., Hal. Bot. Zeitung (Berlin) 12: 573. 1854. *Leskea glaucina* Mitt., J. Proc. Linn. Soc., Bot., Suppl. 2: 133. 1859. *Thuidium orientale* Mitt. ex Dixon, J. Bot. 51: 329. 1913. *T. glaucinoides* var. *verrucosum* M. Fleisch., Musci Buitenzorg 4: 1527. 1923. **(Plate 5. 63**)

Plants yellowish green to pale greenish; main stem creeping, tomentose, bi or tri pinnately branched; stem leaves erect spreading, ovate-lanceolate to triangular, acuminate apex, 0.58-0.6×0.38-0.4 mm, margin crennulated; costa single, reached upto top; branch leaves erect-spreading, concave, ovate-acuminate, 0.38-0.4×0.19-0.22 mm, acute at apex, irregularly crenulate at margin; costa single, reached above

the mid leaf; cells papillate; branch leaves cells quadrate-hexagonal to rhomboid; 8-9×14-15 µm at tip; 7.2-7.4×7.5-8.8 µm at middle; 16-19×6-9 µm at base; stem leaves cells quadrate-hexagonal, 7-9 µm wide at tip; elongated hexagonal at base; sporophyte unbranched, brownish, long, small, finger shaped shaped.

Habitat: This plant is seen on bark and rocks in the shola forest.

Distribution:

World: India, Indonesia, Malaysia, Philippines, Thailand and Vietnam.

India: Himachal Pradesh (Alam, 2013), Jammu & Kashmir (Alam, 2013), Karnataka (Aruna & Krishnappa, 2014), Kerala (Nair *et al*., 2005a), Tamil Nadu (Daniels, 2010, Daniels & Daniel, 2013, Daniels *et al*., 2018), Uttarakhand (Alam, 2013)**.**

Kerala: Idukki (Present Collection), Kannur (Manju *et al*., 2009b), Kozhikode (Manju *et al*., 2008a), Thiruvananthapuram (Manju *et al*., 2009a), Wayanad (Nair *et al.,* 2005a).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Checkpost, 28.11.2012, 1200m, *RajileshV.K.* 8280; Mannankudi, 29.11.2012, 1700 m, *Rajilesh V.K.* 8916; Company estate, 30.11.2012, 1600 m, *Rajilesh V.K.* 8932; Muthupara, 11.03.2014, 1500m, *Rajilesh V.K.* 9847; Changalakavala, 12.03.2014, 1550 m, *Rajilesh V. K.* 10922, 10935; Chundel, 28.11.2014, 1460 m, *Rajilesh V.K.* 11645e (MBGH).

REGMATODONTACEAE Broth.,

Regmatodon Brid.

Bryol. Univ. 2: 204. 1827.

Regmatodon orthostegius Mont., Ann. Sci. Nat., Bot., Ser. 2.17: 248.1842; Gangulee, Moss. E. India 3 (7). 1563. 1978. *Anhymenium polycarpon* Griff., Culcutta J. Nat. Hist. 3: 275, pl. 16.1843. *Regmatodon polycarpus* (Griff.) Mitt. J.

Proc. Linn. Soc., Bot., Suppl. 1(2):127. 1859. *R. secundus* Kiaer. Forh. Vidensk. Selsk.Kristiani 1882 (24):38. 2f. 5-7, 3 f. 1-5. 1883. **(Plate 5.64)**

Plants light greenish-yellowish green, dense tufted on logs, main stem creeping, pinnately branched, branches erect, julaceous, 1-1.2 mm long; leaves dense, imbricate, erectopatent, concave, ovate-shortly apiculate, 0.9- 1.2 mm long, 0.35-0.4mm wide; costa single, pale brownish, reached above the mid leaf; leaf cells incrassate, irregularly rhomboid, 10-13 ×6-7 µm at tip and middle; wide, irregular rhomboid–sub hexagonal near to costa at base; rectangular, 9-10×7-8 µm at basal marginal cells; sporophyte on base of branches; seta long, erect, 0.9-1.2 mm long, smooth; capsule erect, ovate- cylindrical, 2.5 mm long, 0.6 mm wide; peristome double,; exostome brownish, thick transverse lamellae, short, 215µm; endostome large, lanceolate, thin, 450µm long.

Habitat: Plants seen on logs in the forest.

Distribution:

World: China and India.

India: Kerala (Manju *et al*., 2008b), Sikkim (Gangulee, 1978), Tamil Nadu (Daniels *et al*., 2018), West Bengal (Gangulee, 1978).

Kerala: Idukki (Present Collection); Kerala (Manju *et al*., 2008b).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park,Vellapara, 27.04.2016, 1780 m, *Rajilesh V.K.* 14232(MBGH).

BRACHYTHECIACEAE Schimp.,

Syn.Musc.Eur.2:637.1876.

Plants greenish-yellowish green, generally glossy, prostrate, irregularly branched; leaves usually plicate, ovate-lanceolate or oblong- lanceolate, acute or acuminate tip, concave- strongly concave; costa single, reach above mid leaf; cells at

medium half smooth or with projecting ends, leaf base often with differentiated of few alar cells; seta long, operculam long-rostrate.

Key to the genera

1a. Leaves ovate-lanceolate..... **2**

1b. Leaves ovate-acuminate. **3**

2a. Basal cells quadrate-rectangular; alar slightly differentiated..... .... ***Brachythecium***

2b. Basal cells rhomboid; alar not differentiated ..... ***Rhynchostegiella***

3a. Alar cells ushally present **4**

3b. Alar cells absent ..... ***Rhynchostegium***

4a. Leaves large, squrrose; margin slightly denticulate . .....***Aerobryum***

4b. Leaves small, erectopatent; margin denticulate ..... ***Eurhynchium***

Aerobryum Dozy & Molk.,

Ned. Kruidk. Arch. 2(4): 279. 1851.

Aerobryum speciosum Dozy & Molk., Ned. Kruidk. Arch. 2(4): 279 1851. Gangulee, Moss. E. India 2(5). 1347. 1976; Nair *et al*. Bryoph.Wayanad, 154. 2005. **(Plate 5.65)**

Plants yellowish, glossy, stem long branched, secondary stem long, pendant; leaves squarrose, widely spreading, broad, ovate, 3-3.2×1.5-2mm, base wide and slightly cordate, tip narrow, acuminate, margin slightly wavy above the middle leaf, shortly denticulate at margin, costa single, above the mid leaf; leaf cells thick walled, rhomboid-linear, smooth, 36-42×6-7 µm at tip, 75-82×7-8 µm at middle, basal cells slightly rectangular, porose,75-80×20-22 µm, alar cells 35-40×30-33 µm.

Habitat: Plants hanging from branches of shola trees.

Distribution:

World: Bhutan, China, India, Indonesia, Japan, New Guinea, Philippines, Sri Lanka and Taiwan.

India: Kerala (Nair *et al*., 2005a; Manju *et al*., 2008a; Manju *et al*., 2009b), West Bengal (Gangulee, 1976).

Kerala: Idukki (Present Collection), Kannur (Manju *et al*., 2009b), Kozhikode (Manju *et al*., 2008a), Wayanad (Nair *et al*., 2005a).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Chundel, 09.04.2013, 1200 m, *Rajilesh V.K.* 9427; Aduvilanthankudi, 13.03.2014, 1600 m, *Rajilesh V.K.* 10942b; Chundel, 26.04.2016, 1300 m, *Rajilesh V.K.* 14215 (MBGH).

Brachythecium Schimp.,

Bryol. Eur. 6: 5. 1853.

Plants pale green to yellowish green, glossy or not, dense mat on rocks, bark; main stem creeping, brownish or not, stem irregularly pinnately branched; leaves whorled, closely or loosely imbricate, erectopatent, concave or not, ovate lanceolate to oblong-lanceolate, 1.6-2.6×0.55-0.9 mm, auriculate or not, acuminate to acute at apex; margin denticulate, slightly near at base; costa single, reach above the mid leaf, cells elongated, rhomboid, at middle and tip, basel cells quadrate to sub quadrate-rectangular, lax or not, alar slightly distinguished, quadrateor sub quadrate. sporophyte on main branches; perichaetial leaves long, narrow, linear-lanceolate, entire margin, acuminate tip; seta erect, long, smooth, brownish; capsule erect, cylindrical.

Key to the species

1a. Leaves closely imbricate; base auriculate; stem leaves ovate-oblong lanceolate, less than 0.6 mm wide .... ***B. buchananii***

1b. Leaves loosely imbricate; base not auriculate; leaves ovate lanceolate, more than 0.8 mm wide .... ***B. formosanum***

Brachythecium buchananii (Hook.) A. Jaeger, Ber. Thatigk. St. Gallischen Naturwiss. Ges. 1876–77: 341. 1878. Gangulee, Moss. E. India 3(7). 1711. 1978; Nair *et al*., Bryoph. Wayanad, 180. 2005. *Hypnum cuspidiferum* Mitt., Proc. Linn. Soc. Bot., Suppl.1: 78. 1859. *Brachythecium planiusculum* Muell., Hal. Nuovo Giorn. Bot. Ital., n.s., 4: 268. 1897. *Rhynchostegium microrusciforme* Muell., Hal. Nuovo Giorn. Bot. Ital., n.s., 5:202.1898. *Oxyrrhynchium microrusciforme* (Muell. Hal.) Bronbnth., Nat. Pflanzenfam. I (3): 1155. 1909. *Brachythecium buchananii* var. *japonicum* Cardot, Bull. Soc. Bot. Geneve 3:289.1911. *B. abakanense* Kaal., Kongel. Norske Vidensk. Selsk. Skr. (Trondheim) 1918(2): 8. 1919. *Platyhypnidium microrusciforme* (Muell. Hal.) M. Fleisch, Musci Buitenzorg 4: 1537.1923. *Brachythecium yunnanense* Herzog, Hedwigia 65:167.1925. *B. siamense* Dixon, J. Siam Soc. Nat. Hist. Suppl. 9:36.1932. *B.carinatum* Dixon, Rev. Bryol. Lichenol. 7: 114. 1934. **(Plate 5.66)**

Plants pale green to yellowish green, glossy, dense mat on rocks, bark; main stem creeping, highly branched, stem 5-6 cm long, branches irregularly pinnate, 5-8 cm long; leaves whorled, imbricate, erectopatent, concave, ovate to oblong-lanceolate, 1.6-1.8×0.55-0.6 mm, base wide, auriculate, acuminate to acute at apex; margin denticulate, slightly near at base; costa single, reach above the mid leaf, cells elongated, rhomboid, 60-80×3.5-6 µm at middle and tip, basel cells sub quadrate-rectangular, lax, smooth, 25-32×13-20 µm, alar slightly distinguished, quadrate, 27-30×27-30.

Habitat: Plant is seen as mat form on bark of trees and rocks in the shola forests.

Distribution:

World: Bhutan, China, Japan, India, Korea, Myanmar, Nepal, Pakisthan, Philippines, Thailand and Vietnam.

India: Jammu & Kashmir (Kour *et al*., 2018), Karnataka (Aruna & Krishnappa, 2014), Kerala (Manju *et al*., 2008b), Meghalaya (Gangulee, 1978), West Bengal (Gangulee, 1978).

Kerala: Idukki (Present collection)

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Chundel, 08.04.2013, 1200 m, *Rajilesh V.K.* 9408; Mannankudi, 26.11.2014, 1600 m, *Rajilesh V.K.* 11570; Chundel, 28.11.2014, 1460 m, *Rajilesh V.K.* 11645c (MBGH).

Brachythecium formosanum Takaki, J. Hattori Bot. Lab. 15: 2. 8. 1955; Gangulee, Moss. E. India 3(7). 1703. 1978. **(Plate 5. 67)**

Plants pale green- yellowish green, tufted on bark; main stem creeping, brownish, rhizomatous, irregularly pinnately branched; secondary branches short; leaves whorled, erectopatent, imbricate; stem leaves wider, large, ovate-lanceolate, 2.2-2.6×0.8-0.9 mm; branch leaves narrowly elongated, small, 1.8-2.2×0.4-0.5 mm, margin denticulate near at base, acuminate at apex; costa single, reach above the mid leaf; leaves cells narrow, elongated linear at tip and near to base 90-110×8-10 µm, slightly shorter and wide, quadrate-rectanular, 45-55×25-35 µm at base; alar cells sub quadrate to quadrate, 35×25 µm; sporophyte on main branches; perichaetial leaves long, narrow, 3-3.3×0.4-0.45 mm, linear-lanceolate, slightly curved near to tip, entire margin, acuminate tip; seta erect, 1.5-1.7 cm long, smooth, brownish; capsule erect, cylindrical, 2.2 mm long, 0.7 mm in diameter; operculam conic-shortly rostrate, 1mm high; peristome double, normal, exostome wide, large; endostome ciliate, small; spore papillose, 16 in diameter.

Habitat: Plant is seen as mat form on bark of the stem along with the other mosses like fissidens and thuidium etc. in the shola forest.

Distribution:

World: Bhutan, China, India, Nepal and Taiwan.

India: Andhra Pradesh (Sandhya Rani *et al*., 2014), Arunachal Pradesh (Vohra & Kar, 1996).

Kerala: Idukki (Present Collection).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Muthupara, 11.03.2014, 1450 m, *Rajilesh V.K.* 9484; Kurisukavala, 28.11.2014, 1550 m, *Rajilesh V.K.* 11622 (MBGH).

Note: The present collection is a new Record for Kerala

Eurhynchium Schimp.,

Bryol. Eur. 5: 217. 1854.

Eurhynchium hians (Hedw.) Sande Lac., Ann. Mus. Bot. Lugduno-Batavi 2: 299. 1866. Gangulee, Moss. E. India 3(7). 1738. 1978. *Hypnum hians* Hedw., Sp. Musc. Frond. 272. pl. 70: f. 11–14. 1801. *H. swartzii* Turner Muscol. Hibern. Spic. 151. pl. 14:f.1.1804. *Pterigynandrum apiculatum* Brid. Muscol. Recent. Suppl. 1:137. 1806. *Eurhynchium swartzii* (Turner) Curn., Bryoth. Eur. 12: 593. 1862. *E. orotavense* Renauld & Cardot, Bull. Herb. Boissier, ser. 2, 2: 439. 7 f.18. 1902. *E. praelongum* var. *laxirete* Renauld & Cardot, Bull. Herb. Boissier, ser.2, 2: 439. 1902. **(Plate 5. 68)**

Plants pale greenish-yellowish green, glossy, loosely tufted on bark or on soil cutting; main stem creeping, rhizomatous, 4-8 cm long, pinnately branched; secondary branches short, erect; leaves loosely tufted, erectopatent; stem leaves short, 1-1.2×0.45-0.5-mm,-concave, slightly cordate base, acuminate tip; branch leaves ovate, acute tip, 1.2-1.4×0.55-0.6 mm, margin denticulate at base; costa single, reach above the mid leaf; leaf cells elongated- narrow rhomboid, 45-55×5-6 µm; exteme basel cells rectangular, 35-38×10-12 µm, lax, alar not differentiated.

Habitat: Plant is seen on bark of the shola trees along with *Homaliodendron flabellatum, Homalia trichomanoides* (Hedw.) Schimp*., Lejeunea wightii* Lindenb. *and Thuidium cymbifolium* (Dozy & Molk.) Dozy & Molk.

Distribution:

World: Bhutan, Canada, China, Europe, India, Nepal, N. America and Western and Tibet.

India: Andhra Pradesh (Sandhya Rani *et al*., 2014), Jammu & Kashmir (Kour *et al*., 2018), Kerala (Manju *et al*., 2008b), Uttarakhand (Bahuguna *et al.,* 2016).

Kerala: Idukki (Present Collection).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Chundel, 08.04.2013, 1430 m, *Rajilesh V. K.*, 8997; Karipara, 12.03.2014, 1650 m, *Rajilesh V. K.* 10918; Vellapara, 27.11.2014, 1780 m, *Rajilesh V. K.* 11580c, 11585 (MBGH).

Rhynchostegiella (Schimp.) Limpr.,

Laubm. Deutschl. 3: 207. 1896.

Plants yellowish green, glossy, lax or tufted on log, bark or on land cuttings; main stem creeping, pinnately branched, branches short, erect or not; feathery or not; leaves whorled or not, erect spreading, imbricate or not, ovate-lanceolate, base wide, auriculate, acuminate tip, faintly denticulate at base; costa single, reached middle; basel cells rhomboid, elongated rhomboid at middle and tip; alar cells rectangular or not differentiated; sporophytes on main branch; seta erect, brownish; capsule erect, ovate-cylindrical, brownish.

Key to the species

1a. Loosely foliate; leaves not whorled; alar undifferentiated ..... ***R. menadensis***

1b. Densely foliate; leaves whorled; alar differentiated ..... ***R. scabriseta***

Rhynchostegiella menadensis (Sande Lac.) E.B. Bartram, Philipp. J. Sci. 68: 302.1933; Gangulee, Moss. E. India 3(7). 1730. 1978. *Hypnum menadense* Sande Lac. Bryol. Jav. 2: 156. 255. 1866. *Rhynchostegium fissidentoides* Paris, Index Bryol. 1128 1898. *R. ovalifolia* Dixon, J. Siam Soc., Nat. Hist. Suppl. 9: 36 1932. *R. percomplanata* Dixon, J. Bombay Nat. Hist. Soc. 39: 788. 1937. **(Plate 5. 69)**

Plants yellowish green, glossy, loose mat on log, bark; main stem creeping, 2-3cm long, pinnately branched, branches short, feathery, loosely foliate; leaves erect-spreading, 0.8-0.9×0.37-0.4 mm, ovate-lanceolate, base wide, auriculate, acuminate tip, faintly denticulate at base; costa single, reached middle; basal cells rhomboid, 30-35×7-9 µm; elongated rhomboid, 62-80×3-5µm at middle and tip; alar cells undifferentiated; branch leaves narrow, ovate-lanceolate, 1.5-1.6×0.36-0.38 mm, decurrent base, acuminate at apex; sporophyte not known.

Habitat: Plant is seen on logs and bark along with other mosses in the shola forest.

Distribution:

World: China, India, Indonesia, Philippines and Thailand.

India: Uttarakhand (Bargali *et al.*, 2014).

Kerala: Idukki (Present Collection).

Specimes examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Chundel, 08.04.2013, 1450 m, *Rajilesh V.K.* 9406; Vattapara, 28.11.2014, 1620 m, *Rajilesh V.K.* 11640; Sivanpara, 28.11.2012, 1550 m, *Rajilesh V.K.* 8236b (MBGH).

Note: The present collection is a new distributional record to Peninsular India.

Rhynchostegiella scabriseta (Schwagr.) Broth., Nat. Pflanzenfam. I (3): 1161. 1909; Gangulee, Moss. E. India 3 (7). 1728. 1978. *Hypnum scabrisetum* Schwagr., Sp. Musc. Frond., Suppl. 2(2): 28lb. 1830. **(Plate 5.70)**

Plants yellowish green, glossy tufted on bark, on soil cutting; main stem prostrate, short, pinnately branched; branches erect, 2-2.5 cm long, densely foliate; leaves whorled, erect-spreading, imbricate, 1.6-1.7×0.6-0.66 mm, ovate-lanceolate, base wide, decurrent, apex narrow acuminate, shortly denticulate margin; costa single, reached above the middle; leaf cells narrow, elongated- rhomboid 28-43×4.2-5.5 µm from base to apex; alar rectangular, 16-23×9-11 µm; sporophytes on main

branch; seta erect,1.8-2 mm long, brownish, rough; capsule erect, ovate-cylindrical, brownish, 2.2-2.5 mm long, 0.5 mm in diameter; peristome normal.

Habitat: Plant is seen on bark and soil cutting along with other mosses in the shola forest.

Distribution:

World: India and Nepal.

India: Himachal Pradesh (Alam, 2013), Jammu & Kashmir (Alam, 2013; Kour *et al*., 2018), Manipur (Govndapyari, 2014), Uttarakhand (Alam, 2013; Bahuguna *et al*., 2016)

Kerala: Idukki (Present Collection)

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Chundel, 09.04.2013, 1200 m, *Rajilesh V. K.* 9450; Kurisukavala, 28.11.2014, 1550 m, *Rajilesh V. K.* 11624; Karipara, 12.03.2014, 1650 m, *Rajilesh V. K.* 10915; Aduvilanthankudi, 13.03.2014, 1600 m, *Rajilesh V. K.* 10960 (MBGH).

Note: This taxon is a new distributional record to Peninsular India.

Rhynchostegium Schimp.

Bryol. Eur. 5: 197. 1852.

Rhynchostegium herbaceum (Mitt.) A. Jaeger, Ber. Thatigk. St. Gallischen Naturwiss. Ges. 1876–77: 368. 1878. Gangulee, Moss. E. India 3(7). 1749. 1978; Nair *et al.,* Bryoph. Wayanad, 183. 2005. *Hypnum herbaceum* Mitt., J. Proc. Linn. Soc., Bot., Suppl. 1: 81. 1859. **(Plate 5.71)**

Plants brownish-green, glossy, thin tufted on soil cutting; main stem creeping, branched, 8-10 cm long; secondary stem short, erect; leaves whorled, loosely tufted, erect-erectopatent, slightly imbricate, ovate, acute tip, 2.2-2.4×1.2-1.4 mm, margin minutely denticulate; costa single, reach above the mid leaf; leaf

cells narrow , rhomboid, 80-100×6-7 µm at tip, middle; basel cells shorter, quadrate-rectangular, 30-50×12-15 µm; sporophytes on main stems; seta erect, smooth, 1.6-2 cm long, brownish; capsule horizontal, brownish, oblong-cylindrical, 2-2.2 mm long; peristome double, normal; exostome yellowish brown, 410 µm long, 110 µm wide at base; endostome pale yellowish, thin, ciliate.

Habitat: Plant is seen on soil cutting in the shola forest.

Distribution:

World: India and Sri Lanka.

India: Jammu & Kashmir (Kour *et al*., 2018), Karnataka (Aruna & Krishnappa, 2014), Kerala (Nair *et al*., 2005a, 2008b), West Bengal (Gangulee, 1978).

Kerala: Idukki (Present collection) Wayanad (Nair *et al.,* 2005a).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Muthupara, 11.03.2014, 1500 m, *Rajilesh V.K.* 9486; Aduvilanthankudi, 13.03.2014, 1600 m, *Rajilesh V.K.* 10961(MBGH).

METEORIACEAE Kindb.,

Gen. Eur. N. Amer. Bryin. 7. 1897

Plants yellowish-green, glossy, stem long, pinnately branched, widely spreading, margin slightly wavy above the middle leaf, margin plicate, leaves squarrose, leaves ovate-lanceolate, imbricate; tip narrow, acuminate, spreading, pendant; leaf cells linear-rhomboid, shortly denticulate or denticulate at margin; costa single, faint, above the mid leaf, basal cells rectangular, thicker, smooth, porose.

Key to the genera

1a. Leaves cells with multipapillate **2**

1b. Leaves cells with one or two papillate **3**

2a. Leaves less than1mm long; costa faint below the mid leaf ..... ***Floribundaria***

2b. Leaves more than 1 mm long; costa strong above the mid leaf....***Cryptopapillaria***

3a. Leaves narrow, base flat; tip long subulate .....***Aerobryopsis***

3b. Leaves wide, base cordate; tip long subulate or not **4**

4a. Cells with single papilla **5**

4b. Cells with double papilla .....***Meteoriopsis***

5a. Leaf base cordate, apex long subulate; costa reached at middle . ... ***Aerobryidium***

5b. Leaf base slightly auriculate, apex acuminate; costa reached at tip..... ..... ***Trachypodopsis***

Aerobryidium M. Fleisch. ex Broth.,

Nat. Pflanzenfam. (3): 820. 1906.

Aerobryidium filamentosum (Hook.) M. Fleisch, Nat. P flanzenfam. I (3): 821. 1906; Gangulee, Moss. E. India 2 (5). 1322. 1976. *Neckera filamentosa* Hook., Musci Exot. 2: 158 1819. *Aerobryum filamentosum* (Hook.) M. Fleisch. ex Ther., Bull. Soc. Bot. Geneve 26: 87. 1936. *A. taiwanense* Nog. J. Hattori Bot. Lab. 3: 71. 27. 1948. **(Plate 5.72)**

Plants yellowish green-golden, glossy; stems 8-12 cm long, creeping, pinnately branched, secondary branches long, pendant, 8-15 cm long; leaves dense, squarrose, imbricate, 2.5-3.2×0.9-1.4 mm, ovate-lanceolate, cordate base, apex margin curved inwards to form long subulate tip, which clearly curled, margin plicate, faintly denticulate, costa single, about two-thirds of the leaf; leaf cells linear-rhomboid, with a single papilla on the lumen except at tip and base, tip cells 35-38×5-6 µm, middle cells 40-42×5-6, basel cells 50-55×6-8, thick walled, porose, cells at alar region 10-14×9-12, slightly quadrate; sporophyte on lateral branches.

Habitat: Plants hanging from branches of shola trees.

Distribution:

World: India and South East Asia.

India: Andhra Pradesh (Sandhya Rani *et al*., 2014), Karnataka (Schwarz, 2013), Kerala (Manju *et al*., 2008b), Tamil Nadu (Alam *et al*., 2011; Daniels & Daniel, 2013; Daniels *et al*., 2018), West Bengal (Gangulee, 1976).

Kerala: Iduuki (Present Collection).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Thakkalikavala, 25.11.2014, 1600m, *Rajilesh V.K.* 11524d; Vattapara, 28.11.2014, 1620m, *Rajilesh V. K.* 11656; Chundel, 04.08.2015, 1200 m, 11635, 11653; Njandar, 04.08.2015, 1400 m, *Rajilesh V.K.* 11669 (MBGH).

Aerobryopsis M. Fleisch.,

Hedwigia 44: 304. 1905.

Aerobryopsis wallichii (Brid.) M. Fleisch., Musci Buitenzorg 3: 789 1908. Gangulee, Moss. E. India 2(5).1319. 1976; Nair *et al.,* Bryoph. Wayanad, 154. 2005. *Hypnum wallichii* Brid., Bryol. Univ. 2: 416 1827. *Neckera longissima* Dozy & Molk., Ann. Sci. Nat., Bot., ser. 3, 2: 313. 1844. *Aerobryum wallichii* (Brid.) Muell., Hal. Linnaea 40: 262 1876. *A. pseudolanosum* Broth. & Geh., Biblioth. Bot. 44: 17. 1898. *Aerobryopsis longissima* (Dozy & Molk.) M. Fleisch., Hedwigia 44: 305. 1905. **(Plate 5.73)**

Plants yellowish green, glossy, golden yellowish when dry, primary stem creeping on tree branches; secondary branches hanging from trees, long, pinnately branched, twisted, 30-40 cm long; leaves complanate, imbricate, spreading, 2-2.2×0.45-0.55 mm, ovate-lanceolate, apex gradually narrowed to long subulate, margin denticulate, costa single, reached above the mid leaf, faint; single central papilla on each cells except extreme base and tip, tip cells hyaline, 60-65×9-10µm, middle cells narrow elongate, 65-70×5.5-6 µm, basal cells rectangular, 50-52×35-37 µm.

Habitat: Plants hanging from branches of shola trees.

Distribution:

World: Australia, Burma, India, Indonesia, Mexico, Nepal, New Guinea, Philippines, Sri Lanka, Sumatra, Vietnam and West Indies.

India: Himachal Pradesh (Alam, 2013), Jammu & Kashmir (Alam, 2013), Kerala (Manju *et al*., 2008b; Prajitha *et al*., 2013), Uttarakhand (Alam, 2013; Bahuguna *et al*., 2016), West Bengal (Gangulee, 1976).

Kerala: Idukki (Present collection), Palakkad, Silent Valley National park, (Prajitha *et al*., 2013)

Specimen/s examined: India, Kerala, Idukki District, Mathikettan Shola National Park, Karipara, 12.03.2014, 1650 m, *RajileshV.K.* 10907; Mannakudi, 26.11.2014, 1800 m, *Rajilesh V. K.* 11568 (MBGH).

Note: Prajitha *et al.* (2013) reported this species as new record for India collected from Silent Valley National Park of Kerala state.

Cryptopapillaria M. Menzel,

Willdenowia 22: 181. 1992.

Cryptopapillaria fuscescens (Hook.)M. Menzel. Willdenowia 22: 183. 1992; Gangulee, Moss. E. India 2(5).1284. 1976; Nair *et al.,* Bryoph. Wayanad, 155. 2005. *Neckera fuscescens* Hook., Musci Exot.2: 157. 1819. **(Plate 5.74)**

Plants yellowish green to greenish, 10-12 cm long, slender, pinnately branched; leaves dense, erect, imbricate, appressed to stem, ovate-oblong lanceolate, base auriculate, apex acuminate, margin denticulate at base; costa single, strong, above the middle; leaf cells linear-rhomboid, 25-30×3-4 μm at apex, multipapillate except at basal cells, thick walled; rectangular cells, 35-40×10-13 μm at leaf attachment;sporophyte unknown.

Habitat: Plants growing on logs, stem and bark.

Distribution:

World: Bhutan, India, Indonesia, Myanmar, Nepal, Philippines, Sri Lanka, Thailand, Tonkin and Yunnan.

India: Karnataka (Schwarz & Frahm, 2013), Kerala (Nair *et al.*, 2005, 2006, 2009), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013; Daniels *et al*., 2018), West Bengal (Gangulee, 1976).

Kerala: Idukki (Present Collection); Aralam (Manju *et al*., 2009) Kozhikode (Manju *et al*., 2008a), Wayanad (Nair *et al*., 2005a).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Aduvilanthankudi, 13.03.2014, 1600 m, *Rajilesh V.K.* 10941; Vellapara, 27.11.2014, 1780 m, *Rajilesh V.K.* 11613; Chundel, 28.11.2014, 1460 m, *Rajilesh V.K.* 11643 (MBGH).

Floribundaria M. Fleisch.,

Hedwigia 44: 301. 1905.

Floribundaria walkeri (Renauld & Cardot) Broth., Nat. Pflanzenfam. I (3): 822. 1906. Gangulee, Moss. E. India 2(5). 1306. 1976; Nair *et al*., Bryoph.Wayanad, 157. 2005. *Papillaria walkeri* Renauld & Cardot, Bull. Soc. Roy. Bot. Belgique 34(2): 70. 1896. *Floribundaria emodi* Muell. Hal., Hedwigia 44: 304. 1905. *F. samoana* Broth*.,* Mitt. Inst. Allg. Bot. Hamburg 8: 404. 1931. *F. brevifolia* Dixon, Ann. Bryol. 9: 66. 1937. **(Plate 5. 75)**

Plants pale greenish, caespitose on bark or on soil cutting; stem small, slender, delicate, 2-4 cm long, creeping, rarely branched; branches short, 4-8mm long, irregular. Leaves lax erect spreading, small, 0.6-0.8×0.2-0.22mm, ovate-lanceolate, tip narrow acuminate, margin flat, entire; costa single, faint, less than middle of the leaf; leaf cells narrow, linear, incrassate, multipapillate, 2- 6-papilla in lumen, basal cells rhomboid-linear, 24-28×5-6 µm, middle cells 30-36×3.2-3.5 µm, narrow, rhomboid, linear, tip cells 33-42×4-5.5 µm. Sporophyte not seen.

Habitat: Plants growing on logs, stem and on land cutting.

Distribution:

World: India, China and Philippines.

India: Karnataka (Aruna & Krishnappa, 2014), Kerala (Nair *et al*., 2005, Manju *et al.,* 2008a), Odisha (Mishra *et al.*, 2016), Tamil Nadu (Daniels & Daniel, 2013; Daniels *et al*., 2018).

Kerala: Idukki (Present Collection) Kozhikode (Manju *et al*., 2008a), Wayanad (Nair *et al*., 2005a).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Checkpost, 28.11.2012, 1200 m, *Rajilesh V. K.* 8283; Mannankudi, 29.11.2012, 1600 m, *Rajilesh V.K.* 8904, 8919; Aduvilanthankudi, 13.03.2014, 1600 m, *Rajilesh V.K.* 10938b; Mannakudi, 26.11.2014, 1800 m, *Rajilesh V.K.* 11549; Udumbupara, 24.11.2014, 1600 m, *Rajilesh V.K.* 10972; Thakkalikavala, 25.11.2014, 1600 m, *Rajilesh V.K.* 11507; Njandar, 04.08.2015, 1400 m, *RajileshV.K.* 11680 (MBGH).

Meteoriopsis M. Fleisch. ex Broth.,

Nat. Pflanzenfam. 1(3): 825. 1906.

Meteoriopsis reclinata (Muell. Hal.) M. Fleisch., Nat. Pflanzenfam. I (3): 826. 1906; Gangulee, Moss. E. India 2 (5). 1354. 1976; Nair *et al.,* Bryoph. Wayanad, 159. 2005. *Pilotrichum reclinatum* Muell., Hal. Bot. Zeitung (Berlin) 12: 572. 1854. *Meteorium sinense* Muell., Hal. Nuovo Giorn. Bot. Ital., n.s., 4: 264. 1897. *Meteorium subreclinatum* Muell. Hal.,Bull. Soc. Roy. Bot. Belgique 38(1): 29. 1900. *Meteoriopsis reclinata f*o. *Pilifer* M. Fleisch., Musci Buitenzorg 3: 834. 1907. *M. reclinata* var. *ceylonensis* M. Fleisch., Musci Buitenzorg 3: 834. 1908. *Floribundaria robustula* Broth. & Watts, Proc. Linn. Soc. New South Wales 43: 560. 1918. *Meteoriopsis formosana* Nog., J. Hattori Bot. Lab. 3: 92. f. 40. 1948. **(Plate 5.76)**

Plants yellowish green, glossy, brownish below, (sometimes golden yellowish), dense tuft on log, tree branches; stem creeping, branched; branches pinnate, pendant, 8-22 cm long; leaves dense, squarrose, spreading, 2-2.5×1.2-1.8 mm, ovate-lanceolate, plicate; base sheath, broad, slightly cordate, margin faintly denticulate; tip deflexed, acuminate-acute; costa single, reached just above the mid leaf; cells incrassate, linear, elongate, 1 or 2 papillate in centre of lumen except at base and tip, apical cells 35-52× 4-6 µm, middle cells 40-60×3-4 µm, basal cells 27-32×8-13 µm, rectangular, faintly porose; costa single; sporophyte not seen.

Habitat: Plants hanging from tree branches.

Distribution:

World: Australia, China, India, Indonesia, Japan, Myanmar, Nepal, New Guinea, Sri Lanka and Thailand.

India: Andhra Pradesh (Sandhya Rani *et al*., 2014), Karnataka (Schwarz, 2013**;** Schwarz & Frahm, 2013; Aruna & Krishnappa, 2014)); Kerala (Nair *et al*., 2005a; 2006), Maharashtra (Chaudhary *et al*., 2008), Meghalaya (Gangulee, 1976), Orissa (Mishra *et al*., 2016), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013; Daniels *et al*., 2018).

Kerala: Idukki (Present Collection, Nair *et al*., 2006), Wayanad (Nair *et al.,* 2005a).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Vattapara, 26.11.2014, (1620m), *Rajilesh V.K.* 11636; Mannankudi, 28.11.2012, (1600m), *Rajilesh V.K.* 8274; Karipara, 12.03.2014, (1650m), *Rajilesh V.K.* 9500; Muthupara, 13.03.2014, (1500m), *Rajilesh V.K.* 9489; Thakkalikavala, 25.11.2014, (1600m), *Rajilesh V.K*. 11506b (MBGH).

Trachypodopsis M. Fleisch.,

Hedwigia 45: 64. 1906.

Trachypodopsis serrulata (P. Beauv.) M. Fleisch., Hedwigia 45: 67 1906; Gangulee, Moss. E. India 2 (5). 1234. 1976. *Pilotrichum serrulatum* P. Beauv.,

Prodr. Aetheogam. 83.1805. *Neckera nodicaulis* Muell., Hal. Linnaea 40: 269.1876. *Trachypus nodicaulis* (Muell. Hal.) Besch. Ann. Sci. Nat., Bot., ser. 6, 10: 270. 1880. *T. rutenbergii* Muell. Hal. Abh. Naturwiss. Vereine Bremen 7: 209. 1881. *Papillaria rutenbergii* Muell., Hal. Abh. Naturwiss.Vereine Bremen 7: 209. 1881. **(Plate 5.77)**

Plants yellowish green, robust, caespitose, stem reddish; main stem short, creeping, developing out of rhizomatous base; secondary stem pinnately branched, hanging-ascending,10cm long; leaves dense, erect-spreading, plicate, lanceolate, acuminate, 2.7-3.2×0.52-0.54mm, strongly flexuose, slightly curved, appressed to stem when dry, margin serrulate throughout, base slightly auriculate; costa single, prominent, reached near to the apex; leaf cells incrassate, rhomboid-linear, 24-37×5.5-6.5 μm, smooth at apex; inner cells rhomboid, single papilla at centre of lumen,17-20×5-5.5 μm; basal cells irregular rectangular, porose, smooth, 30-47×5.5-6μm near to costa; group of quadrate-rhomboid to rectangular, 7-14×5-7 μm, smooth cells extreme base near to the margin; alar not distinguished; sporophyte not seen.

Habitat: Plants seen on bark.

Distribution:

World: Burma, India, Indonesia, Philippines, Central and South Africa, Mexico, Sumatra and Thailand.

India: Karnataka (Schwarz & Frahm, 2013; Aruna & Krishnappa, 2014), Meghalaya (Gangulee, 1976), Uttarakhand (Bahuguna *et al*., 2016), West Bengal (Gangulee, 1976).

Kerala: Idukki (Present Collection) Silent Valley NP (Vohra *et al*., 1982; Nair *et al*., 2005).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Sivanpara, 28.11.2012, 1500 m, *Rajilesh V.K.* 8248; Changalakavala,

12.03.2014, 1550 m, *Rajilesh V.K.* 10930, 10933; Vellapara, 27.11.2014, 1780 m, *Rajilesh V.K.* 11607 (MBGH).

Note: The present collection is a new Record to Kerala.

HYPNACEAE Schimp.,

Coroll. Bryol. Eur. 113. 1856.

Plants yellowish green, glossy, slender-moderately robust; main stem creeping, branching regularly to irregularly pinnate; leaves falcate or not, ovate or oblong-lanceolate, acuminate; costa short, double, faint; cells linear, rhomboid, rectangular, smooth or rarely papillose; alar cells poorly differentiated; sporophyte on main stem; seta long, slender, smooth; capsule usually horizontal, ovoid.

Key to the genera

1a. Plants soft; leaf distichous, widely spreading ..... ***Taxiphyllum***

1b. Plants not soft; leaf normal, whorled **2**

2a. Leaf strongly falcate, lanceolate; costa double **3**

2b. Leaf not falcate, ovate, costa faint ..... ***Vesicularia***

3a. Leaf dimorphic, ovate –lanceolate .... ***Foreauella***

3b. Leaf not dimorphic, linear-lanceolate ..... ***Ectropothecium***

Ectropothecium Mitt.,

J. Linn. Soc., Bot. 10: 180. 1868.

Ectropothecium sikkimense (Renauld & Cardot) Renauld & Cardot. Bull. Soc. Roy. Bot. Belgique. 41(1): 109. 1905; Gangulee, Moss. E. India 3(8).1996. 1980. *Cupressina lonchopteris* Muell.Hal. Index Bryol. Suppl. 106. 1900. *C. mussooriensis* Muell. Hal. Bull. Soc. Roy. Bot. Belgique 41(1): 109. 1905. *Ectropothecium mussuriense* Broth. Rec. Bot. Surv. India. 13(1): 128. 1931. *Hypnum darjeelingense* Ando. Hikobia. 6: 41. 1971. **(Plate 5.78)**

Plants yellowish green, silky, tufted on stem; stem rigid, erect, pinnately branched; leaves appressed to stem when dry, strongly falcate, linear-lanceolate, 2-2.4×0.6-0.7 mm, plicate, tip gradually narrowed into a long acumen, margin denticulate at apex; costa short, double; leaf cells linear rhomboid, 35-70×4-5 μm; alar slightly differentiated into irregular rectangular cells; sporophyte on main stem; seta slender, erect, brownish, 3 cm long, curved ait tip; capsule horizontal, oblong-ovate cylindrical, small, brownish; peristome normal.

Habitat: Plants seen on stem.

Distribution:

World: Bhutan and India.

India: Himachal Pradesh (Alam, 2013), Jammu & Kashmir (Alam, 2013), Kerala (Nair & Madhusoodanan, 2003; Manju *et al*., 2009), Uttarakhand (Alam, 2013).

Kerala: Idukki (Present Collection), Thiruvananthapuram, Agasthyamala (Manju *et al*., 2009), Wayanad (Nair & Madhusoodanan, 2003).

Specimen examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Sivanpara, 28.11.2012, (1450m), *Rajilesh V. K.* 8251 (MBGH).

Foreauella Dixon & P. de la Varde,

Arch.Bot.Bull.Mens. 1:175. 1927.

Foreauella orthothecia (Schwagr.) Dixon & P. de la Varde, J. Bot. 75: 129. 1937; Gangulee, Moss. E. India 3(8). 1886. 1980; Nair *et al*., Bryoph.Wayanad, 188.2005. *Hypnum orthothecium* Schwagr., Sp. Musc. Frond., Suppl. 3 1(1): 220 b. 1827. *Leskea secunda* Harv., Icon. Pl. 1: pl. 23: f. 1. 1836. *Foreauella indica* Dixon & P. de la Varde, Arch. Bot. Bull. Mens. 1 (8–9): 175. 9. 1927. *Hypnum curvatirameum* Hampe, Rev. Bryol., n.s. 2: 24. 1929. (**Plate 5. 79)**

Plants yellowish-brown to greenish, golden silky when dry; caespitose on bark; main stem prostrate, densely branched; branches pinnate, short; leaves

dimorphic, falcate, leaves appressed to stem, stem leaves 1-1.2×0.3-0.33 mm, broad- triangular, acuminate, obovate base, faintly denticulate at margin; costa double, short; branch leaves 1.15-1.3×0.44-0.47mm, erect spreading, ovate-lanceolate, acuminate, slightly plicate, concave, apiculate at tip, margin slightly denticulate; costa double, short, below the mid leaf; leaf cells irregularly rhomboid 25-28×6-8 μm at base, 55-65×3-5 μm at middle and tip; alar not much differentiated, cells rectangular, 20-22 × 12-16 μm, hyaline; sporophyte not seen.

Habitat: Plants seen on bark.

Distribution:

World: India, Nepal, Philippines and Thailand.

India: Kerala (Nair *et al.,* 2005a; Manju *et al*., 2009a, 2009b), Odisha (Gangulee, 1980; Mishra *et al*., 2016), Tamil Nadu (Daniels, 2010), West Bengal (Gangulee, 1980).

Kerala: Idukki (Present Collection), Kannur (Manju *et al*., 2009b), Thiruvananthapuram (Manju *et al*., 2009a), Wayanad (Nair *et al.,* 2005a).

Specimen examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Checkpost, 11.03.2014, 1200 m, *Rajilesh V.K*. 9469 (MBGH).

Taxiphyllum maniae (Renauld & Paris) M. Fleisch. Musci. Buitenzorg 4:1435, 1436.1923; Gangulee, Moss. E. India 3 (8). 1947. 1980. *Isopterygium maniae* Renauld & Paris, Rev. Bryol. 29: 84. 1902. *Isopterygium taxirameoides* Muell. Hall. Rev. Bryol. 34: 55. 1907. **(Plate 5. 80)**

Plants yellowish green, glossy, soft, low tuft, mat form on stem bark, medium plants, 1-1.3 cm long, main stem creeping, branched, branching rare, irregular, thin, complanate; leaves widely spreading, distichous, ovate-lanceolate, concave, 1-1.2× 0.5 -0.6mm, short acuminate to acute apex, margin dentate; costa short, double, faint; leaf cells narrow, rhomboid, 30- 35×7-8 μm at tip; linear-elongated to rhomboid, 50- 60× 6-7 μm at middle; basal cells irregular rectangular, quadrate towards margin.

Habitat: Plants seen on bark.

Distribution:

World: India, Java, Madagascar, Nepal and New Guinea

India: Himachal Pradesh (Alam, 2013), Jammu & Kashmir (Alam, 2013; Sharma *et al*., 2016), Kerala (Mufeed *et al*., 2014), Uttarakhand (Alam, 2013)

Kerala: Idukki (Present Collection) Kozhikode, Thusharagiri (Mufeed *et al*., 2014)

Specimen examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Checkpost, 11.03.2014, 1200 m, *Rajilesh V.K.* 9469 (MBGH).

Vesicularia (Muell. Hal.) C.Muell.,

Hal. Bot.Jahrb.Syst.23(3): 330. 1896.

Vesicularia montagnei (Schimp.) Broth., Nat. Pflanzenfam. I(3): 1094. 1908; Gangulee, Moss. E. India 3(8). 2001. 1980. *Pterygophyllum montagnei* Bel., Voy. Indes Or., Bot. 2(Crypt.): 85. 1834. *Hookeria meyeniana* Hampe, Icon. Musc. 3. 1844. *Acosta meyeniana* (Hampe) Muell., Hal. Linnaea 21: 194 1848. **(Plate 5.81)**

Plants yellowish green, glossy; forming mat on log, stem prostrate; main stem irregularly branched, secondary branches pinnate, short, complanate; leaves erectopatent, deflexed at tip when dry, ovate, apex sharply abruptly acuminate, slightly concave, faintly denticulate at top, 1.2-1.4×0.4-0.6 mm; costa double, short, faint; leaf cells rhomboid-hexagonal, basel cells 53-82×14-17 μm, middle and tip cells hexagonal, 52-56×24-29 μm; alar not differentiated; sporophytes on main branches; seta brownish, slender, long, 2 cm, erect; capsule brownish, ovate-cylindrical, 1.2-1.4 mm long, 0.55 mm in. diameter; peristome teeth normal.

Habitat: Plants seen on logs.

Distribution:

World: Australia, Bangladesh, Borneo, China, India, Philippines, Sri Lanka, Thailand and Vietnam.

India: Kerala (Mufeed *et al*., 2014), Madhya Pradesh (Nath *et al*., 2012; Gupta *et al.,* 2013), Maharashtra (Magdum *et al*., 2017), Manipur (Govndapyari, 2014) West Bengal (Gangulee, 1980; Rawat *et al.,* 2016).

Kerala: Idukki (Present Collection), Kozhikode (Mufeed *et al*., 2014)

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Muthupara, 11.03.2014, (1450m), *Rajilesh V.K.* 9469; Changalakavala, 12.03.2014, (1550m), *Rajilesh V.K.* 10923; Aaduvilanthankudi, 13.03.2014, (1600m), *Rajilesh V.K.* 10937(MBGH).

HYLOCOMIACEAE M. Fleisch.,

Nova Guinea 12(2): 125. 1914.

Plants brownish green, glossy, tufted on stem bark; main stem creeping, pinnately branched; secondary branches erect; leaves spreading, imbricate, oblong-lanceolate, slightly concave, acute at apex, margin dentate, prominent near to tip; costa distinct, double; cells linear-rhomboid, incrassate; alar cells quadrate to irregularly rectangular.

Ctenidium (Schimp.) Mitt.,

J. Linn. Soc. Bot.12: 509. 1869.

Ctenidium lychnites (Mitt.) Broth. Nat. Pflanzenfam. I (3): 1048 1909; Gangulee, Moss. E. India 3(8). 2013. 1980; Nair *et al*., Bryoph. Wayanad, W.G., 190. 2005. *Stereodon lychnites* Mitt., J. Proc. Linn. Soc., Bot., Suppl. 1(2): 114. 1859. **(Plate 5. 82)**

Plants yellowish green, glossy, dense mat on log or bark of the trees; main stem creeping, pinnately branched; secondary branches short, slightly erect; leaves dense, erectopatent; stem leaves large, 1.2.-1.4×0.6-0.7 mm, ovate-triangular,

narrowly acuminate tip, base cordate, auriculate, margin denticulate throughout; costa double, faint, short, one fourth of leaf length; branch leaf spreading, narrow, 1-1.2×0.3-0.35 mm, ovate to lanceolate, slightly auriculate base, margin minutely toothed; costa double, very faint, short; leaf cells elongated rhomboid, 22-38×5-6 µm at tip, 45-55×4-5 µm at middle, 25-30×6-7 µm at base; alar cells hyaline, quadrate-rectangular, 20-23×13-14 µm; sporophyte unknown.

Habitat: Plants seen as thick mat on logs and bark of trees.

Distribution:

World: India, Philippines and Sri Lanka

India: Kerala (Nair *et al.,* 2005a; Manju *et al*., 2009), Tamil Nadu (Verma *et al.,* 2011; Thamizharasi *et al*., 2018).

Kerala: Idukki (Present Collection), Wayanad (Nair *et al.,* 2005a) Thiruvananthapuram, Agasthyamala BR (Manju *et al*., 2009)

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Checkpost, 28.11.2012, 1200 m, *Rajilesh V.K.* 8260; Mannankudi, 29.11.2012, 1800 m, *Rajilesh V.K.* 8287; Aaduvilanthankudi, 13.03.2013, 1600 m, *Rajilesh V.K.* 10936, 10939; Changalakavala, 12.03.2014, 1550m, *Rajilesh V.K.* 10931; Mannankudi, 26.11.2014, 1600 m, *Rajilesh V.K.* 11566b Vellapara, 27.11.2014, 1780 m, *Rajilesh V.K.* 11586b (MBGH).

Leptohymenium Schwagr.,

Sp. Musc. Frond., Suppl. (1,2): sub pl. 246, f. c. 1828.

Leptohymenium tenue (Hook.) Schwagr., Sp. Musc. Frond., Suppl. 3 1(2): pl. 246c 1828; Gangulee, Moss. E. India 3(8). 2035. 1980; *Neckera tenuis* Hook., Trans. Linn. Soc. London, 9: 315. 27 f. 3. 1808. *Hypnum ehrenbergianum* Muell., Hal.Bot. Zeitung (Berlin) 14: 458. 1856. *Leptohymenium patulum* Schimp. ex Besch., Mem.

Soc. Sci. Nat. Cherbourg 16:246. 1872. *Leptohymenium ehrenbergianum* (Muell. Hal.) M. Fleisch. & Ther., Smithsonian Misc. Collect. 85(4): 44. 1931. **(Plate 5.83)**

Plants brownish green, glossy, tufted on stem bark; main stem creeping, pinnately branched; secondary branches erect; leaves spreading, appressed to stem, imbricate, oblong-lanceolate, 1.4-1.5×0.35-0.5 mm, slightly concave, acute at apex, margin dentate, prominent near to tip; costa distinct, double, below the mid leaf; basal cells linear-rhomboid, incrassate, 48-55×6-7 µm near to costa, middle cells 40-47×3-5 µm, tip cells 22-28×6-7 µm; alar cells quadrate to irregularly rectangular, 15-18×9-12 µm; sporophyte not seen.

Habitat: Plants seen on stem bark.

Distribution:

World: Burma, India, Mexico and Thailand.

India: Kerala (Manju *et al*., 2008b), Meghalaya (Gangulee, 1980).

Kerala: Idukki (Present Collection).

Specimen examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Vellapara, 27.11.2014, (1780m), *Rajilesh V.K*. 11586 (MBGH).

ENTODONTACEAE Kindb.,

Gen.Eur.N. Amer. Bryin.7.1897.

Plants pale yellow-yellowish green, glossy, delicate to robust; stem prostrate, complanate to foliate, pinnately branched; leaves oblong, ovate-oblong lanceolate, concave; margin slightly dentate above and crenulate below; costa double, short or faint; branch leaves similar to stem leaves but smaller; sporophyte on main stem; seta long, smooth, yellowish to reddish; capsule erect, cylindrical to urn shaped.

Entodon Muell. Hal.,

Linnaea 18(6)704.1844.

Plants pale yellow-yellowish green, glossy, forming mat on log or rocks, delicate to robust; stem prostrate, complanate to foliate, pinnately branched; branches, simple; stem leaves oblong ovate-oblong lanceolate, concave; margin slightly dentate above and crenulate below; costa double, short or faint; leaf cells narrow elongate to rhomboid linear, alar cells numerous, quadrate or rectangular extending up to costa or not; branch leaves similar to stem leaves but smaller; sporophyte on main stem; seta long, smooth, yellowish to reddish; capsule erect, cylindrical to urn shaped.

Key to the species:-

1a. Stem 2-3cm long, seta reddish, capsule urn shaped … ..... ***E. ovicarpus***

1b. Stem more than 3cm long, seta yellowish, capsule cylindrical-elliptical 2

2a. Plants delicate, exostome teeth 0.3 mm long … ..... ***E. plicatus***

2b. Plants robust, exostome teeth more than 0.3 mm long …..... 3

3a. Stem leaves oblong-ovate, endostome segments long ciliate ..... ***E. macropodus***

3b. Stem leaves oblong-lanceolate, endostome segments not ciliate 4

4a. Endostome segments inserted to exostome .... ***E. nepalensis***

4b. Endostome segments free 5

5a. Stem leaves 1.6-1.8×0.8-1 mm,aar cells 8-10cells high at leaf margin,10-12 cells wide at leaf base extending to costa …..... ***E. chloropus***

5b. Stem leaves 2-2.2×0.7-0.9 mm, alar cells 6-9 cells high at leaf margin, 6-8 cells wide at leaf base nearly extending to costa ... . ***E. scariosus***

Entodon chloropus Ren. & Card., Bull. Soc .R. Belg., 38 (1):34. 1990; Gangulee, Moss. E. India 3(8):1787.1980. **(Plate 5.84)**

Plants yellowish green, glossy, mat form on soil cutting and stem; stem prostrate, 3-4 cm long, complanate foliate, pinnately branched, simple, 1-1.5 cm

long; stem leaves oblong, lanceolate, 1.6-1.8×0.8-1.0 mm, constricted at base, acute, concave, margins denticulate at apex; costa short, double very faint; leaf cells narrow, elongate linear, 90-125×6-7 µm at middle, 40-70×6-7 µm at tip; alar cells lax quadrate, 28-32×12-13 µm, 8-10 cells high at leaf margin, 10-12 cells wide at leaf base, nearly extending to costa; branch leaves similar to stem leaves but a little narrower, 1.6-1.8×0.65-0.7 µm; sporophyte on main stems; perichaetial leaves oblong, lanceolate, 3.3 mm long; seta erect, straw coloured, 1.5-2.5mm long, smooth; capsule erect, cylindrical, brown 3 mm long, 0.7 mm in diameter; annulus none; operculum conic-rostrate; peristome double,exostome teeth linear-lanceolate, 0.35-0.4 mm long, reddish brown; endostome segments linear, shorter than teeth, free, spore numerous, 12-14 µm, papillose.

Habitat: On land cuttings.

Distribution:

World: China, India and Nepal.

India: Karnataka (Schwarz, 2013; Schwarz & Frahm, 2013), Kerala (Rajesh & Manju, 2014), Manipur (Govndapyari, 2014), Tamil Nadu (Daniels, 2010), Uttarakhand (Bahuguna *et al*., 2012; Bargali *et al.*, 2014), West Bengal (Gangulee, 1980).

Kerala: Idukki (Present collection).

Specimen/s examined: India, Kerala, Idukki District., Mathikettan Shola National Park, Shivapara, 28.11.2012, 1550m, *Rajilesh V.K.* 8201b; Vattapara, 07.04.2013, 1650m, *Rajilesh V.K.* 8991; Karipara, 12.03.2014, 1660m, *Rajilesh V. K.* 10917 (MBGH).

Note: Rajesh and Manju (2014) recorded this species as new distributional record to Kerala State.

Entodon macropodus (Hedw.) Muell., Hal. Lannaea 18: 707. 1845; Gangulee, Moss. E. India 3(8). 1789. 1980. *Neckera macropoda* Hedw., Sp. Musc. Frond., 207. 1801. *Cylindrothecium drummondii* Sull, in.Gray, Manual (ed.2) 664.1856.

Stereodon angustifolius Mitt., J.Proc. Linn. Soc. Bot. Suppl.1:106.1859. *Entodon angustifolius* (Mitt.) A.Jaeger, Ber.Thatigk. St. Gattischonn Naturwiss Ges. 1876-77:287.1879. *Entodon drummondii* (Sull.) A.Jaeger, Ber. Thatigk. St. Gallischen Naturwiss. Ges. 1876-77:282.1878. *Entodon delavayi* Besch., Ann.Sci. Nat. Bot., Ser.7, 15:87.1892. *Taxiphyllum yasudae* Broth. Ann. Bryol. 1: 25. 1928. *Entodon excavates* Broth., Symb. Sin.4:114. 1929. *Glossadelphus doii* Sakurai, Bot. Mag. (Tokyo) 49:143.1935. *G. yasudae* Dixon & Sakurai, Bot. Mag. (Tokyo) 52: 135. 1938. **(Plate 5.85)**

Plants pale yellowish green, glossy, firmly attached to bark of trees, robust; stem prostrate 3-6 cm long, attenuate, irregularly pinnately branched; branches simple, short 0.7-1 cm long; leaves dense, complanate, imbricate, oblong-ovate 1.8-2.0×6-0.8 mm, concave, acute apex; costa short bifurcate, faint; leaf cells slightly elliptical to linear, 35-40×4-7 µm at tip, linear elongate, 80-105×4-5 µm at middle; alar quadrate-rectangular, chlorophyllose, 25-30×17-25 µm, 6-8 cells high at leaf margin, 6-7 cells wide at leaf base, not reached to costa; branch leaves similar to stem leaves but little shorter; sporophyte on main stem; perichaetial leaves ovate-oblong, long-acuminate, 3 mm long; seta yellowish-green, 1-2 cm long, smooth; capsules erect, cylindrical, brown 3-4×0.5-0.7 mm; annulus none; operculam conic, peristome double, exostome teeth linear, lanceolate, 4-4.2 mm long, yellowish brown, endostome segments long, ciliate; spore numerous, 10-15 µm diameter, papillose.

Habitat: On bark.

Distribution:

World: China, India, Japan, Myanmar, Nepal, South and North America and Vietnam.

India: Kerala (Manju *et al*., 2008), Tamil Nadu (Daniels *et al*., 2018)

Kerala: Idukki (Rajeevan, 1990 & Present collection).

Specimen/s examined: Mathikettan shola National park,; Chundel, 09.04.2013, 1200 m, *Rajilesh V. K.* 8999, 9430; Vattapara, 07.04.2013, 1650 m, *Rajilesh V.K.* 8977; Thakkalikavala, 25.11.2014, 1600 m, *Rajilesh V.K.* 11521; Chundel, 28.11.2014, 1460 m, *Rajilesh V. K.* 11645 (MBGH).

Entodon nepalensis Mizush., Fl.E. Himalaya 1:584.1966. F.42: 1966; Gangulee, Moss. E. India 3(8):1773.1980. **(Plate 5.86)**

Plants yellowish green, glossy, forming dense mat form on bark, robust; stem prostrate, 4-5 cm long, sub-pinnately branched; branches with several branch lets, 1.5 cm long; stem leaves broad, oblong, 1.7-1.9×0.6-0.8 mm, concave, apex acute, margin faintly dentate at tip; costa double, short, faint; leaf cells linear, 65-75×8-12 µm at middle, 21-27×3-5µm at tip; alar bulging, cells quadrate,17-39×12-15µm, 10-12 cells high at leaf margin, not extending to costa; branch leaves similar to stem leaves, but smaller, 1.3-1.5×0.4-0.5 mm; sporophyte on main stem; perichaetial leaves ovate-lanceolate, short acuminate, 2-3×0.7-8 mm; seta 1.4-1.7 cm long, yellowish brown, smooth; capsule erect, cylindrical, brown, 2-2.5×0.6-0.7 mm; annulus 2-3 cells high; operculum conic oblique, rostrate; peristome double, exostome teeth linear-lanceolate, 0.45 mm long, papillose, lamella thickened, reddish brown, endostome smooth, narrow; spores large, globose, 40-48 µm in diameter, papillose.

Habitat: On bark of trees.

Distribution:

World: China, India and Nepal.

India: Kerala (Rajilesh & Prakashkumar, 2017), Rajasthan (Alam *et al*., 2012)

Kerala: Idukki (Rajilesh & Prakashkumar, 2017).

Specimen/s examined: India, Kerala, Idukki district, Mathikettan shola National Park, Karipara, 12.03.2014, 1660 m, *RajileshV.K.* 10919; Vellapara, 27.11.2014, 1780 m, *Rajilesh V.K.*11600; Chundel, 28.11.2014, 1430 m, *Rajilesh V.K.* 11647 b (MBGH).

Note: Rajilesh & Prakashkumar (2017) recorded this species as new distributional record to Peninsular India.

Entodon ovicarpus Dix., in J. Bombay. Nat. Hist. Soc., 39:789.1937; Gangulee, Moss. E. India 3(8):1769.1980. **(Plate 5.87)**

Plants yellowish green, glossy, forming tufted on bark and logs; stem prostrate, 2-3 cm long, irregularly pinnately branched; branches short, erect, 4-7 mm long; stem and branch leaves similar; leaves dense, oblong-lanceolate, 1.2-1.5×0.35-0.4 mm, apex acute, margin very finely denticulate at tip, slightly crenulated at base; costa double, short; leaf cells narrow-elongate, slightly elliptical, 45-65×5-7 µm at top, linear– elongate, 60-90×4-6 µm at middle; alar cells quadrate to rectangular, 20-25×10-12 µm, 5-6 cells high at leaf margin, 3-5 cells wide at leaf base, well below to costa; sporophyte on main branches, perichaetial leaves erect spreading, oblong-lanceolate, long acuminate, 1.7-1.9×0.4-0.45 mm; seta reddish, smooth, 2.2 cm long; capsule short, inclined, ovate, urn shaped, 1-1.2 long, 0.8-1 mm in diameter; operculum caducous; peristome double, exostome teeth linear, lanceolate, 0.32-0.35 mm long, papillose, yellowish brown; entostome short, vestigial segments.

Habitat: On bark and logs.

Distribution: India

India: Gujarat (Chaudhary *et al*., 2006), Kerala (Daniels and Kariyappa, 2011), Maharashtra (Chaudhary *et al*., 2008; Magdum *et al*., 2017).

Kerala: Idukki (Present collection), Thiruvananthapuram, Agasthyamala (Daniels and Kariyappa, 2011).

Specimen/s examined: Mathikettan shola National park, Mannankudi, 26.11.2014, 1800 m, *Rajilesh V.K.* 11550a; Vellapara, 1780 m, 23.12.2015, 11697 *Rajilesh V.K.* (MBGH).

Notes: This species is endemic to India.

Entodon plicatus Muell. Hal., Linnaea 18: 706. 1844; Gangulee, Moss. E. India 3: 1791. 1980. Nair *et al*., Bryoph. Wayanad, Western Ghats 185. 2005. *Entodon pallidus* Mitt., Fl. Vit., 398. 1873. *Entodon solanderi* (Angstrom) A. Jaeger Ber., Thatigk. St. Gallischen Naturwiss. Ges. 1876–77: 292. 1878. *E. tasmanicus* Mitt., Trans. & Proc. Roy. Soc. Victoria, 19: 85. 1882. *E. aneitensis* Mitt., Proc. Linn. Soc. New South Wales 7: 102. 1882. *E. flaccidisetus* Muell. Hal., Enum. Bryin. Exot., Suppl., 2, 98. *E. armittii* Muell. Hal. Oefvers. Forh. Finska Vetensk.-Soc. 37: 169. 1895. *E. hillebrandii* Muell. Hal. Flora 82: 461. 1896. *E. longidens* Broth., Oefvers. Forh. Finska Vetensk. Soc. 47(14): 8. 1905. *E. terrae-reginae* Dixon, Proc. Roy. Soc. Queensland, 53(2): 36. 1941. *E. plicatiformis* Dixon, Notes Roy. Bot. Gard. Edinburgh 20: 100 1948. **(Plate 5. 88)**

Plants yellowish green, glossy, mat form on log, robust; stem prostrate, 3-4 cm long, complanate foliate; branches 1-1.5 cm long, irregularly pinnately branched; stem leaves erectopatent, oblong-ovate, 1.7-2 x 0.6-0.8 mm, concave, apex acute, margin slightly denticulate above, constricted at base; costa short double; leaf cells linear, elongate, 100-115 x 5-5.5 µm at middle; leaf cells short, rhomboid-linear, 30-33 x 6-8 µm at tip; alar cells quadrate- rectangular, 6-7 cells high at leaf margin, 8-10 wide at leaf base; branch leaves oblong, lanceolate, 1.5-1.7 x 0.5-0.7 mm; sporophyte on main stem, erect; perichaetial leaves oblong-lanceolate, 3 mm long; seta yellowish, 1.5-2.2 cm long, smooth; capsule erect cylindrical, brownish, 3.5-4 x 0.6-0.8 mm, annulus none;operculum rostrate, cup shaped; peristome double, 16 in number, exostome teeth linear-lanceolate, 0.3 mm long, reddish brown, endostome segments linear, ciliate, shorter than teeth; spore numerous, 12-14 µm, papillose.

Habitat: Mat form on logs.

Distribution:

World: Australia, Bhutan, Burma, China, Nepal, Philippines, Sri Lanka and Thailand.

India: Himachal Pradesh (Alam, 2013), Jammu & Kashmir (Alam, 2013), Karnataka (Schwarz, 2013; Aruna & Krishnappa, 2014)), Kerala (Easa, 2003; Nair

et al., 2005a), Maharashtra (Chaudhary *et al*., 2008; Magdum *et al*., 2017), Odisha (Gangulee, 1980; Mishra *et al*., 2016)), Rajasthan (Alam *et al*., 2014), Tamil Nadu (Daniels *et al*., 2018), Uttarakhand (Alam,2013)

Kerala: Idukki (Present Collection), Palakkad (Vohra et al., 1982), Wayanad (Nair *et al*., 2005).

Specimen/s examined*:* Mathikettan shola National park, Shivapara, 28.11.2012, 1550 m, *Rajilesh V. K.* 8234; Mannankudi, 29.11.2012 (1800m), *Rajilesh V.K.* 8294; Thakkalikavala, 25.11.2014 (1500m), *Rajilesh V.K.* 11521, (MBGH).

Entodon scariosus Renauld & Cardot, Bull. Soc. Roy. Bot. Belg. 34 (2): 75.1896; Gangulee, Moss. E. India 3(8) : 1789. 1980. **(Plate 5. 89)**

Plants pale yellowish, glossy, on log and rocks, robust; stem prostrate, 4-5 cm long, complanate to foliate, pinnately branched; branches, simple, short, 0.7 to 1.0 cm long; stem leaves ovate- lanceolate, 0.2 - 2.2 x 0.7-0.9 mm, concave, apex acute; margin slightly dentate above and crenulate below, constricted at base; costa double, short, faintly distinct; leaf cells narrow elongate to linear, 95-135 µm x 4-7 µm at middle, 45-90 µm x 5-7 µm at tip; alar cells numerous, quadrate, 6-9 cells high at leaf margin, 6-8 cells wide at leaf base, extending up to costa; branch leaves similar to stem leaves but smaller, 1.6-1.8 x 0.5-0.65 mm; sporophytes on main stem; perichaetial leaves shortly oblong, long apiculate, 22 mm long; seta pale yellowish, smooth 1.8 - 2 cm long; capsule erect, cylindrical, 3-4 x0.5–0.6 mm; annulus none; operculum short-rostrate; spores not seen.

Habitat: On logs and rocks in high altitude.

Distribution:

World: China and India.

India: Kerala (Daniels *et al*., 2011); Madhya Pradesh (Nath *et al*., 2007)**,** Nagaland (Bansal *et al*., 2011).

Kerala: Idukki (present collection), Thiruvananthapuram (Daniels *et al.*, 2011)

***Specimen/s examined**:* Kerala, Idukki district, Mathikettan Shola National Park, Vattapara, 07.04.2013, (1600m), *Rajilesh V.K.* 8956; Aaduvilanthankudi, 13.03.2014, (1600m), *Rajilesh V.K.* 10953; Checkpost, 28.11.2012, (1200m), *Rajilesh V.K.* 8242; Chundel, 08.04.2013, (1450m), *Rajilesh V.K.* 9415 (MBGH).

PYLAISIADELPHACEAE Goffinet & W. R. Buck,

Monogr. Syst. Bot.Missouri Bot.Gard. 98:238.2004.

Plants yellowish-green, glossy, tuted on substratum; main stem creeping, pinnately branched; branches erect, short; leaves short or medium, ovate-oblong or lanceolate; leaves tip deflexed or not; margin smooth or serrate at tip only; costa absent, if present double faint; leaf cells quadrangular- linear; sporophyte on main stem;capsule horizontal, curved or arcuate.

Key to the genus

1a. Leaf tip deflexed, margin smooth ..... ***Wijkia***

1b. leaf tip not deflexed, margin serrated at tip .... ***Isopterygium***

Isopterygium Mitt.,

J. Linn. Soc., Bot.12: 21, 497–500. 1869.

Plants yellowish green, glossy; main stem creeping, pinnately branched; branches short; leaves spreading, erect, short, ovate or ovate-oblong, concave, short acuminate at apex, magin entire, minutely toothed at apex, costa short, double, very faint or ecostate; cells linear or narrow elongated, smooth, apical and median cells, basal cells irregular or quadrate-rectangular; sporophyte on main stem; seta brownish or yellowish green, erect, slender; capsule brownish, horizontal to drooping or curved, ovate-cylindrical.

Key to the species

1a. Leaf oblong-ovate; costa short and faint, double ..... ***I. serrulatum***

1b. Leaf ovate; costa absent ..... ***I. albescens***

Isopterygium albescens (Hook.) A. Jaeger, Ber. Thatigk. St. Gallischen Naturwiss. Ges. 1876–77: 433. 1878; Gangulee, Moss. E. India 3(8). 1960. 1980; Nair *et al*., Bryoph. Wayanad, 193.2005. *Hypnum albescens* Hook., Sp. Musc. Frond., Suppl. 3, 1(2): 226b. 1828. *H. molliculum* Sull., Proc. Amer. Acad. Arts 3: 78. 1854. *Isopterygium anderssonii* (Angstrom) A. Jaeger, Ber. Thatigk. St. Gallischen Naturwiss. Ges. 1876–77: 433. (Gen. Sp. Musc. 2: 499) 1878. *Aptychus molliculus* (Sull.) Muell. Hal. Flora 82: 471 1896. *Isopterygium argyrocladum* Besch.Bull. Soc. Bot. France 45: 123. 1898. *I. hawaicum* (Muell. Hal.) Paris, Index Bryol. Suppl., 219. 1900. *Ectropothecium coppeyanum* Ther., Bull. Acad. Int. Geogr. Bot. 19: 23. 1909. *Isopterygium pilicuspis* Broth., Ofvers. Finska Vetensk.-Soc. Forh., 53A(11): 36. 1911. *Ectropothecium planuloides* Sakurai, Bot. Mag. (Tokyo), 46: 749. 1932. *E. dealbatum* fo. *albissimum* Sakurai, Bot. Mag. (Tokyo), 47: 344. 1933. **(Plate 5.90)**

Plants yellowish green, firmly attached on logs as thick mat, glossy; main stem creeping, pinnately branched; branches short, 5-6 mm long; leaves spreading, erect, short, 0.6-0.68×0.28-0.3mm, ovate, concave, short acuminate at apex, magin entire, minutely toothed at apex, ecostate; cells linear, smooth, apical cells 32-42×3-5 µm, median cells 38-55×3-4 µm, basel cells 42-52×5-6µm, extreme basal cells 25-30×12-15 µm, quadrate-rectangular; sporophyte on main stem; seta brownish, erect, slender, 1.8-2.2 cm long; capsule brownish, horizontal to drooping, ovate-cylindrical, slightly curved at base, 1.1-1.3 mm long, 0.55 mm in. diameter, peristome double, normal.

Habitat: Plants firmly attached on logs as a mat form.

Distribution:

World: India, Indonesia, Japan, Myanmar, New Zealand, Philippines, Singapore, SriLanka, Sumatra, Thailand and Vietnam,

India: Karnataka (Aruna & Krishnappa, 2014), Kerala (Nair *et al*., 2005a), Manipur (Govndapyari, 2014), Tamil Nadu (Daniels, 2010; Daniels & Daniel, 2013; Daniels *et al*., 2018), Uttarakhand (Bahuguna *et al*., 2016).

Kerala: Idukki (Present Collection), Kozhikode (Rajesh & Manju, 2014), Tvm (Manju *et al*., 2009a), Wayanad (Nair *et al*., 2005a)

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Company estate, 30.11.2012, 1650 m, *Rajilesh V.K.* 8947; Shivanpara, 26.11.2014, 1200 m, *Rajilesh V.K.* 11577 (MBGH).

Isopterygium serrulatum M. Fleisch., Musci Buitenzorg 4: 1433 1923; Gangulee, Moss. E. India 3(8). 1951. 1980. **(Plate 5.91)**

Plants yellowish green, glossy; main stem creeping, irregularly branched; branches complanate, short; leaves spreading, concave, oblong-ovate to lanceolate, 1.4-1.5×0.32-0.52 mm, apex acute, margin minutely dentate at apex; costa short, double, very faint; leaf cells narrow elongated, 35-45×6.2-7.7 µm at tip, 93-98×4.5-5.5 µm at middle, irregular rectangular, 45-52×12-15 µm at base; sporophyte on main stem near the branches; seta slender, yellowish green, erect, 2-2.2 cm long; capsule horizontal, curved, ovate-cylindrical, 2-2.5 mm long, 0.68 mm in diameter; peristome double; exostome teeth brownish yellow, 1.7 mm length, 0.2 mm wide at base; endostome narrow, hairy; spores small, 12 µm, yellowish.

Habitat: Plants seen on rocks.

Distribution:

World: India.

India: Kerala (Manju *et al*., 2008b), Tamil Nadu (Alam *et al*., 2011).

Kerala: Idukki (Present Collection), Kerala (Manju *et al*., 2008b).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Check post, 28.11.2012, 1200m, *Rajilesh V.K.* 8275; Mannankudi, 29.11.2012, 1700m, Rajilesh *V.K.* 8908 (MBGH).

Wijkia deflexifolia (Ren. & Card.) Crum in Bryologist, 74: 171, 1971; Gangulee, Moss. E. India, 3(8):1860, 1980; *Acanthocladium deflexifolium* Ren. & Card.in Bull. Soc. R. Bot. Belg., 41(1):92, 1905. *Acanthocladium benguetense* Broth., Philipp. J. Sci., 31: 294. 1926. *Brotherella subintegra* Broth., Ann. Bryol., 1: 24. 1928. **(Plate 5.92)**

Plants yellowish green, glossy, dense tufted on bark; main stem creeping, 1.5-2cm long, pinnately branched, branches erect, 0. 8-1.2 cm long; leaves dense, erectopatent, ovate–lanceolate, deflexed tip narrow acuminate at apex, margin smooth; ecostate; leaf cells linear- rhomboid, 25- 32× 4-6µm at apex, middle cells narrow, linear-rhomboid, 65-90× 4-5µm; alar cells differentiated to large one row of cells, quadrangular, yellowish brown, 60-70× 25 -33µm; sporophyte on main branches; seta reddish brown, slender, 1.6-2 mm long; capsule horizontal, arcuate, cylindrical;opeculam conic-rostrate; peristome double, normal.

Habitat: Plants seen on bark.

Distribution:

World: Bhutan and India.

India: Kerala (Present Collection), Tamil Nadu (Palani *et al*., 2017)

Kerala: Idukki (Present Collection).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, 25.11.2014, (1600m), *Rajilesh V.K.* 10994 (MBGH).

Note: This plant is endemic to Bhutan and India, is new record to Kerala .

SEMATOPHYLLACEAE Broth.,

Nat. Pflanzenfam. 1(3): 706. 1905.

Plants yellowish green to brownish green, glossy, slender to robust; stem prostrate or erect, irregularly or pinnately branched; leaves ovate-acuminate, concave or not; costa double, short or absent; cells linear, smooth or rarely papillose; alar cells large, differentiated, coloured or hyaline; sporophyte on main stem; seta smooth, long; capsule horizontal or inclined.

Key to the genera

1a. Plants very small delicate; leaves less than 1 mm; alar not inflated..... ..... ***Sematophyllum***

1b. Plants large; leaves more than 1.5 mm long .. **2**

2a. Leaves oblong –ovate; costa hyaline ..... ***Meiothecium***

2b. Leaves ovate –lanceolate; costa coloured **3**

3a. Leaves dense, margin smooth; alar clerarly inflated .. .. ***Acroporium***

3b. Leaves lax, margin serrated; alar not inflated..... ..... ***Chionostomum***

Acroporium Mitt.,

J.Linn. Soc., Bot.10: 182–184. 1868.

Acroporium baviense (Besch.) Broth., Nat. Pflanzenfam. (ed.2) 11: 437 1925; Gangulee, Moss. E. India 3(8). 1876. 1980. *Sematophyllum baviense* Besch., J. Bot. (Morot) 4: 205. 1890. *S. brevipes* Broth., Philipp. J. Sci., 8: 95. 1913. **(Plate 5. 93)**

Plants pale green, glossy, stem brownish, plant silky when dry; main stem creeping, firmly attached on log; branches pinnate, short; leaves dense, whorled, erectopatent, slightly imbricate, concave, 1.55-1.65×0.42-0.5 mm, ovate-lanceolate, acute apex, entire margin, slightly curved on both margin at top; ecostate; leaf cells linear rhomboid,49-46×5.8-6.3 μm at tip, 62-80×4-6 at middle, basal cells gradually shorter, 37-50×11-13 μm, incrassate; alar cells clearly differentiated, yellowish

brown, curved, oblong, inflated, 67-88×24-34 μm; sporophyte on main stem; seta brownish,1-5-1.8 cm long; capsule horizontal to inclined, ovate, cylindrical; peristome normal, exostome yellowish, 257 μm long, 73 μm wide at base, papillose; spore small, round, 11-12 μm in. diameter.

Habitat: Plants seen on bark and logs.

Distribution:

World: India, Thailand and Vietnam.

India: Assam and Meghalaya (Gangulee, 1980; Dandotiya *et al*., 2011); Kerala (Brijithlal *et al.,* 2008).

Kerala: Idukki (Present collection).Thiruvananthapuram, Neyyar W S (Brijithlal *et al.,* 2008).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Aaduvilanthankudi, 13.03.2014, 1600m, *Rajilesh V.K.* 10949; Thakkalikavala, 25.11.2014, 1600m, *Rajilesh V.K.* 11524 (MBGH).

Chionostomum rostratum (Griff.) C. Muell. Hal. in Linnaea, 36:21,1869; Gangulee, Moss. E. India, 3(8):1840, 1980. *Neckera rostrata* Griff. In Cal. J. Nat. Hist, 23:70, 1843. *Chionostomum rostratum* var. *microcarpum* Broth in Oefvers. Forth. Finskavetensk. Soc. 62 A (9):50.1921. *C. latifolium* Ther. & Henry in Siam. Nat. Hist. Suppl. 10(1):20, 1935. **(Plate 5.94)**

Plant yellowish green, silky, dense, tufted on bark; main stem creeping, up to 2-3 cm long, irregularly pinnately branched, branches 1-1.5 cm long; leaves appressed to the stem when dry, lax, erectopatent, concave, ovate-lanceolate, acuminate at apex, margin slightly serrate, reflexed at middle; ecostate; leaf cells smooth, narrow, elongated -rhomboidal, 65-72×3-5 μm at middle, shortening towards the tip, 40-50×4-5μm; alar differentiated in to rectangular, 38-42×22-24μm, yellowish.

Habitat: Plants seen on bark of the stem.

Distribution:

World: China, India, Philippines, Sri Lanka, Taiwan, Thailand and Vietnam

India: Kerala (Manju *et al*., 2009b; Jyothilakshmi *et al*., 2016), Uttarakhand (Bahuguna *et al*., 2016).

Kerala: Idukki (Present Collection), Kannur (Manju *et al*., 2009b), Kozhikode, Vallikattukavu (Jyothilakshmi *et al*., 2016).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Shivanpara, 28.11.2012, 1500 m, *Rajilesh V.K.* 8252; Chundel, 09.04.2013, 1460 m, *Rajilesh V.K.* 9446 (MBGH).

Meiothecium microcarpum (Harv.) Mitt., J. Linn. Sco., Bot. 10: 185. 1868. Gangulee, Moss. E. India 3(8). 1874. 1980. *Pterogonium microcarpum* Harv., Icon. Pl., 1: pl. 24: f. 12. 1836. *Pterigynandrum lineolatum* Duby. Syst.Verz. 1842-1844. 130. 1846. *Neckera lecocytus* Muell. Hal. Syn. Musc. Frond. 2: 76. 1850. *N.macrocarpa* Muell. Hal. Syn. Musc. Frond. 2: 78. 1850. *Pterogoniella wattsii* Broth. Ofvers. Finska Vetensk. Soc. Forh. 42: 109. 1900. *Meiothecium wattsii* (Broth.) Broth. Nat. Pflanzenfam. I (3): 1103. 1908. **(Plate 5. 95)**

Plants yellowish green, glossy, tufted on logs, main stem prostrate, branched, branches pinnate, medium; leaves dense, erectopatent to spreading, concave, slightly plicate, 1.5- 2 mm long, 0.5-0.7mm wide, oblong –ovate, apex short acuminate, entire margin; costa absent; leave cells elongated – rhomboid, 30-45 ×7-8 μm; basal alar cells rectangular, large, hyaline, extending to leaf insertion; sporophyte on main stem; seta erect, yellowish, smooth; capsule horizontal, 1.8 mm long.

Habitat: Plants seen on logs.

Distribution:

World: Borneo, India, Java, Japan, Moluccas, New Guinea, New Caledonia, Philippines, Singapore and Sri Lanka.

India: Madhya Pradesh (Nath *et al.,* 2012)

Kerala: Idukki (Present Collection).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Karipara, 12.03.2014, (1660m), *Rajilesh V.K.* 10902 (MBGH).

Note: This species is new distributional record to Peninsular India

Sematophyllum Mitt.,

J.Linn. Soc., Bot. 8: 5. 1864.

Sematophyllum micans (Mitt.) Braithw., Brit. Moss Fl. 3: 154.113 B.1902; Gangulee, Moss. E. India 3(8). 1879. 1980. *Stereodon micans* Mitt., J. Proc. Linn. Soc., Bot., Suppl., 1(2): 114. 1859. *Hypnum novae-caesareae* Austin, Musci Appalach., 440. 1870. *H. micans* Wilson, Brit. Fl. Ed. 4, 2: 86–87. 1833. *Rhaphidostegium novae-caesareae* (Austin) Kindb., Enum. Bryin. Exot. 33. 1888. **(Plate 5. 96)**

Plants pale greenish to yellowish green, epiphytic on log, slender, small; main stem creeping, brownish; branches short, filiform, erect; leaves lax, erectopatent, concave, small, 0.5-0.78×0.25-0.3 mm, ovate-acuminate, tip bent to one side, margin faintly denticulate at tip, ecostate; leaf cells linear elongated, 27-45×4-6 µm at tip, 50-70×5-6 µm at middle, 28-38×4-6 µm at base; alar cells differentiated to large, inflated, oblong, hyaline, 20-28×10-11 µm.

Habitat: Plants seen on bark and logs.

Distribution:

World: India, Europe and U S A

India: Kerala (Daniels *et al*., 2011); Meghalaya (Gangulee, 1980).

Kerala: Idukki (Present Collection), Thiruvananthapuram (Daniels *et al.*, 2011).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Shivanpara, 28.11.2012, (1500m), *Rajilesh V.K.* 8252; Chundel, 09.04.2013, (1460m), *Rajilesh V.K.* 9446 (MBGH).

CRYPHAEACEAE Schimp.,

Coroll. Bryol. Eur. 97. 1856.

Plants yellowish green, caespitose on bark; main stem prostrate, densely branched, branches medium, pinnate; leaves erectopatent to spreading, branch leaf linear ovate, stem leaf ovate, concave, acuminate to acute apex, entire margin; costa single, strong, ending just below the tip; leaf cells with three parallel row of arrangement, cells ovate to elliptical- narrow, elongated-rectangular; sporophyte terminal on branches; capsule hidden.

Schoenobryum concavifolium (Griff.) Gangulee. Moss. E. India 2(5). 1209. 1976; Nair *et al*., Bryoph. Wayanad, 144. 2005. *Orthotrichum concavifolium* Griff. in Cal. J. Nat. Hist., 2: 400. 1842. *Schoenobryum julaceum* Doz. & Molk. in Musci Fr. Ined. Archip. Indici, 6: 184. 1848. *Acrocryphaea mexicana* Schimp., Mem. Soc. Sci. Nat. Math. Cherbourg, 16: 217. 1872. *A. corymbosa* Paris, Index Bryol., 7. 1894. *A. corymbosula* Paris & Schimp., Index Bryol., 7. 1894. *Schoenobryum gardneri* (Mitt.) Manuel, Bryologist, 80: 523. 1977. *S. madagassum* (Muell. Hal.) Manuel, Bryologist, 80: 523. 1977. *S. subintegrum* (Renauld & Cardot) Manuel, Bryologist, 80: 524. 1977. **(Plate 5. 97)**

Plants yellowish green, caespitose on bark; main stem prostrate, densely branched, branches medium, pinnate; leaves erectopatent to spreading, branch leaf linear ovate, stem leaf ovate, concave, 1-1.2 mm long, 0.7-0.8 mm wide, acuminate to acute apex, entire margin; costa single, strong, ending just below the tip; leaf cells ovate to elliptical near to costa and tip, papillate at middle; two or three layered narrow, elongated-rectangular cells present at middle near to margin; basal cells narrow– elongated near to costa, 16-18 ×7-8µm, irregular ovate, shorter towards

margin; oblique oval near margin; marginal cells small, irregular oval cells placed crosswise; sporophyte terminal on branches; capsule hidden.

Habitat: Plants seen on bark.

Distribution:

World: Bangladesh, Burma, Java, India, Nepal, New Guinea, Philipines, Sri Lanka, Thailand and Vietnam.

India: Karnataka (Schwarz & Frahm, 2013), Kerala (Nair *et al*., 2005b), Tamil Nadu (Daniels *et al*., 2018), Uttarakhand (Alam, 2013).

Kerala: Idukki (Present collection), Wayanad (Nair *et al.,* 2005a).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Kurisukavala, 28.11.2014, (1600m), *Rajilesh V.K.* 11627b (MBGH).

PTEROBRYACEAE Kindb.,

Eur.N. Amer.Bryin.1: 15. 1897.

Plants yellowish green, slender to robust; secondary branches pinnately branched; leaves dense, ovate-acuminate, erectopatent or erect-squarrose, broadly ovate, tip cucullate or apiculate; base cordate or auriculate, margin entire or faintly denticulate at tip; costa single or bifurcate, double or none; leaf cells incrassate, elongated or rhomboid-linear, thick walled, porose at bas; marginal basal cells yellowish coloured, quadrate; alar cells usually differentiated, yellowish brown, rectangular.

Pterobryopsis M. Fleisch.,

Hedwigia 45: 56. 1905.

Plants yellowish green, slender to robust, main stem creeping, wiry; secondary stem pinnately branched; leaves dense, imbricate, ovate-acuminate, erectopatent or erect-squarrose, concave, broadly ovate, tip cucullate or apiculate;

base cordate or auriculate, margin entire or faintly denticulate at tip; costa single or bifurcate, double or none; leaf cells incrassate, elongated or rhomboid-linear, thick walled, porose at bas; marginal basal cells yellowish coloured, quadrate; alar cells usually differentiated, yellowish brown, rectangular.

Key to the species

1a. Leaf tip cucullate, costa bifurcating 2

1b. Leaf tip flat; costa single or rarely dichotomly at tip only 3

2a. Leaves base cordate . ..... ***P acuminata***

2b. Leaves base auriculated .. .. ***P. auriculata***

3a. Leaves apex short apiculate, margin incurved ..... ***P. frondosa***

3b. Leaves apex long apiculate, margin usually flat ..... ***P. pilifolia***

Pterobryopsis acuminata (Hook.) M.Fleisch., Hedwigia 45: 59. 1905. Gangulee, Moss. E. India 2(5). 1273. 1976; Nair *et al*., Bryoph. Wayanad, 152.2005. *Neckera acuminata* Hook., Musci Exot., 2: 15. 151. 1819. *Garovaglia conchophylla* Renauld & Cardot, Bull. Soc. Roy. Bot. Belgique 41(1): 69. 1905. *Pterobryopsis handelii* Broth., Akad. Wiss. Wien Sitzungsber., Math.-Naturwiss. Kl., Abt. 1,133: 572 1924. *P. morrisonicola* Nog., J. Hattori Bot. Lab. 2: 69. 16 f. 3–5 1947. **(Plate 5. 98)**

Plants yellowish green, main stem creeping, wiry; secondary stem pinnately branched, yellowish green-brownish, 3-4 cm long, rigid; leaves dense, imbricate, erectopatent, concave, 2.4-3×1-1.2 mm, broadly ovate, tip apiculate, cucullate, base cordate, 0.4 mm wide, margin faintly denticulate at tip; costa single, reaching above the mid leaf or 2/3 as long as leaf; leaf cells incrassate, elongated, linear, 45-60×5.3-5.5 µm at tip, 60-67×4-4.5 µm at middle, inner basal cells highly porose, 38-47×4-5 µm, thick walled; marginal basal cells 9-11 rows, yellowish coloured, quadrate, 11-13×8-9 µm; alar cells yellowish brown, rectangular; sporophyte not seen.

Habitat: Plants seen on bark and land cuttings.

Distribution:

World: India, Myanmar and Nepal

India: Kerala (Nair *et al.,* 2005a; Manju *et al*., 2009b), Maharashtra (Chaudhary *et al*., 2008; Magdum *et al*., 2017), Tamil Nadu (Daniels *et al*., 2018), Uttarakhand (Rai *et al.,*2016).

Kerala: Idukki (Present collection), Kannur (Manju *et al*., 2009b), Wayanad (Nair *et al.,* 2005a).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Karipara, 13.03.2014, 1650 m, *Rajilesh V.K.* 10919; Aaduvilanthankudi, 13.03.2014, 1600 m, *Rajilesh V.K.* 10941 & 10942 (MBGH).

Pterobryopsis auriculata Dixon, J. Bombay Nat. Hist. Soc. 39: 782. pl. 1: f. 10. 1937. Gangulee, Moss. E. India 2 (5). 1264. 1976. **(Plate 5. 99)**

Plants yellowish green, main stem creeping; secondary stem pinnately branched, yellowish green 6-12 cm long, rigid; leaves dense, erect-squarrose, concave, 2.4-3×1-1.2mm, broadly ovate, base auriculate, tip apiculate, cucullate, margin entire; costa single, reaching above the mid leaf or 2/3 as long as leaf; leaf cells incrassate, elongated, linear, porose, 50-60×5-6 μm at tip and middle; basal cells highly porose, 38-47×4-5 μm; cells in auricle quadrate-rectangular, 15-22×9-13 μm, hyaline cells with yellowish walls; sporophyte not seen.

Habitat: Plants seen on stem bark.

Distribution:

World: Bangladesh, India and Thailand.

India: Kerala (Manju & Rajesh, 2011). Tamil Nadu (Daniels & Daniel, 2013).

Kerala: Idukki (Present Collection), Palakkad (Manju & Rajesh, 2011).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Company estate, 30.11.2012, 1600m, *Rajilesh V.K.* 8928; Muthupara,

11.03.2014, 1500 m, *Rajilesh V.K.* 9476; Sivanpara, 26.11.2014, 1550m, *Rajilesh V.K.* 11575; Vellapara, 23.12.2015, 1650 m, *Rajilesh V.K.* 11688 (MBGH).

Pterobryopsis frondosa (Mitt.) M. Fleisch., Hedwigia 45: 60 1905; Gangulee, Moss. E. India 2(5). 1268. 1976. *Meteorium frondosum* Mitt., J. Proc. Linn. Soc., Bot., Suppl., 1: 86. 1859. *Endotrichum frondosum* A. Jaeger Ber., Thatigk. St. Gallischen Naturwiss. Ges. 1875–76: 233, 1876. **(Plate 5. 100)**

Plants yellowish green, glossy, main stem creeping, wiry, secondary stem pinnately branched, erect, 7-10 cm long; leaves dense, erectopatent, imbricate, ovate-oblong, concave, 2.4-2.6×1.4-1.8 mm, slightly cordate base, short apiculate apex, margin recurved above, entire; costa single, above the mid leaf, bifurcate (some leaves shows single costa with very short costa at base); leaves cells rhomboid-linear elongate, porose, 38-42×13-14 μm at apex, 60-65×6-8 μm at middle, inner basal cells rhomboid-rectangular, 32-38×12-14 μm, margin basal cells rectangular-quadrate, 12-14×8-9 μm, yellowish brown; sporophyte on short branches; seta erect, short, brownish, 4-6 mm long; capsule erect, ovate-cylindrical, 1.8 mm long, 1 mm in. diameter; peristome double, exostome teeth lanceolate-subulate, 0.3-0.4×0.03 mm; endostome teeth narrow, delicate, reduced to short filaments.

Habitat: Plants seen on bark along with *Heteroscyphus perfoliatus* (Mont.) Schiff.

Distribution:

World: India and Sri Lanka.

India: Karnataka (Schwarz, 2013); Kerala (Manju *et al*., 2008b).

Kerala: Idukki (Present collection). Kerala (Manju *et al*., 2008b).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Mannankudi, 29.11.2012, 1700 m, *Rajilesh V.K.* 8918a; Company estate, 30.11.2012, 1600 m, *Rajilesh V.K.* 8955; Udumbupara, 24.11.2014, 1550 m, *Rajilesh V.K.* 10971; Vellapara, 27.11.2014, 1650 m, *Rajilesh V.K.* 11583, 11600 (MBGH).

Pterobryopsis pilifolia (Dixon) Magill, J.Hattori Bot. Lab. 48: 68. 1980. *Symphysodontella pilifolia* Dixon, J. Bombay Nat. Hist. Soc. 39: 782. pl. 1: f. 8.1937; Gangulee, Moss. E. India 2(5). 1279.1976. **(Plate 5. 101)**

Plants yellowish green, glossy, main stem creeping, wiry, secondary stem pinnately branched, erect, 8-12 cm long; leaves dense, erectopatent, imbricate, ovate-acuminate, 2.4-2.6×1.4-1.8 mm, cordate base, long apiculate apex, margin flat, entire; leaf of filament branches shows broadly ovate-shortly lanceolate, flat; costa single, above the mid leaf, bifurcate (some leaves shows single costa with very short costa at base); leaves cells rhomboid-linear elongate, porose, 30-42×12-15 μm at apex, 55-68×6-7 μm at middle, basal cells highly porose, incrassate, quadrate-rectangular, 30-35×12-17 μm, yellowish brown; sporophyte unknown.

Habitat: Plants seen on logs.

Distribution:

World: India

India: Eastern Ghats (Daniels *et al.,* 2018), Kerala (Present collection).

Kerala: Idukki (Present collection).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Muthupara, 11.03.2014, (1500m), *Rajilesh V.K.* 9494b; Vattapara, 23.12.2015, (1620 m), *Rajilesh V.K.* 11642 (MBGH).

Notes: The present collection is a new record for Kerala.

NECKERACEAE Schimp.,

Coroll.Bryol. Eur. 99. 1856.

Plants pale greenish, glossy, epiphytic, scandent; main stem creeping, rigid, wiry, with small scale leaves; secondary branches erect or inclined to descending, rare pinnately branched, complanate; leaves dense, complanate, horizontally spreading, slightly spathulate, oblong-obovate, asymmetric; apex rounded or obtuse, acute pointed, serrate margin, inflexed on one side at base, slightly decurrent on the

other side; costa single, above the mid leaf; leaf cells incrassate, smooth, quadrate-polygonal or elongated-rhomboid; sporophyte not seen.

Key to the genera

1a. Leaves oblong-obovate; apex rounded with minutely denticulate ....***Homalia***

1b. Leaves oblong ligulate; apex largely toothed ....***Homaliodendron***

Homalia Brid.,

Bryol.Univ.1: xlvi; 2: 325, 763, 807, 812. 1827.

Homalia trichomanoides (Hedw.) Schimp., Bryol. Eur. 5: 55. 1850. *Leskea trichomanoides* Hedw., Sp. Musc. Frond. 231. 1801. *Homalia jamesii* Schimp., Coroll. Bryol. Eur. 100. 1856. *H. obtusata* Mitt., J. Linn. Soc., Bot. 8: 38. 1865. *H. macounii* Muell., Hal. & Kindb., Cat. Canad. Pl., Musci 163. 1892. *H. fauriei* Broth, Hedwigia 38: 229. 1899. *H. spathulata* Dixon, Rev. Bryol. n.s.1:184.1928. *Homaliodendron obtusatum* (Mitt.) Gangulee, Mosses E. India 2(5): 1416. 1976. *Homalia trichomanoides* (Hedw.) Schimp. var. *trichomanoides* checkl. Bryph. Kerala. 13. 2008 **(Plate 5.102)**

Plants pale greenish, glossy, epiphytic on stem bark, scandent; main stem creeping, rigid, wiry, with small scale leaves; secondary branches up to 10 cm long, erect to descending, rare pinnately branched, complanate; leaves dense, complanate, horizontally spreading, oblong-obovate, asymmetric, 0.9-1.1 mm long, 0.22 mm wide at base, 0.68-0.71 mm wide at top; apex rounded; margin minutely denticulate, inflexed on one side at base, slightly decurrent on the other side; costa single, above the mid leaf; leaf cells incrassate, smooth; quadrate-polygonal at tip, 7-11 μm; elongated-rhomboid, 18-21×7-8 μm at middle; basal cells irregular rectangular,18-36×4-7 μm.

Habitat: Plants seen as epiphytic on bark along with *Homaliodendron flabellatum, Eurhynchium hians* (Hedw.) Sande Lac., *Lejeunea wightii* Lindenb. and *Thuidium cymbifolium*(Dozy & Molk.) Dozy & Molk.

Distribution:

World: Bhutan, India and Tibet.

India: Himachal Pradesh (Alam, 2013), Jammu & Kashmir (Alam, 2013), Tamil Nadu (Daniels & Daniel, 2013), Uttarakhand (Alam, 2013).

Kerala: Idukki (Present collection).

Specimen/s examined*:* India, Kerala, Idukki District., Mathikettan Shola National Park, Sivanpara, 28.11.2012, (1500m), *Rajilesh V.K.* 8231; Company estate, 29.11.2012, (1600m), *Rajilesh V.K.* 8948; Karipara, 12.03.2014, (1650m), *Rajilesh V.K.* 10915c; Vellapara, 28.11.2014, (1780m), *Rajilesh V.K.* 11580e (MBGH).

Note: The present collection is a new record to Kerala

Homaliodendron M. Fleisch.,

Hedwigia 45: 72. 1906.

Homaliodendron flabellatum (Sm.) M. Fleisch. Hedwigia 45:74. 1906; Gangulee, Moss. E. India 2(5). 1426. 1976; Nair *et al*., Bryoph. Wayanad, 162.2005. *Hookeria flabellata* Sm., Trans. Linn. Soc. London, 9: 280. 23 f. 2. 1808. *Climacium neckeroides* Brid., Bryol. Univ.2: 276.1827. *Neckera australasica* Muell. Hal., Syn. Musc. Frond., 2: 42. 1850. *N. javanica* Muell., Hal.Syn. Musc. Frond. 2: 41. 1850. *N. scalpellifolia* Mitt., J. Proc. Linn. Soc., Bot., Suppl. 2: 119. 1859. *Homalia intermedia* Angstrom, Ofvers. Forh. Kongl. Svenska Vetensk. Akad. 29(4): 17. 1872. *Neckera mohriana* Muell., Hal. Linnaea 38: 646. 1874. *Homalia praelonga* Reichardt, Sitzungsber. Kaiserl. Akad. Wiss., Math. Naturwiss. Cl., Abt. 1 75: 573. 1877. *H. densa* Bosw., J. Bot. 30: 98. 1892. *Homaliodendron squarrosulum* M. Fleisch. ex P. de la Varde, Rev. Bryol. Lichenol., 10: 141. 1937. *H. decompositum* (Brid.) K.A. Wagner, Bryologist, 55: 144. 1952. (**Plate 5. 103).**

Plants pale greenish, glossy, robust, epixylic, scandent; main stem creeping, rigid, wiry, with small scale leaves; secondary branches inclined to descending, pinnately branched, up to 10 cm long, frondose, complanate; leaves dense, complanate, horizontally spreading, longitudinally plicate when dry, oblong-ligulate, slightly spathulate, asymmetric, 1.3-1.4 mm long, 0.3mm wide at base, 0.7 wide at

top; apex obtuse, acute pointed, serrate; margin serrate above, minutely denticulate below, inflexed on one side at base; costa single, above the mid leaf; leaf cells incrassate, smooth; quadrate-polygonal,12-15×8-9 μm at tip and margin; gradually elongated-rhomboid, 27-34×6-8 μm at middle near to costa; basal cells larger rhomboidal, 42-50×6-7 μm, margin basal cells quadrate-rectangular; sporophyte not seen.

Habitat: Plants seen as epiphytic on bark along with *Homalia trichomanoides* (Hedw.) Schimp., *Lejeunea wightii* Lindenb. and *Thuidium cymbifolium* (Dozy & Molk.) Dozy & Molk.

Distribution:

World: Australia, Bhutan, Burma, India, Indonesia, Japan, Nepal, Philippines and Thailand.

India: Kerala (Nair *et al*., 2005a), Meghalaya (Gangulee, 1976), Tamil Nadu (Daniels & Daniel, 2013; Daniels *et al*., 2018), West Bengal (Gangulee, 1976).

Kerala: Idukki (Present Collection), Wayanad (Nair *et al*., 2005a).

***Specimen/s examined**:* India, Kerala, Idukki District., Mathikettan Shola National Park, Chundel, 08.04.2013, 1400 m, *Rajilesh V.K.* 8993; Udumbupara, 24.11.2014, 1600 m, *Rajilesh V.K.* 10971 b; Vellapara, 28.11.2014, 1780 m, *Rajilesh V.K.* 11580 d (MBGH).

ECOLOGY

Bryophytes form an important element of diverse vegetations and play complex ecological role in any ecosystems. The dominant vegetation type of the study area are West coast tropical evergreen forests, Shola forest and Grasslands. Evergreen forest has a great variety of habitats for bryophytes. The high humid climatic conditions, undulating topography and presence of many perennial streams of Mathikettan Shola National Park are highly significant for the growth and proliferation of liverworts and mosses and hence the degree of diversity and abundance is very high. Bryophytes are ecologically tolerant plants as they grow even on hard surface and survive successfully. By the growth of these plants its growing substratum will change from hard to humus nature that becomes suitable for colonization to seed plants. Ecological studies have demonstrated that the character state of many morphological features is correlated with environmental factors (Glime, 2017).

The growth and distribution of bryophytes are largely depend on microclimatic factors *viz*. rain fall, temperature, latitude and altitude and by micro environmental conditions like shade, humidity, humus and temperature (Glime, 2017). It is evident that these environmental variations like altitudinal variations, habitat differences, temperature changes, light intensity etc affect the species morphology and its availability in this area. The present study focuses the whole bryophyte populations and their response to environmental factors. The anthropogenic activities of human beings in the forest and plantation of cardamom and coffee also affect the diversity in the area. The present study aimed to find out the species richness and the habitat preference of each species. The study also focuses to the distribution of taxa by altitudinal variation, vegetation type and habitat type.

Altitude and distribution of the taxa

The study area is undulating with hillocks of varying heights. The altitude ranges between 1200-1984 m altitudes. The elevation increases from west to east

and the highest point, Madigatta (1984m) is located in the eastern border of the Park adjoining Tamil Nadu. The forest is seen as a continuous patch from 1200 m upto 1500 m above which it is seen as small patches dispersed among the grasslands. The study reveals that growth and diversity of bryophytes depends on altitudinal differences.

The study also reveals that the maximum diversity of species is seen in middle altitudinal ranges. In the range 1501- 1600 m, a total of 49 species could be reported, followed by 1401-1500 m altitudinal ranges where 42 species are found, a total of 91 taxa are found in these two zones. The altitude range between 1601-1984 m includes grassland and shola forests, where an ideal microclimate for the growth and diversity of bryophytes exists. 1601- 1700 m altitude range includes 38 species. 1701 to 1800 m altitude includes 30 species. Minimum number of species are seen in high altitude range between 1801-1984 m. This area has only 5 species. Some taxa like *Ctenidium lychnites* (Mitt.) Broth., *Floribundaria walkeri* (Renauld & Cardot) Broth., *Hypopterygium tamarisci* (Sw.) Brid. ex Mull., *Plagiomnium rhynchophorum* (Hook.) T.J. Kop., etc. were found in all the altitudinal ranges. In the lower region of the study area between 1200-1300 m a total of 32 species are distributed and above the area between 1301 to 1400 m only 12 species are found.

Some of the species present in mid zone between 1400-1600 m is extended to 1600-1800 m, few species were also found in low altitude zone. The taxa found in this area are having vigorous vegetative growth and many taxa forms thick patches on the substratum. The trees in this zone were usually festooned abundantly with hanging bryophytes. A detailed list of species occurring in this altitude is given in Table 4.

Forest type and Bryophyte Distribution

The dominant vegetation types of this area are West coast tropical evergreen forests, Shola forest and Grasslands. The climatic condition *viz.* temperature, humidity, rain fall, sun light, soil type, etc are different in different forest types. These climatic factors are affecting the distribution pattern of Bryophytes in different areas. The study reveals that a total of 90 taxa are distributed in shola forest

type and was followed by west coast tropical evergreen forest with 52 taxa and minimum number of species is found to be occurring in grasslands. Only 14 taxa are found in grasslands.

West coast tropical evergreen forests

Ecologically, these forests are most advanced and floristic richness is high and these forests need preservation for both tangible and intangible benefits. It is the climax vegetation in Kerala and is best represented at 600 to 1200 m altitudes, at certain places it extends up to 1400 m. Some of the common trees of the top story include species like *Bhesa indica* (Bedd.) Ding Hou*, Bischofia javanica* Blume*, Calophyllum calaba* L., *Chionanthus sp., Litsea sp.*, *Dysoxylum malabaricum* Bedd., *Syzygium sp.,* etc. The second storey comprises species like *Actinodaphne sp., Aglaia sp., Baccaurea courtallensis* (Wight) Muell.-Arg.*,* etc. The third storey of species represented by small trees like *Agrostachys sp., Evonymus* sp.*, Memecylon* sp.*,* etc. Most of these trees are festooned with Bryophytes, lichens, aroids, ferns, orchids etc.

A total of 51 taxa are found in different substratum of this forest type. The common liverworts in this type of forests include *Calycularia crispula* Mitt. *Marchantia linearis* Lehm. & Lindenb.*, Pallavicinia lyellii* (Hook.) Gray, *Reboulia hemisphaerica* (L.) Raddi., etc. and the mosses, *Brachymenium nepalense* Hook., *B. ochianum* Gangulee*, Brachythecium buchananii* (Hook.) A. Jaeger., *Daltonia marginata* Griff*, Entodon nepalensis* Mizush., *E. plicatus* Mull., *E. scariosus* Renauld & Cardot, *Hookeriopsis secunda* (Griff.) Broth., *H. utacamundiana* (Mont.) Broth., etc. A detailed list of species occurring in this vegetation type is given in Table 5.

Shola Forests

This type of forest is the continuation of the 'West Coast Tropical Evergreen Forests' in the higher altitudes. The shola patches are seen from about 1500-1800 m. These forests have high ecological significance and the vegetation is also very characteristic. The trees are stunted with an umbrella shaped canopy. *Rhododendron*

arboretum, Cinnamomum sp., Litsea sp., Elaeocarpus sp., Syzygium sp., Symplocos sp. are some common plants in this forest. The branches of these plants are crooked and densely covered with epiphytic bryophytes, ferns, lichens and orchids. The diversity and frequency of bryophytes in this area is maximum and there are about 87 specie are distributed in this vegetation. Liverwotrs like *Bazzania tridens* Reinw., (Blume & Nees) Trevis., *Jungermannia comata* (S.Hatt.) Amak., *J. shinii* Amakaw., and *Plagiochila arbuscula* Lindenb., *P. fruiticosa* Mitt., *P. sciophila* Nees *ex* Lindenb., etc are growing maximum in these forests. Mosses like *Acroporium baviense* (Besch.) Broth., *Aerobryidium filamentosum* (Hook.) M. Fleisch, *Aerobryopsis wallichii* (Brid.) M. Fleisch., *Aerobryum speciosum* Dozy & Molk., *Brachymenium nepalense* Hook., *B. ochianum* Gangulee, *Entodon chloropus* Ren. & Card., *E. macropodus* (Hedw.) Mull., *E. nepalensis* Mizush., *E. plicatus* Mull., *E. ovicarpus* Dix., *E. scariosus* Renauld & Cardot, *Fissidens anomalus* Mont., *Floribundaria walkeri* (Renauld & Cardot) Broth., *Hookeriopsis secunda* (Griff.) Broth., *Hookeriopsis utacamundiana* (Mont.) Broth., *Meteoriopsis reclinata* (Mull. Hal.) M. Fleisch., *Plagiomnium rhynchophorum* (Hook.) T. J. Kop., *Pyrrobryum spiniforme* (Hedw.) Mitt. *Thuidium cymbifolium* (Dozy & Molk.) Dozy & Molk., *T. pristocalyx* (Mull. Hal.) A. Jaeger, etc are common in this forest. Some genera such as *Aerobryidium filamentosum* (Hook.) M. Fleisch., *Campylopus involutus* (Muell. Hal.) A. Jaeger, *Cephaloziella kiaeri* (Austin) S. Arnell, *Cheilolejeunea serpentina* (Mitt.) Mizut., *Chiloscyphus campanulatus* Steph., *Cryptopapillaria fuscescens* (Hook.) M. Menzel., *Daltonia marginata* Griff ., *Entodon chloropus* Ren. & Card., *Fissidens crispulus* Brid. var *crispulus*, *Fissidens pellucidus* Hornsch., *Homaliodendrum flabellatum* (Sm.) M. Fleisch., *Hookeriopsis secunda* (Griff.) Broth., *Hookeriopsis utacamundiana* (Mont.) Broth., *Lejeunea cavifolia* (Ehrh.) Lindb., *L. obscura* Mitt., *L. tuberculosa* Steph. *L.wightii* Lindenb., *Leptohymenium tenue* (Hook.) Schwagr., *Meiothecium microcarpum* (Harv.) Mitt., *Metzgeria lindbergii* Schiffn., *Philonotis mollis* (Dozy & Molk.) Mitt., *Plagiochasma ruprestre* (G. Forst.) Stephani, *Plagiochila arbuscula* Lindenb., *P. fruiticosa* Mitt., *Porella acutifolia* (Lehm. & Lindenb.) Trevis., *P. campylophylla* (Lehm. & Lindenb.) Trevis., *Pterobryopsis pilifolia* (Dixon) Magill, *Regmatodon orthostegius* Mont.,

Rhynchostegium herbaceum (Mitt.) A. Jaeger, *Riccardia levieri* Schiffn., *Schoenobryum concavifolium* (Griff.) Gangulee., *Sematophyllum micans* (Mitt.) Braithw., *Targionia hypophylla* L., *Trachypodopsis serrulata* (P. Beauv.) M. Fleisch and *Wijkia deflexifolia* (Ren. & Card.) Crum. are found only in shola forests, but some species are extended to evergreen forest also. It is noted that the size and growth of the many species and the development of sporophyte is maximum in this area. All the Meteoriaceae members are hanging abundantly from the branches of shola trees. Mosses like *Entodon spp. Thuidium cymbifolium* (Dozy & Molk.) Dozy & Molk., *T. pristocalyx* (Mull. Hal.) A. Jaeger, are firmly attached to the substratum to form as thick patches or mat. The endemic species *viz*. *Chiloscyphus campanulatus* Steph., *Entodon ovicarpus* Dix., *Lejeunea wightii* Lindenb., and *Wijkia deflexifolia* (Ren. & Card.) Crum. are found in this vegetation. A detailed list of species occurring in this vegetation type is given in Table 5.

Grass lands and Bryophyte Distribution

The grasslands adjacent to medium or high elevation evergreen forests, are often found with sparse trees, represented by *Terminalia sp., Emblica sp., Careya sp.,* in some places a dwarf palm *Phoenix sp.,* is also found in patches. These plants were found festooned with Meteoriaceae members like *Aerobryopsis wallichii* (Brid.) M. Fleisch., *Aerobryum speciosum* Dozy & Molk., *Floribundaria walkeri* (Renauld & Cardot) Broth. and *Meteoriopsis reclinata* (Muell. Hal.) M. Fleisch. by hanging from branches and *Entodon macropodus* (Hedw.) Mull., *Entodon ovicarpus* Dix., *Pelekium velatum* Mitt., etc are found at the base and trunk part of the stem. The commonly represented grasses are *Androprogon sp., Arundinella sp., Agrostis sp., Chrysopogon sp.* and *Heteropogon sp*. The grasses in this zone are mixed with other herbs like *Crotalaria sp., Desmodium sp., Lobelia sp., Osbeckia sp., etc.* In grasslands the genus *Campylopus* is very common and it is specific in this habitat. Some other specific vegetation of bryophytes are *Aerobryopsis wallichii* (Brid.) M. Fleisch., *Aerobryum speciosum* Dozy & Molk., *Bryum argenteum* Hedw., *Entodon macropodus* (Hedw.) Mull., *E. ovicarpus* Dix., *Floribundaria walkeri* (Renauld & Cardot) Broth., *Meteoriopsis reclinata* (Mull. Hal.) M. Fleisch., *Pelekium velatum*

Mitt. and *Philonotis hastata* (Duby) Wijk & Margad. Here *Campylopus flexuosus* (Hedw.)Brid. is the dominant bryophyte and forms thick mat on all wet rocks of grasslands. A detailed list of species occurring in this vegetation type is given in Table 5.

Habitats and Bryophyte Association

Though the bryophytes are cosmopolitan in distribution, most of them exhibit strong preference to specific microhabitats. The microhabitats of bryophyte communities are determined by the intensity of light, availability of water, humidity and physical and chemical character of substratum. The bryophytes communities of Mathikettan Shola can be mainly categorized under two ecological types *viz*. epiphytic and terrestrial. Epiphytic and Terrestrial communities have several microhabitats. The study reveals that 73 taxa are found as epiphytic and 46 taxa are terrestrial. (**Plate 6.1- 6.8**. shows some of the microhabitats of bryophytes)

Epiphytes

In the present study area majority of the taxa *viz*., 73 out of 104 species are found to be epiphytic. Epiphytic habitat includes many type of microhabitats such as base of tree, main trunk, upper part and branches of trees, epiphyllous, logs (dead and decomposing wood), etc. The species grow on bark depends upon the chemical and physical conditions of bark. A detailed list of species occurring in this habitat is given in Table 5.

Base of trees: -. Evergreen and shola forests provide the moist shady habitat for the plants, were the epiphytic species are usually unique. The buttresses and large exposed roots of trees are covered by many bryophytes and some of the usually inhabited plants in such parts are *Calycularia crispula* Mitt., *Entodon spp*., *Hookeriopsis utacamundiana* (Mont.) Broth., *Hypopterygium flavolimbatum* Muell. Hal*., Porella acutifolia* (Lehm. & Lindenb.) Trevis., *P. compylophylla* (Lehm. & Lindenb.) Trevis., *Pyrrhobryum spiniforme* (Hedw.) Mitt., *Thuidium cymbifolium* (Dozy & Molk.) Dozy & Molk., etc.

Upper part of tree trunk: - The surface of tree trunks provide suitable habitat for many bryophytes. The rough barked trees like *Aglaia sp., Baccaurea courtallensis* (Wight) Mull.Arg., *Bhesa indica* (Bedd.) Ding Hou, *Calophyllum calaba* L., *Cullenia exarillata* A. Robyns, *Elaeocarpus sp., Litsea sp.,* present in the study area are found to be more suitable for species *like Bazzania tridens* (Reinw., Blume & Nees) Trevis, *Fissidens anomalus* Mont., *Heteroscyphus argutus* (Mont.) Schiffner, *Hypopterygium flavolimbatum* Muell. Hal., *Leucoloma amoene-virens* Mitt., *Plagiochila* (Brid. ex Lehm. & Lindenb.) Lindenb., *Pterobryopsis acuminata* (Hook.) M.Fleisch., *P. auriculata* Dixon, *P. frondosa* (Mitt.) M. Fleisch., etc.

Branches and Twigs of trees: - The branches and twigs of trees are exposed to direct sunlight and bryophytes inhabit the area is slightly distinct. The highly humid evergreen and shola tree branches are inhabited by liverworts such as *Metzgeria lindbergii* Schiffn., *Porella acutifolia* (Lehm. & Lindenb.) Trevis., *P. campylophylla* (Lehm. & Lindenb.) Trevis., Lejeuneaceae members and mosses like *Macromitrium sulcatum* (Hook.) Brid., *Cryptopapillaria fuscescens* (Hook.) M. Menzel., *Floribundaria walkeri* (Renauld & Cardot) Broth., *Homaliodendron flabellatum* (Sm.) M. Fleisch., etc. In shola trees branches are covered by hanging bryophytes such as *Aerobryidium filamentosum* (Hook.) M. Fleisch, *Aerobryopsis wallichii* (Brid.) M. Fleisch., *Aerobryum speciosum* Dozy & Molk., *Meteoriopsis reclinata* (Mull. Hal.) M. Fleisch., etc.

Epiphyllous

The leaves of some plants, except short-lived ones in the forest also provide a microhabitat for bryophytes. Very few species growing on leaves when compare with other substratum. In the present study Lejeuneaceae members *viz. Cheilolejeunea serpentina* (Mitt.) Mizut. and *Lejeunea cavifolia* (Ehrh.) Lindb., are found on leaves.

On logs

Dead and decomposing wood of fallen trees and twigs provide good microhabitat for many bryophyte species. The present study area contains more such

substratum. Some of the common species which are inhabited on logs are *Acroporium baviense* (Besch.) Broth., *Bazzania tridens* (Reinw., Blume & Nees) Trevis., *Campylopus involutus* (Mull. Hal.) A. Jaeger, *Ctenidium lychnites* (Mitt.) Broth., *Entodon plicatus* Mull., *E. ovicarpus* Dix., *E. scariosus* Renauld & Cardot, *Garckea flexuosa* (Griff.) Margad. & Nork., *Hookeriopsis utacamundiana* (Mont.) Broth., *Jungermannia comata* (S.Hatt.) Amak., *Pterobryopsis acuminata (*Hook.) M.Fleisch., *P. auriculata* Dixon, *P. frondosa* (Mitt.) M.Fleisch., *P. pilifolia* (Dixon) Magill., *Sematophyllum micans* (Mitt.) Braithw., *Vesicularia montagnei* (Schimp.) Broth., etc.

Terrestrial

Out of 104 taxa in the study area 46 taxa were reported as terrestrial. It includes soil cuttings, forest floor and rocks. The chemical and physical nature of soil, availability of light and humid conditions etc. determined the bryophyte distribution in this zone. A detailed list of species occurring in this habitat is given in Table 5.

Distribution of Bryophytes on forest floor and Soil cuttings.

The species inhabit in the forest area and land cuttings of grassland are distinct. The taxa *viz*. *Anthoceros crispulus* (Mont.) Douin, *Entodon chloropus* Ren. & Card., *Fissidens anomalus* Mont., *Jungermannia rubripunctata* (S.Hatt.) Amak., *Jungermannia shinii* Amak., *Marchantia linearis* Lehm. & Lindenb., *Pallavicinia lyellii* (Hook.) Gray., *Plagiomnium rhynchophorum* (Hook.) T.J. Kop., *Pogonatum microstomum* (R. Br. ex Schwagr.) Brid., *Pterobryopsis auriculata* Dixon, *Racopilum orthocarpum* Wilson ex Mitt., *Reboulia hemisphaerica* (L.) Raddi., *Rhynchostegium herbaceum* (Mitt.) A. Jaeger, *Targionia hypophylla* L., etc are found in forest floor. The other taxa were mainly found on vertical land cutting walls in the forest. e.g. *Anthoceros crispulus* (Mont.) Douin, *Fissidens anomalus* Mont., *F. crispulus* Brid. var *crispulus* Brid., *F. involutus* Wilson ex Mitt. subsp. *curvatoinvolutus, F. pellucidus* Hornsch., *Pogonatum microstomum* (R.Br. ex Schwagr.) Brid., *Reboulia hemisphaerica* (L.) Raddi., etc.

are found in land cutting. Some species are found on hard and tight soil while some on loose soil.

On Rocks

Most of the species found on rocks are also seen on other substratum like tree bases, logs and on soil. The nature of rocks found near stream, in grass land and in forest is distinct. The rocks near streams are highly wet where thick patches of bryophytes like *Dumortiera hirsuta* (Sw.) Nees, *Marchantia linearis* Lehm. & Lindenb., *Pallavicinia lyellii* (Hook.) Gray., *Plagiochasma rupestre* (G. Forst.) Steph., *Riccardia levieri* Schiffn. etc. were seen. Rock and stones in sholas and tropical forest area harbours species like *Bryum spp.*, *Entodon spp., Hookeriopsis secunda* (Griff.) Broth., *Hookeriopsis utacamundiana* (Mont.) Broth., *Hypopterygium tamarisci* (Sw.) Brid. ex Muell. Hal., *Isopterygium albescens, Philonotis hastata* (Duby) Wijk & Margad., *P. mollis* (Dozy & Molk.) Mitt., *P. thwaitesii* Mitt., *Thuidium cymbifolium* (Dozy & Molk.) Dozy & Molk., etc. Where as the rocks in grasslands are wide and large, humidity is high and the availability of light is maximum. The bryophytes inhabiting this area are also specific. Species like *Campylopus involutus* (Mull. Hal.) A. Jaeger, *C. flexuosus* (Hedw.) Brid., *Hymenostomum edentulum* (Mitt) Besch., *Rhodobryum roseum* (Hedw.) Limpr., etc. are found in these areas. Among them, *Campylopus flexuosus* (Hedw.) Brid, *C. involutus* (Mull. Hal.) A. Jaeger is found on entire rocks in the form of a thick mat.

Conservation

The collections were made systematically in different seasons from the study area. Epiphytic species were collected from fallen branches or cuttings of branches with specimens. Terrestrial and Lithophytic species were collected along with the substratum as far as possible. The collected specimens were kept in paper packets usually remain fresh and alive for few days and so that can be conserved them alive. These collected specimens were introduced to the conservatory of MBGIPS. The lithophytic species were kept on rocks and epiphytic species kept in the husk of coconut and terrestrial species were kept in round bottomed pot (Bonsai Pot)

keeping vertically. In the conservatory, maintaining suitable microhabitat for each species and provide microclimate with the help of automated fogger system.

The International Union for the Conservation of Nature (IUCN) Red List, lists 92 species of bryophytes as threatened worldwide. *In situ* conservation should be the primary focus for conserving these threatened species, ex situ growth and germplasm storage is also equally important complementary aspects of plant conservation. The study shows that many high altitudinal species are established in the conservatory, which indicates their ecological adaptability under the controlled conditions of conservatory. Among the 104 species 25 species are established in the conservatory including 10 Liverworts, one Hornwort and 14 Mosses (**Plate 6.9**) They are well labelled with species name and family. The study also reveals that terrestrial species are more quickly acclimatized with the ex-situ conservatories than the epiphytic species. Some of the successfully conserved species are *Dumortiera hirsuta* (Sw.) Nees, *Pallavicinia lyellii* (Hook.) Gray, *Reboulia hemisphaerica* (L.) Raddi., *Riccardia levieri* Schiffn*., Philonotis sp.,* etc. The species name, family and habitat of each established species are mentioned in Table.6.

Table.4. Distribution of bryophytes in relation with altitude (X-present, - absent)

SPECIES	ALTITUDE RANGE						
	1200m-1300m	**1301m-1400m**	**1401m-1500m**	**1501m-1600m**	**1601m-1700m**	**1701m-1800m**	**1801m-1984m**
Aerobryidium filamentosum (Hook.) M. Fleisch	**X**	**X**	**-**	**X**	**X**	-	-
Aerobryopsis wallichi (Brid.) M. Fleisch.	-	-	-	-	**X**	**X**	-
Aerobryum speciosum Dozy &Molk.	**X**	-	-	**X**	-	-	-
Anthoceros crispulus (Mont.) Douin	-	-	-	-	-	**X**	-
Bazzania tridens (Reinw., Blume & Nees) Trevis.	-	-	**X**	-	**X**	**X**	-
Brachymenium nepalense Hook.	-	-	-	**X**	-	-	-
Brachymenium ochianum Gangulee	-	-	**X**	-	**X**	-	-
Brachythecium buchananii (Hook.) A. Jaeger	**X**	-	**X**	**X**	-	-	-
Brachythecium formosanum Takaki	-	-	**X**	**X**	-	-	-
Bryum argenteum Hedw.	-	-	-	**X**	**X**	-	-
Bryum wightii Mitt.	**X**	-	-	-	-	-	-
Calicularia crispula Mitt.	**X**	**X**	**X**	**X**	-	-	-
Campylopus flexuosus (Hedw.) Brid.	-	-	**X**	-	**X**	**X**	-
Campylopus involutus (Mull. Hal.) A. Jaeger	-	-	-	**X**	-	**X**	-
Cephaloziella kiaeri (Austin) S. Arnell	-	-	-	-	-	**X**	-
Cheilolejeunea serpentina (Mitt.) Mizut.	-	-	-	-	-	**X**	-
Chiloscyphus campanulatus Steph.	-	-	-	-	-	-	**X**
Chionostomum rostratum (Griff.) C. Mull.	-	-	**X**	-	-	-	-
Cryptopapillaria fuscescens (Hook.) M. Menzel.	-	-	**X**	**X**	-	**X**	-
Ctenidium lychnites (Mitt.) Broth.	**X**		-	**X**	-	**X**	-

Cyathophorella adiantum (Griff.) M. Fleisch.	**X**	-	-	**X**	-	-	-
Daltonia marginata Griff.	-	-	**X**	-	-	**X**	-
Dumortiera hirsuta (Sw.) Nees	**X**	**X**	-	-	-	-	-
Ectropothecium sikkimense (Renauld & Cardot) Renauld & Cardot.	-	-	**X**	-	-	-	-
Entodon chloropus Ren.&Card.	-	-	-	**X**	**X**	-	-
Entodon macropodus (Hedw.) Mull.	-	-	-	**X**	**X**	-	-
Entodon nepalensis Mizush.	-	-	**X**	-	**X**	**X**	-
Entodon ovicarpus Dix.	-	-	-	-	-	**X**	-
Entodon plicatus Mull.	-	-	-	**X**	-	**X**	-
Entodon scariosus Renauld & Cardot	**X**	-	**X**	**X**	-	-	-
Eurhynchium hians (Hedw.) Sande Lac.	-	-	**X**		**X**	**X**	-
Fissidens anomalus Mont.	-	-	**X**	**X**	-	**X**	-
Fissidens crispulus Brid. var *crispulus*	-	-	-	-	-	**X**	-
Fissidens involutus Wilson ex Mitt. subsp. *Curvatoinvolutus*	-	-	-	-	**X**	-	-
Fissidens pellucidus Hornsch.	-	-	-	-	**X**	-	-
Floribundaria walkeri (Renauld & Cardot) Broth.	**X**	-	**X**	**X**	-	**X**	-
Foreauella orthothecia (Schwgr.) Dixon & P. dela Varde	**X**	-	-	-	-	-	-
Garckea flexuosa (Griff.) Margad. & Nork.	-	-	-	**X**	-	-	-
Heteroscyphus argutus (Nees) Schiffner	**X**	-	-	-	**X**	-	-
Heteroscyphus perfoliatus (Mont.) Schiffner	-	-	-	-		**X**	-
Homalia trichomanoides (Hedw.) Schimp.	-	-	-	**X**	**X**	**X**	-
Homaliodendrum flabellatum (Sm.) M. Fleisch.	-	**X**	-	**X**	-	**X**	-
Hookeriopsis secunda (Griff.) Broth.	-	-	-	**X**	-		-

Hookeriopsis utacamundiana (Mont.) Broth.	-	-	-	**X**	-	**X**	-
Hymenostomum edentulam (Mitt.) Besch.	-	-	-	**X**	-	-	-
Hypopterygium favolimbatum Mull.	-	**X**	-	**X**	**X**	-	-
Hypopterygium tamarisci (Sw.) Brid. ex Mull.	**X**	-	-	-	**X**	-	**X**
Isopterygium albescens (Hook.) A. Jaeger	**X**	-	-	-	**X**	-	-
Isopterygium serrulatum M. Fleisch.	**X**	-	-	-	**X**	-	-
Jungermannia comata (S. Hatt.) Amak.	-	**X**	-	-	-	**X**	-
Jungermannia rubripunctata (S. Hatt.) Amak.	**X**	-	-	-	-	-	-
Jungermannia shinii Amakaw	-	-	-	-	-	-	**X**
Lejeunea eifrigii Mizut.	**X**	-	**X**	-	-	-	-
Lejeunea cavifolia (Ehrh.) Lindb.	**X**	-	**X**	**X**	-	-	-
Lejeunea obscura Mitt.	-	-	-	-	**X**	-	-
Lejeunea tuberculosa Steph.	-	-	-	**X**	-	-	-
Lejeunea wightii Lindenb.	-	-	-	-	-	**X**	-
Leptohymenium tenue (Hook.) Schwagr.	-	-	-	-	-	**X**	-
Leptopterigynandrum decolor (Mitt.) M. Fleisch.	-	-	**X**	-	-	-	-
Leucobryum javense (Brid.) Mitt.	**X**	-	**X**	-	-	-	-
Leucoloma amoene virens Mitt.	-	-	**X**	**X**	**X**	-	-
Macromitrium sulcatum (Hook.) Brid.	**X**	-	-	-	**X**	-	-
Marchantia linearis Lehm. & Lindenb.	**X**	-	-	-	**X**	-	-
Meiothecium microcarpum (Harv.) Mitt.	-	-	-	-	**X**	-	-
Meteoriopsis reclinata (Mull. Hal.) M. Fleisch.	-	-	**X**	-	**X**	-	-
Metzgeria lindbergii Schiffn.	-	-	-	**X**	-	**X**	-
Pallavicinia lyellii (Hook.) Gray	**X**	-	**X**	-	-	-	-

Pelekium velatum Mitt.	**X**	**X**	-	**X**	-	-	-
Philonotis hastata (Duby) Wijk & Margad.	-	-	**X**	-	-	-	-
Philonotis mollis (Dozy & Molk.) Mitt.	-	-	-	**X**	**X**	-	-
Philonotis thwaitessi Mitt.	**X**	-	-	**X**	-	-	-
Plagiochasma ruprestre (G. Forst.) Stephani	**X**	-	**X**	-	-	-	-
Plagiochila arbuscula Lindenb.	-	-	**X**	**X**	-	-	-
Plagiochila fruiticosa Mitt.	**X**	**X**	**X**	-	**X**	-	-
Plagiochila sciophila Nees ex Lindenb.	-	-	-	**X**	-	**X**	**X**
Plagiomnium rhynchophorum (Hook.) T.J. Kop.	**X**	**X**	-	**X**	-	**X**	-
Pogonatum microstomum (R. Br.ex Schwagr.) Brid.	-	**X**	**X**	-	-	-	-
Porella acutifolia (Lehm. & Lindenb.) Trevis.	-	**X**	**X**	-	-	-	-
Porella campylophylla (Lehm. & Lindenb.) Trevis.	**X**	-	-	**X**	-	-	-
Pterobryopsis acuminata (Hook.) M. Fleisch.	-	-	-	**X**	**X**	-	-
Pterobryopsis auriculata Dixon	-	-	**X**	**X**	**X**	-	-
Pterobryopsis frondosa (Mitt.) M. Fleisch.	-	-	-	**X**	**X**	-	-
Pterobryopsis pilifolia (Dixon) Magill	-	-	**X**	-	**X**	-	-
Pyrrobryum spiniforme (Hedw.) Mitt.	-	-	**X**	**X**	**X**	-	-
Racopilum orthocarpum Wilson ex Mitt.	-	-	**X**	-	-	**X**	-
Radula javanica Gottsche.	-	-	-	-	**X**	-	-
Reboulia hemisphaerica (L.) Raddi.	-	-	-	**X**	**X**	-	-
Regmatodon orthostegius Mont.	-	-	-	-	-	-	-
Rhodobryum roseum (Hedw.) Limpr.	-	-	**X**		-	-	-
Rhynchostegiella scabriseta (Schwagr.) Broth.	**X**	-	-	**X**	**X**	-	-
Rhynchostegiella menadensis (Sande Lac.) E.B.Bartram	-	-	**X**	**X**	**X**	-	**X**
Rhynchostegium herbaceum (Mitt.) A. Jaeger	-	-	**X**	**X**	-	-	-

Riccardia levieri Schiffn.	-	-	-	**X**	**X**	-	-
Riccardia tenuicostata Schiffn.	**X**	-	**X**		-	-	-
Schoenobryum concavifolium (Griff.) Gangulee.	-	-	-	**X**	-	-	-
Sematophyllum micans (Mitt.) Braithw.	-	-	**X**		-	-	-
Targionia hypophylla L.	-	-	**X**	**X**	-	-	-
Taxiphyllum maniae (Renauld & Paris) M. Fleisch.	**X**	-	-		-	-	-
Thuidium cymbifolium (Dozy &Molk) Dozy & Molk.	-	**X**	**X**		**X**	**X**	-
Thuidium pristocalyx (Mull. Hal.) A. Jaeger	**X**	-	**X**	**X**	**X**	-	-
Trachypodopsis serrulata (P. Beauv.) M. Fleisch	-	-	**X**		-	**X**	-
Vesicularia montagnei (Schimp.) Broth.	-	-	**X**	**X**	-	-	-
Wijkia deflexifolia (Ren. & Card.) Crum	-	-	-	**X**	-	-	-

Table.5. Distribution of bryophytes in relation with forest type and habitat.

EF- (West Coast Tropical Evergreen Forests); SEF- (Semi evergreen Forests); GL - (Grassland) (X-present, - absent)

SPECIES	FOREST TYPE			HABITAT							
						Epiphytic			Terrestrial		
	EF	SF	GL	Base of trees	Upper part of Tree Trunk	Branches and Twigs	Logs	Epiphyllous	Soil (Forest Floor)	Soil (Land cutting)	Rock
Acroporium baviense (Besch.) Broth.	X	X	-	-	X	-	X	-	-	-	-
Aerobryidium filamentosum (Hook.) M. Fleisch.	-	X	-	-	-	X	-	-	-	-	-
Aerobryopsis wallichi (Brid.) M. Fleisch.	-	X	X	-	-	X	-	-	-	-	-
Aerobryum speciosum Dozy & Molk.	-	X	X	-	-	X	-	-	-	-	-
Anthoceros crispulus (Mont.) Douin	-	-	-	-	-	-	-	-	X	-	-
Bazzania tridens (Reinw., Blume & Nees) Trevis.	X	X	-	X	X	-	X	-	-	-	X
Brachymenium nepalense Hook.	X	X	-	-	-	-	-	-	-	-	X
Brachymenium ochianum Gangulee	X	X	-	-	-	-	-	-	-	-	X
Brachythecium buchananii (Hook.) A. Jaeger	X	X	-	-	X	-	-	-	-	-	X
Brachythecium formosanum Takaki	X	X	-	-	X	-	-	-	-	-	X
Bryum argenteum Hedw.	-	-	X	-	-	-	-	-	-	-	X
Bryum wightii Mitt.	X	-	-	-	-	-	-	-	X	-	X
Calicularia crispula Mitt.	X	-	-	X	-	-	-	-	-	-	-
Campylopus flexuosus (Hedw.) Brid.	-	X	X	-	-	-	-	-	-	-	X

Campylopus involutus (Muell. Hal.) A. Jaeger	-	X	-	-	-	-	X	-	X	-	-
Cephaloziella kiaeri (Austin) S. Arnell	-	X	-	-	-	-	-	-	X	-	-
Cheilolejeunea serpentina (Mitt.) Mizut.	-	X	-	-	-	X	-	X	-	-	-
Chiloscyphus campanulatus Steph.	-	X	-	-	-	-	X	-	-	-	-
Chionostomum rostratum (Griff.) C. Muell.	X		-	-	X	-	-	-	-	-	-
Cryptopapillaria fuscescens (Hook.) M. Menzel.		X	-	-	-	X	X	-	-	-	-
Ctenidium lychnites (Mitt.) Broth.	X	X	-	-	X	-	X	-	-	-	-
Cyathophorella adiantum (Griff.) M. Fleisch.	-	X	-	-	X	-	-	-	-	-	-
Daltonia marginata Griff.	-	X	-	-	X	-	-	-	-	-	-
Dumortiera hirsuta (Sw.) Nees	X		-	-	-	-	-	-	-	-	X
Ectropothecium sikkimense (Renauld & Cardot) Renauld & Cardot.	-	-	-	-	X	-	-	-	-	-	-
Entodon chloropus Ren.&Card.	-	X	-	-	-	-	-	-	X	-	-
Entodon macropodus (Hedw.) Muell.	-	X	X	X	-	-	-	-	-	-	-
Entodon nepalensis Mizush.	X	X	-	-	X	-	-	-	-	-	-
Entodon ovicarpus Dix.		X	X	X	-	-	-	-	-	-	-
Entodon plicatus Muell.	X	X	-	-	-	-	X	-	-	-	-
Entodon scariosus Renauld & Cardot	X	X	-	-	-	-	X	-	-	-	X
Eurhynchium hians (Hedw.) Sande Lac.	X	X	-	-	X	-	X	-	-	-	-
Fissidens anomalus Mont.	X	X	-	-	X	-	X	-	-	-	-
Fissidens crispulus Brid. var *crispulus*	-	X	-	-	-	-	-	-	-	X	-
Fissidens involutus Wilson ex Mitt. subsp. *curvatoinvolutus*	-	-	X	-	-	-	-	-	-	X	-

Fissidens pellucidus Hornsch.	-	X	-	-	-	-	-	-	-	-	X
Floribundaria walkeri (Renauld & Cardot) Broth.	X	X	X	-	X	X	X	-	-	-	-
Foreauella orthothecia (Schwgr.) Dixon & P. dela Varde	X	-	-	-	X	-	-	-	-	-	-
Garckea flexuosa (Griff.) Margad. & Nork.	X	X	-	-	-	-	X	-	-	-	-
Heteroscyphus argutus (Nees) Schiffner	X	X	-	-	X	-	-	-	-	-	-
Heteroscyphus perfoliatus (Mont.) Schiffner	X	X	-	-	X	-	-	-	-	-	-
Homalia trichomanoides (Hedw.) Schimp.	X	X	-	-	X	-	-	-	-	-	-
Homaliodendrum flabellatum (Sm.) M. Fleisch.	-	X	-	X	X	-	-	-	-	-	-
Hookeriopsis secunda (Griff.) Broth.	-	X	-	-	-	-	-	-	-	-	X
Hookeriopsis utacamundiana (Mont.) Broth.	-	X	-	X	X	-	-	-	-	-	-
Hymenostomum edentulam (Mitt.) Besch.	X	X	-	-	-	-	-	-	-	-	X
Hypopterygium favolimbatum Muell.	-	X	X	-	X	-	-	-	-	-	-
Hypopterygium tamarisci (Sw.) Brid. ex Muell.	X	X	-	-	X	-	-	-	-	-	X
Isopterygium albescens (Hook.) A. Jaeger	-	-	-	-	-	-	X	-	-	-	-
Isopterygium serrulatum M. Fleisch.	X	-	-	-	-	-	-	-	-	-	X
Jungermannia comata (S. Hatt.) Amak.	X	X	-	-	-	-	X	-	-	-	-
Jungermannia rubripunctata (S. Hatt.) Amak.	X	-	-	-	-	-	-	-	-	X	-
Jungermannia shinii Amakaw	X	X	-	-	-	-	-	-	-	X	-
Lejeunea cavifolia (Ehrh.) Lindb.	X	X	-	-	-	-	X	X	-	X	-

Lejeunea eifrigii Mizut.	**X**	-	-	-	-	-	**X**	-	-	**X**	-
Lejeunea obscura Mitt.	-	**X**	-	-	**X**	-	-	-	-	-	-
Lejeunea tuberculosa Steph.	-	**X**	-	-	-	**X**	-	-	-	-	-
Lejeunea wightii Lindenb.	-	**X**	-	**X**	**X**	-	-	-	-	-	-
Leptohymenium tenue (Hook.) Schwagr.	-	**X**	-	-	**X**	-	-	-	-	-	-
Leptopterigynandrum decolor (Mitt.) M. Fleisch.	**X**	-	-	-	-	-	-	-	-	-	**X**
Leucobryum javense (Brid.) Mitt.	**X**	**X**	-	-	-	-	**X**	-	-	-	-
Leucoloma amoene virens Mitt.	**X**	**X**	-	-	**X**	-	-	-	-	-	-
Macromitrium sulcatum (Hook.) Brid.	**X**	**X**	-	-	**X**	-	-	-	-	-	-
Marchantia linearis Lehm. & Lindenb.	**X**	**X**	-	-	-	-	-	-	-	**X**	**X**
Meiothecium microcarpum (Harv.) Mitt.	-	**X**	-	-	-	-	**X**	-	-	-	-
Meteoriopsis reclinata (Muell. Hal.) M. Fleisch.	-	**X**	**X**	-	-	**X**	-	-	-	-	-
Metzgeria lindbergii Schiffn.	-	**X**	-	-	**X**	**X**	-	-	-	-	-
Pallavicinia lyellii (Hook.) Gray	**X**	-	-	-	-	-	-	-	-	-	**X**
Pelekium velatum Mitt.	-	**X**	**X**	-	**X**	-	**X**	-	-	-	-
Philonotis hastata (Duby) Wijk & Margad.	-	**X**	**X**	-	-	-	-	-	-	-	**X**
Philonotis mollis (Dozy & Molk.) Mitt.	-	**X**	-	-	-	-	-	-	-	-	**X**
Philonotis thwaitessi Mitt.	**X**	**X**	-	-	-	-	-	-	-	-	**X**
Plagiochasma ruprestre (G. Forst.) Stephani	-	**X**	-	-	-	-	-	-	-	-	**X**
Plagiochila arbuscula Lindenb.	-	**X**	-	-	**X**	-	-	-	-	-	-
Plagiochila fruiticosa Mitt.	-	**X**	-	-	**X**	-	-	-	-	-	-
Plagiochila sciophila Nees ex Lindenb.	**X**	**X**	-	-	-	-	-	-	-	-	**X**
Plagiomnium rhynchophorum (Hook.)	**X**	**X**	-	-	-	-	**X**	-	**X**	-	**X**

T.J. Kop.											
Pogonatum microstomum (R. Br.ex Schwagr.) Brid.	X	-	-	-	-	-	-	-	-	X	-
Porella acutifolia (Lehm. & Lindenb.) Trevis.	-	X	-	X	X	-	-	-	-	-	-
Porella campylophylla (Lehm. & Lindenb.) Trevis.	-	X	-	X	X	-	-	-	-	-	-
Pterobryopsis acuminata (Hook.) M. Fleisch.	X	X	-	-	X	-	-	-	-	-	X
Pterobryopsis auriculata Dixon	X	-	-	-	X	-	-	-	-	-	-
Pterobryopsis frondosa (Mitt.) M. Fleisch.	X	X	-	-	X	-	-	-	-	-	-
Pterobryopsis pilifolia (Dixon) Magill		X	-	-	-	-	X	-	-	-	-
Pyrrobryum spiniforme (Hedw.) Mitt.	X	X	-	X	X	-	X	-	-	-	-
Racopilum orthocarpum Wilson ex Mitt.	X	X	-	-	X	-	X	-	-	-	X
Radula javanica Gottsche.	-	-	-	-	X	-	-	-	-	-	-
Reboulia hemisphaerica (L.) Raddi.	X	-	-	-	-	-	-	-	-	X	-
Regmatodon orthostegius Mont.	-	X	-	-	-	-	X	-	-	-	-
Rhodobryum roseum (Hedw.) Limpr.	-	X	X	X	-	-	-	-	-	-	X
Rhynchostegiella menadensis (Sande Lac.)E.B.Bartram	X	X	-	-	X	-	X	-	-	-	-
Rhynchostegiella scabriseta (Schwagr.) Broth.	X	X	-	-	X	-	-	-	X	-	-
Rhynchostegium herbaceum (Mitt.) A. Jaeger	-	X	-	-	-	-	-	-	-	X	-
Riccardia levieri Schiffn.	-	X	-	-	-	-	-	-	-	-	X
Riccardia tenuicostata Schiffn.	X		-	-	-	-	-	-	-	-	X
Schoenobryum concavifolium (Griff.)	-	X	-	-	X	-	-	-	-	-	-

Gangulee.											
Sematophyllum micans (Mitt.) Braithw.	-	**X**	-	-	**X**	-	**X**	-	-	-	-
Targionia hypophylla L.	-	**X**	-	-	-	-	-	-	-	**X**	-
Taxiphyllum maniae (Renauld & Paris) M. Fleisch.	**X**	-	-	-	**X**	-	-	-	-	-	-
Thuidium cymbifolium (Dozy & Molk) Dozy & Molk	-	**X**	**X**	**X**	-	-		-	-	-	**X**
Thuidium pristocalyx (Muell. Hal.) A. Jaeger	-	**X**	**X**	**X**	-	-	-	-	-	-	**X**
Trachypodopsis serrulata (P. Beauv.) M. Fleisch	-	**X**	-		**X**		-	-	-	-	-
Vesicularia montagnei (Schimp.) Broth.	**X**	**X**	-	**X**	-	-	**X**	-	-	-	-
Wijkia deflexifolia (Ren. & Card.) Crum	-	**X**	-	-	**X**		-	-	-	-	-

Table. 6. List bryophytes successfully conserved at MBGIPS, Kozhikode

LIVERWORTS		
Species	**Family**	**Habitat**
Calycularia crispula Mitt.	Calyculariaceae	Lithophytic
Cheilolejeunea serpentina (Mitt.) Mizut.	Lejeuneaceae	Epiphytic
Dumortiera hirsuta (Sw.) Nees	Marchantiaceae	Terrestrial, Lithophytic
Heteroscyphus argutus (Nees) Schiff.	Geocalycaceae	Epiphytic
Marchantia linearis Lehm. & Lindenb.	Marchantiaceae	Terrestrial, Lithophytic
Pallavicinia lyellii (Hook.) Gray	Pallaviciniaceae	Terrestrial, Lithophytic
Plagiochasma rupestre (G. Forst.) Steph.	Aytoniaceae	Terrestrial, Lithophytic
Reboulia hemisphaerica (L.) Raddi.	Aytoniaceae	Terrestrial
Riccardia levieri Schiffn.	Aneuraceae	Terrestrial, Lithophytic
Targionia hypophylla L.	Targioniaceae	Terrestrial
HORNWORTS		
Anthoceros crispulus (Mont.) Douin	Anthocerotaceae	Terrestrial
MOSSES		
Bryum argenteum Hedw.	Bryaceae	Terrestrial
Campylopus flexuosus (Hedw.) Brid.	Dicranaceae	Terrestrial, Lithophytic
Fissidens anomalus Mont.	Fissidentaceae	Terrestrial
Fissidens crispulus Brid.var *crispulus*	Fissidentaceae	Terrestrial
Floribundaria walkeri (Renauld & Cardot) Broth.	Meteoriaceae	Epiphytic
Homaliodendron flabellatum (Sm.) M. Fleisch.	Neckeraceae	Epiphytic
*Macromitrium sulactum (*Hook.) Brid.	Orthotrichaceae	Epiphytic
Meteoriopsis squarrosa (Mull. Hal.) M. Fleisch.	Meteoriaceae	Epiphytic
Philonotis hastata (Duby) Wijk & Margad.	Bartramiaceae	Terrestrial, Lithophytic
Philionotis thwaitesii Mitt.	Bartramiaceae	Terrestrial
Plagiomnium rhynchophorum (Hook.) T.J. Kop.	Mniaceae	Terrestrial
Pogonatum microstomum (R. Br. ex Schwagr.) Brid.	Polytrichaceae	Terrestrial
Pterobryopsis auriculata Dixon	Pterobryaceae	Terrestrial
Thuidium pristocalyx (Mull. Hal.) A. Jaeger	Thuidiaceae	Lithophytic

DISCUSSION

Bryophytes, the second largest group of land plants next to flowering plants, are one of the least studied groups in Plant Kingdom and the available data on this interesting plant group is very sparse. The scarcity of authentic literature and lack of experts made the plant identification extremely difficult and hence, mainstream botanists usually ignored this group. In India, Himalayas and Western Ghats harbour the highest number of Bryophytes. Northern India has bryologically more explored than southern India. The present investigation may trigger more bryological investigations in south India especially in Kerala state. Detailed floristic explorations of smaller geographical areas are found to be more fruitful than studying vast and different places. Mathikettan shola National Park is such a limited area (12.82 sq.km) with high percentage of endemism and biodiversity. Abundant rainfall, humid climatic conditions, undulating topography and presence of perennial water sources in this area are highly significant for the growth and proliferation of liverworts and mosses. The area has not been subjected to bryological explorations so far. Hence, the present work is an important step towards the assessment of biodiversity of the National Park in general and role of bryophyte in this unique ecosystem in particular.

The present study focussed on a comparatively smaller geographical area of great biodiversity which is found to be an effective method for developing a national database. In this study, 104 species of bryophytes could be documented including many new distributional records to Kerala and Peninsular India. The occurrence of 104 species in a smaller area of 12.82 sq. km shows the bryological richness of Mathikettan Shola National Park when compared to the total number of species reported from the entire state of Kerala, i.e., 650 species (Manju & Rajesh, 2017).

The present study reveals the occurrence of 104 species of Bryophytes belonging to 71 genera under 45 families and 17 orders. Hypnales is the largest order with 13 families followed by Jungermanniales with 5 families, Dicranales and Marchantiales each with 4 families, Hookeriales and Porellales each with 3 species,

Bryales and Metzgeriales each with 2 species, Anthocerotales, Bartramiales, Fossombroniales, Hypnodendrales, Orthotrichales, Pallaviciniales, Polytrichales, Pottiales and Rhyzogoniales represented with single family. Out of this, Liverworts comprises 30 species belonging to 19 genera and 16 families, hornworts is represented by a single species and mosses comprises 73 species belonging to 51 genera and 25 families. Lejeuneaceae with 6 species, Jungermanniaceae, Lophocoleaceae and Plagiochilaceae each with 3 species are the largest families in Liverworts. In Mosses Brachytheciaceae with 7 species, Entodontaceae and Meteoriaceae with 6 species each, and Bryaceae with 5 species are the largest families followed by Hypnaceae, Fissidentaceae, Sematophyllaceae and Pterobryaceae with 4 species each and Leucobryaceae, Bartramiaceae, Hypopterygiaceae and Thuidiaceae are with 3 species each. The other families *viz.,* Aytoniaceae, Aneuraceae, Porellaceae, Hookeriaceae, Hylocomiaceae and Neckeraceaeare are represented by 2 species each, and Anthocerotaceae, Calyculariaceae, Cephaloziaceae, Cryphaeceae, Daltoniaceae, Ditricaceae, Dumortieraceae, Lepidoziaceae, Leskeaceae, Marchantiaceae, Metzgeriaceae, Mniaceae, Orthotrichaceae, Pallaviciniaceae, Polytrichaceae, Pottiaceae, Radulaceae, Racopilaceae, Regmatodontaceae, Rhizogoniaceae, Targioniaceae and Trachypodaceae are represented with single species. Among the genera *Entodon* is the largest genus with 6 species followed by *Lejeunea* with 5 species, *Fissidens* and *Pterobryopsis* with 4 species, *Jungermannia*, *Philonotis* and *Plagiochila* with 3 species each, *Brachymenium, Brachythecium, Bryum, Campylopus, Heteroscypus, Hookeriopsis, Hypopterygium, Isopterygium, Porella, Rhynchostegiella, Riccardia* and *Thuidium* with 2 species each. Other 52 genera are represented by single species each. The details are given in Table 7.

Table 7. List of Bryophytes collected and Identified from Mathikettan Shola National Park.

ORDER	FAMILY	SPECIES	HABITAT
Liverworts			
Marchantiales	Marchantiaceae	*Marchantia linearis* Lehm. &Lindenb.	Rock
	Aytoniaceae	*Plagiochasma ruprestre* (G. Forst.) Steph.	Rock
		Reboulia hemisphaerica (L.) Raddi.	Soil
	Targioneaceae	*Targionia hypophylla* L.	Soil
	Dumortieraceae	*Dumortiera hirsuta* (Sw.) Nees	Rock
Fossombroniales	Calicullariaceae	*Calicularia crispula* Mitt.	Bark
Pallaviciniales	Pallaviciniaceae	*Pallavicinia lyellii* (Hook.) Gray	Rock
Metzgeriales	Metzgeriaceae	*Metzgeria lindbergii* Schiffn.	Bark
	Aneuraceae	*Riccardia levieri* Schiffn.f	Rock
		Riccardia tenuicostata Schiffn.,	Rock
Porellales	Porellaceae	*Porella acutifolia* (Lehm. & Lindenb.) Trevis.	Bark
		Porella campylophylla (Lehm. & Lindenb.) Trevis.	Bark
	Radulaceae	*Radula javanica* Gottsche	Bark
	Lejeuneaceae	*Cheilolejeunea serpentina* (Mitt.) Mizut.	Bark
		Lejeunea cavifolia (Ehrh.) Lindb.	Log, Rock
		Lejeunea eifrigii Mizut.	Log, Soil
		Lejeunea obscura Mitt.	Bark
		Lejeunea tuberculosa Steph.	Bark
		Lejeunea wightii Lindenb.	Bark
Jungarmaniales	Lepidoziaceae	*Bazzania tridens* (Reinw., Blume & Nees) Trevis.	Bark,Log, Rock
	Lophocoleaceae	*Chiloscyphus campanulatus* Steph.	Log
		Heteroscyphus argutus (Reinw., Blume & Nees) Schiffn	Bark
		Heteroscyphus perfoliatus (Mont.) Schiff.	Bark
	Plagiochilaceae	*Plagiochila arbuscula* Lindenb.	Bark
		Plagiochila fruiticosa Mitt.	Bark
		Plagiochila sciophila Nees ex Lindenb.	Rock
	Cephaloziaceae	*Cephaloziella kiaeri* (Austin) S. Arnell	Soil

	Jungermanniaceae	*Jungermannia comata* (S. Hatt.) Amak.	Log
		Jungermannia rubripunctata (S.Hatt.) Amak.	Soil
		Jungermannia shinii Amakaw	Soil
Hornworts			
Anthocerotales	Anthocerotaceae	*Anthoceros crispulus* (Mont.) Douin	Soil
Mosses			
Polytrichales	Polytrichaceae	*Pogonatum microstomum* (R.Br. ex Schwagr.) Brid.	Soil cutting
Dicranales	Fissidentaceae	*Fissidens anomalus* Mont.	Bark
		F.crispulus var. *crispulus*	Bark
		F. involutus subsp. *curvatoinvolutus*	Soil
		Fissidens pellucidus Hornsch.	Rock
	Ditrichaceae	*Garckea flexuosa* (Griff.) Margad. & Nork.	Log
	Dicranaceae	*Leucoloma amoenevirens* Mitt.	Bark
	Leucobryaceae	*Campylopus flexuosus* (Hedw.) Brid.	Rock
		Campylopus involutus (Mull. Hal.) A. Jaeger	Log
		Leucobryum javense (Brid.) Mitt.	Log
Pottiales	Pottiaceae	*Hymenostomum edentulam* (Mitt.) Besch.	Rock
Bryales	Bryaceae	*Brachymenium nepalense* Hook.	Bark
		Brachymenium ochianum Gangulee	Rock
		Bryum argenteum Hedw.	Rock
		Bryum wightii Mitt.	Rock, Soil
		Rhodobryum roseum (Hedw.) Limpr.	Bark, Rock
	Mniaceae	*Plagiomnium rhynchophorum* (Hook.) T.J. Kop.	Rock, Soil
Bartramiales	Bartramiaceae	*Philonotis hastata* (Duby) Wijk & Margad.	Rock
		Philonotis mollis (Dozy & Molk.) Mitt.	Rock
		Philonotis thwaitessii Mitt.	Rock
Orthotrichales	Orthotrichaceae	*Macromitrium sulcatum* (Hook.) Brid.	Bark
Rhyzogoniales	Rhizogoniaceae	*Pyrrobryum spiniforme* (Hedw.) Mitt.	Bark, Log
Hypnodendrales	Racopilaceae	*Racopilum orthocarpum* Wilson ex Mitt.	Rock,Soil,Log
Hookeriales	Hypopetrygiaceae	*Cyathophorella adiantum* (Griff.) M. Fleisch.	Bark
		Hypopterygium flavolimbatum Mull.	Bark

		Hypopterygium tamarisci (Sw.) Brid. ex Mull.	Rock, Bark
	Daltoniaceae	*Daltonia marginata* Griff.	Bark
	Hookericaeae	*Hookeriopsis secunda* (Griff.) Broth.	Rock
		Hookeriopsis utacamundiana (Mont.) Broth.	Rock, Bark
Hypnales	Leskeaceae	*Leptopterigynandrum decolor* (Mitt.) M. Fleisch.	Rock
	Thuidiaceae	*Pelekium velatum* Mitt.	Bark, Log
		Thuidium cymbifolium (Dozy & Molk.) Dozy & Molk.	Rock, Bark
		Thuidium pristocalyx (Mull. Hal.) A. Jaeger	Bark, Rock
	Regmatodontaceae	*Regmatodon orthostegius* Mont.	Log
	Brachytheciaceae	*Aerobryum speciosum* Dozy &Molk.	Bark
		Brachythecium buchananii (Hook.) A. Jaeger	Bark, Rock
		Brachythecium formosanum Takaki	Bark
		Eurhynchium hians (Hedw.) Sande Lac.	Bark
		Rhynchostegiella menadensis (Sande Lac.) E.B. Bartram	Bark
		Rhynchostegiella scabriseta (Schwagr.) Broth.	Bark, Soil
		Rhynchostegium herbaceum (Mitt.) A. Jaeger	Soil
	Meteoriaceae	*Aerobryidium filamentosum* (Hook.) M. Fleisch	Bark
		Aerobryopsis wallichii (Brid.) M. Fleisch.	Bark
		Cryptopapillaria fuscescens (Hook.)M. Menzel.	Log
		Floribundaria walkeri (Renauld & Cardot) Broth.	Log, Bark
		Meteoriopsis reclinata (Mull. Hal.) M. Fleisch.	Bark
		Trachypodopsis serrulata (P. Beauv.) M. Fleisch	Bark
	Hypnaceae	*Ectropothecium sikkimense* (Renauld & Cardot) Renauld & Cardot.	Bark
		Foreauella orthothecia (Schwagr.) Dixon & P. de la Varde	Bark

		Taxiphyllum maniae (Renauld & Paris) M. Fleisch.	Bark
		Vesicularia montagnei (Schimp.) Broth.	Log
	Hylocomiaceae	*Ctenidium lychnites* (Mitt.) Broth.	Log, Bark
		Leptohymenium tenue (Hook.) Schwagr.	Bark
	Entodontaceae	*Entodon chloropus* Ren.&Card.	Soil
		Entodon macropodus (Hedw.) Mull.	Bark
		Entodon nepalensis Mizush.	Bark
		Entodon ovicarpus Dix.	Bark
		Entodon plicatus Mull.	Log
		Entodon scariosus Renauld & Cardot	Log
	Pylaisiadelphaceae	*Isopterygium albescens* (Hook.) A. Jaeger	Log
		Isopterygium serrulatum M. Fleisch.	Rock
		Wijkia deflexifolia (Ren. & Card.) Crum	Bark
	Sematophyllaceae	*Acroporium baviense* (Besch.) Broth.	Bark, Log
		Chionostomum rostratum (Griff.) C. Mull.	Bark
		Meiothecium microcarpum (Harv.) Mitt.	Log
		Sematophyllum micans (Mitt.) Braithw.	Bark, Log
	Cryphaeaceae	*Schoenobryum concavifolium* (Griff.) Gangulee.	Bark
	Pterobryaceae	*Pterobryopsis acuminata* (Hook.) M. Fleisch.	Soil, Bark
		Pterobryopsis auriculata Dixon	Bark
		Pterobryopsis frondosa (Mitt.) M. Fleisch.	Bark
		Pterobryopsis pilifolia (Dixon) Magill	Log
	Neckeraceae	*Homalia trichomanoides* (Hedw.) Schimp.	Bark
		Homaliodendrum flabellatum (Sm.) M. Fleisch.	Bark

Out of the 30 species of liverworts one species is a new record to the Peninsular India and four species are new to Kerala. In mosses out of the 73 species six are new to Peninsular India and seven species are new to Kerala.

List of species recorded as new to Peninsular India

Liverworts

- *Jungermannia comata* Nees.

Mosses

- *Daltonia marginata* Griff.
- *Entodon nepalensis* Mizush. (Rajilesh & Prakashkumar, 2017)
- *Leptopterigynandrum decolor* (Mitt.) M. Fleisch.
- *Meiothecium microcarpum* (Harv.) Mitt.
- *Rhynchostegiella menadensis* (Sande Lac.) E.B. Bartram.
- *Rhynchostegiella scabriseta* (Schwagr.) Broth.

List of species recorded as new to Kerala.

Liverworts

- *Calycularia crispula* Mitt.
- *Chiloscyphus campanulatus* Steph.
- *Lejeunea obscura* Mitt.
- *Metzgeria lindbergii* Schiffn.

Mosses

- *Brachythecium formosanum* Takaki.
- *Entodon chloropus* Ren.&Card.
- *Homalia trichomanoides* (Hedw.) Schimp.
- *Hookeriopsis utacamundiana* (Mont.) Broth.

- *Pterobryopsis pilifolia* (Dixon) Magill.
- *Trachypodopsis serrulata* (P. Beauv.) M. Fleisch.
- *Wijkia deflexifolia* (Ren. & Card.) Crum.

Habitat and Ecology

When critically observed the 104 taxa recorded from the study area based on ecological paramaters like altitudinal variations, forest types and habitat nature, it has been found that some species viz. *Bazzania tridens* (Reinw., Blume & Nees) Trevis., *Brachythecium buchananii* (Hook.) A. Jaeger, *Bryum argenteum* Hedw., *Ctenidium lychnites* (Mitt.) Broth., *Entodon scariosus* Renauld & Cardot, *Floribundaria walkeri* (Renauld & Cardot) Broth., *Hypopterygium tamarisci* (Sw.) Brid. ex Mull., *Plagiomnium rhynchophorum* (Hook.) T.J. Kop., *Racopilum orthocarpum* Wilson ex Mitt., *Rhynchostegiella scabriseta* (Schwaegr.) Broth., *Thuidium cymbifolium* (Dozy & Molk.) Dozy & Molk, etc are found in almost all forest types and substratum. Out of the 104 taxa, 90 are reported from the shola forest areas and was followed west coast tropical evergreen forest with 52 taxa. About 14 taxa were reported from grassland.

Plants like *Aerobryidium filamentosum* (Hook.) M. Fleisch, *Cyathophorella adiantum* (Griff.) M. Fleisch., *Daltonia marginata* Griff., *Fissidens pellucides* Hornsch., *Hookeriopsis secunda* (Griff.) Broth., *Hookeriopsis utacamundiana* (Mont.) Broth., *Hypopterygium favolimbatum* Mull., *Isopterygium albescens* (Hook.) A. Jaeger, *Lejeunea obscura* Mitt., *L. tuberculosa* Steph., *L. wightii* Lindenb., *Leptohymenium tenue* (Hook.) Schwagr., *Meiothecium microcarpum* (Harv.)Mitt., *Metzgeria lindbergii* Schiffn., *Philonotis mollis* (Dozy & Molk.) Mitt., *Plagiochasma rupestre* (G.orst) Steph., *Plagiochila arbuscula* Lindenb., *Plagiochila fruiticosa* Mitt., *Porella acutifolia* (Lehm. & Lindenb.) Trevis., *Porella campylophylla* (Lehm. & Lindenb.) Trevis., *Pterobryopsis pilifolia* (Dixon) Magill, *Radula javanica* Gottsche., *Regmatodon orthostegius* Mont., *Rhynchostegium herbaceum* (Mitt.) A. Jaeger, *Riccardia levieri* Schiffn., *Schoenobryum concavifolium* (Griff.) Gangulee., *Sematophyllum micans* (Mitt.) Braithw., *Targionia hypophylla* L., *Trachypodopsis serrulata* (P. Beauv.) M. Fleisch, *Wijkia*

deflexifolia (Ren. & Card.) Crum., etc. are mainly associated with shola forests. From this it is evident that shola forest areas are the most suitable habitat for the growth of bryophytes. It is also noted that the size and growth of the many species and the development of sporophyte is maximum in this area.

Altitude wise distribution of the taxa were studied and noted that in the 1501- 1600m altitudinal ranges where total 49 taxa have been reported, followed by 1401-1500 m altitudinal ranges where 42 taxa have been reported. Minimum number about 5 taxa were found at 1801-1984 m altitudinal ranges

The habitat wise distribution data of 104 taxa revealed that a total 58 taxa are truly epiphytes and 31 taxa are exclusively terrestrial. The rest are found in both as epiphyte and in terrestrial habitats. The epiphytic species are profusely growing on stem, bark, log, etc. The epiphytes usually hang from tree branches or firmly attach to the substratum and grow as a thick mat on logs.

Endemic plants

The National Park is also home to some Indian endemic bryophytes viz., *Chiloscyphus campanulatus* Steph., *Entodon ovicarpus* Dix., *Floribundaria walkeri* (Renauld & Cardot) Broth., *Lejeunea wightii* Lindenb. *Heteroscyphus perfoliatus* (Mont.) Schiff., *Hookeriopsis secunda* (Griff.) Broth., *Isopterygium serrulatum* M. Fleisch., *Pterobryopsis auriculata* Dixon, *Pterobryopsis pilifolia* (Dixon) Magill and *Rhynchostegiella scabriseta* (Schwagr.) Broth. and *Wijkia deflexifolia* (Ren. & Card.) Crum.

Economically important plants

Based on the literature studies it is found that some of the plants collected from the study area are used as antifungal, antimicrobial, anticancer agent and some species used as other purpose like indicators, skin diseases, etc. The list of economically important species, family and their uses are given in the table 8.

Table 8. The list of economically important bryophytes found in MSNP.

Species	Family	Uses
Bazzania tridens (Reinw., Blume & Nees) Trevis.	Lepidoziaceae	Antimicrobial properties (Zhu *et al;* 2006.)
Brachythecium sp.	Brachytheciaceae	Site indicators for Gypsum (Bahuguna *et al,* 2013)
Bryum spp.	Bryaceae	Site indicators for Gypsum (Bahuguna *et al,* 2013)
Bryum argenteum Hedw.	Bryaceae	Antifungal, Antipyretic (Chandra *et al*., 2017)
Dumortiera hirsuta (Sw.) Nees	Marchantiaceae	Antibiotic (Chandra *et al*., 2017)
Fissidens sp.	Fissidentaceae	Rock builders (Issac, 2013)
Entodon nepalensis Mizush.	Entodontaceae	Antibacterial (Alam *et al*., 2012)
Marchantia sp.	Marchantiaceae	Anticancer (Chen, 2005)
Pallavicinia lyellii (Hook.) Gray	Pallaviciniaceae	Antimicrobial (Subhisha & Subramoniam, 2005)
Philonotis hastata (Duby) Wijk & Margad.	Bartramiaceae	Antimicrobial agent (Makinde *et al.,* 2015)
Plagiochila sp.	Plagiochilaceae	Antimicrobial, Anti-leukemic (Chandra *et al*., 2017)
Plagiochasma rupestre (G. Forst.) Steph.	Aytoniaceae	Antifungal activity (Alam, 2012)
Plagiomnium rhynchophorum (Hook.) T.J. Kop.	Mniaceae	Anticancer (Martin *et al*., 2018)
Reboulia sp.	Aytoniaceae	Antimicrobial activity (Saxena & Harinder, 2004)
Targionia hypophylla L.	Targioniaceae	Skin diseases (Chandra *et al*., 2017)

Ex-situ Conservation

The study shows that out of 104 species 25 taxa are successfully established in the conservatory which includes 10 Liverworts, 1 Hornwort and 14 Mosses. These high altitude plants were successfully acclimatized with the climatic conditions provided in the conservatory. Out of 25 taxa in the conservatory 19 taxa are terrestrial and 6 taxa are epiphytic. It is shown that terrestrial and lithophytic species *viz. Dumortiera hirsuta* (Sw.) Nees, *Pallavicinia lyellii* (Hook.) Gray, *Philonotis hastata* (Duby) Wijk & Margad*., P. thwaitesii* Mitt. *Riccardia levieri* Schiffn*., Reboulia hemisphaerica* (L.) Raddi., etc. are well acclimatized on the large rocky substratum, where many species colonize to form continuous patches. These plants provide substratum for higher plants to grow. Some pteridophytes also grow along with bryophytes. These species were also seen on vertically placed round bottomed flat pot (Bonsai pot) in the conservatory. Epiphytic species kept in the husk of coconut and small pieces of palm bark.

Species conserved as *ex situ* in the MBGIPS may serve as important resource for researchers and students to study the plants which are mostly growing on high altitude forest areas. In the future these plants may also be used for studying the applied aspects of these plants. It will be very advantageous to the students and teachers of biology and nature lovers to observe the live specimens of bryophytes conserved at MBGIPS.

SUMMARY

The present study conducted in the Mathikettan Shola National Park, one of the smallest National Park in Kerala state (12.82 sq. km), during the period 2012-2018. The area has not been subjected to detailed bryological explorations till the present attempt. Abundant rainfall, humid climatic conditions, undulating topography and presence of perennial water sources, etc. makes the park an ideal place for the growth and proliferation of bryophytes.

The present study reports 104 species of Bryophytes from the study area belonging to 71 genera under 45 families and 17 orders. Among the three phylums, Marchantiophyta (liverworts) comprise 30 species belonging to 19 genera and 16 families, Anthocerotophyta (hornworts) with one species and Bryophyta (mosses) represented by 73 species belonging to 51 genera and 25 families (Fig.2). Hypnales is the largest order with 13 families followed by Jungermanniales with 5 families, Dicranales and Marchantiales each with 4 species, Hookeriales and Porellales each with 3 species each, Bryales and Metzgeriales with 2 species each and 10 orders are represented by single families each.

Family wise analysis revealed that Lejeuneaceae with 6 species, Jungermanniaceae and Plagiochilaceae with 3 species are the largest families in Liverworts. Brachytheciaceae with 7 species, Meteoriaceae and Entodontaceae with 6 species each are the largest families in mosses followed by Bryaceae with 5 species and Fissidentaceae, Hypnaceae Pterobryaceae and Sematophyllaceae with 4 species each. 22 families are represented by single species each. Among the genera, *Entodon* is the largest genus with 6 species followed by *Lejeunea* with 5 species, *Fissidens* and *Pterobryopsis* with 4 species, *Jungermannia, Philonotis* and *Plagiochila* each with 3 species, *Bryum, Brachymenium, Brachythecium, Campylopus, Heteroscyphus , Hookeriopsis, Hypopterygium, Porella, Riccardia*, *Rhynchostegiella* and *Thuidium* each with 2 species each), 48 genera are represented by single species each.

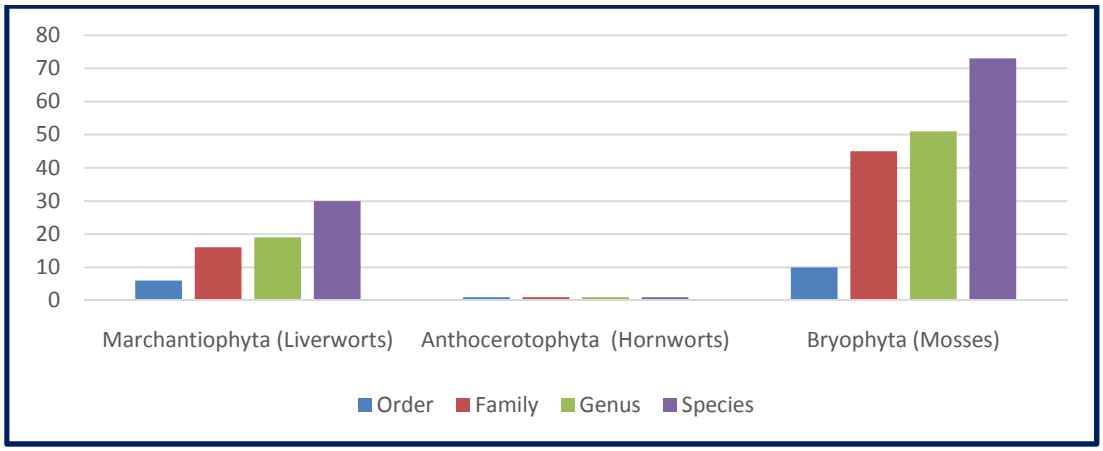


Fig. 2. Analysis of different phylums of Bryophytes in Mathikettan Shola National Park.

Jungermannia comata Nees., *Daltonia marginata* Griff., *Entodon nepalensis* Mizush., *Leptopterigynandrum decolor* (Mitt.) M. Fleisch., *Meiothecium microcarpum* (Harv.) Mitt., *Rhynchostegiella menadensis* (Sande Lac.) E.B. Bartram. And *Rhynchostegiella scabriseta* (Schwagr.) Broth. are newly reported from Peninsular India. *Calycularia crispula* Mitt., *Chiloscyphus campanulatus* Steph., *Lejeunea obscura* Mitt., *Metzgeria lindbergii* Schiffn., *Brachythecium formosanum* Takaki, *Entodon chloropus* Ren. & Card., *Homalia trichomanoides* (Hedw.) Schimp., *Hookeriopsis utacamundiana* (Mont.) Broth., *Pterobryopsis pilifolia* (Dixon) Magill., *Trachypodopsis serrulata* (P. Beauv.) M. Fleisch., *Wijkia deflexifolia* (Ren. & Card.) Crum. are new records to the state of Kerala.

Habitat and ecological analysis revealed that out of the 104 taxa identified, 90 were found to be occurred in the shola forest areas and was followed by west coast tropical evergreen forest with 52 taxa, about 14 taxa were reported from grasslands (Fig.3).

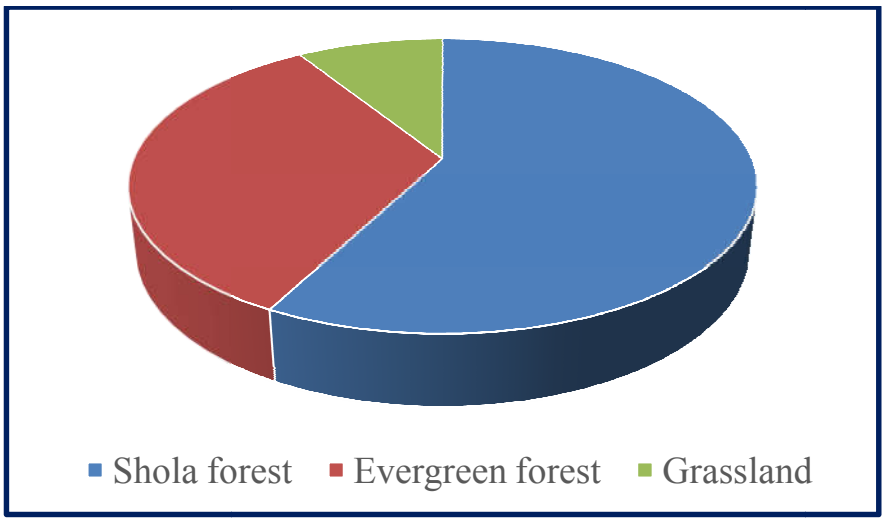


Fig. 3. Distribution of bryophytes in various forest types

Altitude wise distribution of the taxa were studied and noted that maximum species (49 taxa) found in 1501-1600 m ranges, followed by 1401-1500 m altitudinal ranges with 42 taxa. Minimum number (5 taxa) was found at 1801-1984 m altitudinal ranges (Fig.4).

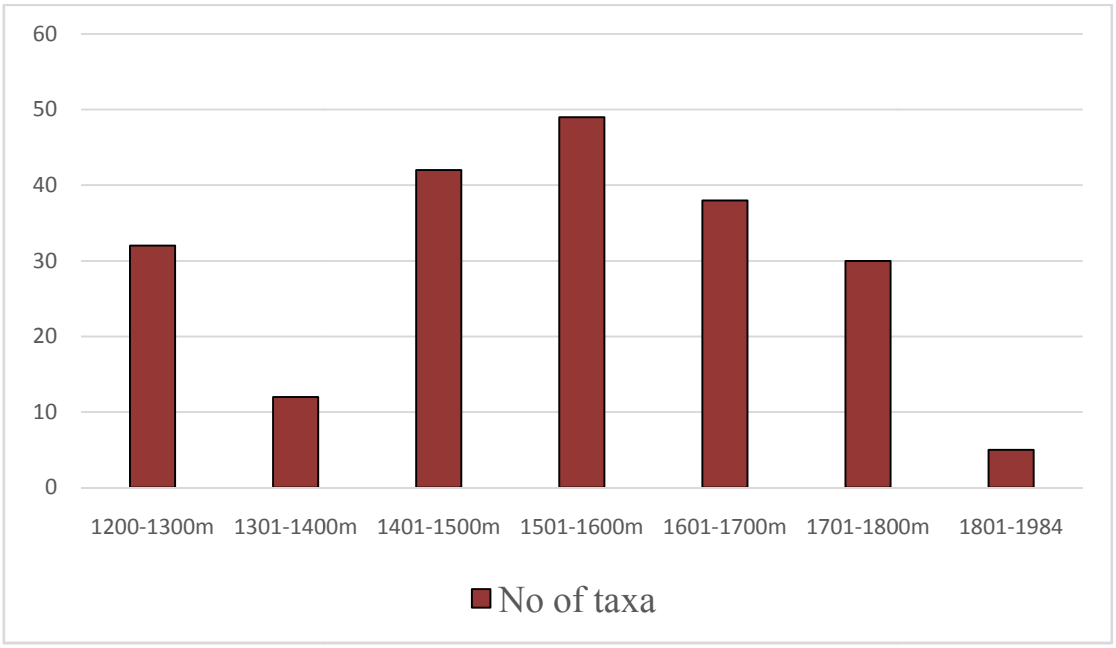


Fig. 4. Distribution of bryophytes in various altitudinal levels

The habitat wise distribution data of 104 taxa revealed that a total 58 taxa are truly epiphytes and 31 taxa are exclusively terrestrial. The rest are found both as epiphyte and terrestrial habitats (Fig.5).

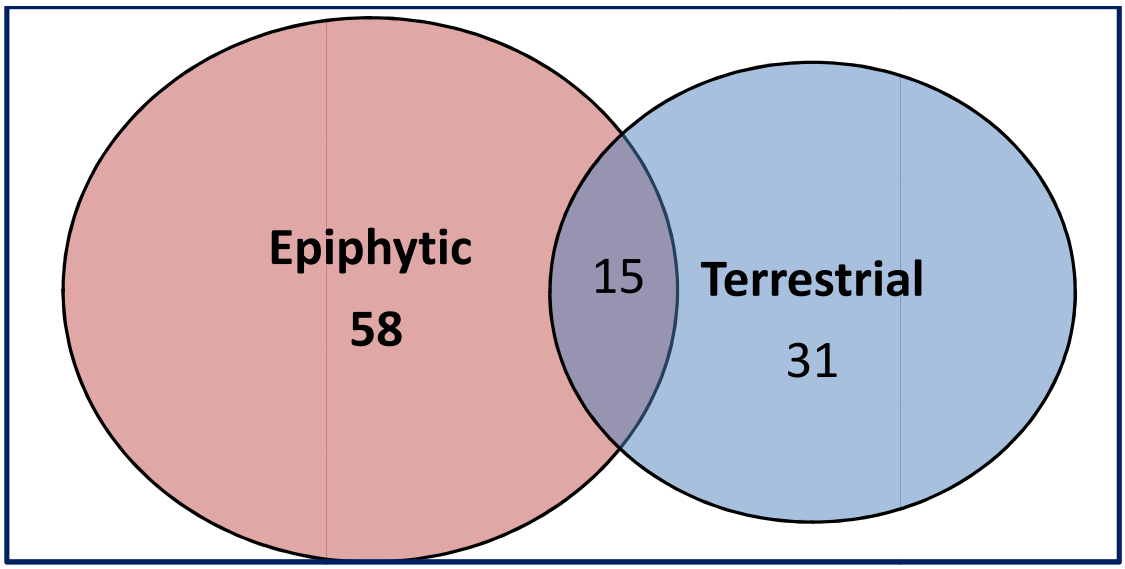


Fig. 5. Habitat wise Distribution of bryophytes in Mathikettan Shola National Park

Out of the 104 species from the study area 25 taxa could be successfully conserved in the Bryophyte conservatory at MBGIPS which includes 10 liverworts, one hornwort and 14 mosses.

The present study attempted to throw light on the unexplored bryophyte diversity of Mathikettan Shola National Park in the Idukki district of Kerala state. The Western Ghats biodiversity hotspot is exceptionally rich in bryophyte diversity and the bryoflora present here is comparatively less explored than other parts of the country. Hence, the present work may trigger more wide and comprehensive bryological survey in this part of the country, which may ultimately results in the discoveries of novelties and more useful plants for mankind.

BIBLIOGRAPHY

Adderley, L. 1964. Two species of moss as culture media for orchids. *Amer. Orchid Soc. Bull.* 34: 967-968.

Alam, A. 2012a. Antifungal activity of *Plagiochasma rupestre* (Forst.) Steph. extracts, *Researcher*, 4(3): 62-64.

Alam, A. 2012b. Liverworts Flora of Parson's valley, Nilgiri hills (Western Ghats), South India. *Archive for Bryology* 119: 1-20.

Alam, A., 2013. *Moss flora of Munsiyari (Uttarakhand), Western Himalayas, India*. Univ. Bibliothek.

Alam, A., K.K. Behera, S.Vats and M.Iqbal. 2013. *A preliminary study on bryodiversity of Similipal Biosphere Reserve (Odisha), India*. Univ.-Bibliothek.

Alam, A., K.K. Rawat, P.K. Verma,V. Sharma and D.S.Gupta. 2015. Moss flora of central India. *Plant science today*, *2*(4).159-171.

Alam, A., P.K Verma, G. Asthana and S.Yadav. 2011. *Moss Flora of Palni Hills (Tamil Nadu), India*- A Checklist. Univ.-Bibliothek..

Alam, A. and S.C. Srivastava. 2009. Liverwort diversity in Palni hills (Tami Nadu)- A checklist. *Nelumbo*. 51: 99-122.

Alam, A. and S.C. Srivastava. 2012. Hepaticae of Nilgiri Hills, Western Ghats (India), Vol. I: Terrestrial Diversity. Lambert Academic Publishers, Germany. 400.

Alam, A., S. Pandey, V. Singh, S.C. Sharma and V. Sharma. 2014. Moss flora of Mount Abu (Rajasthan), India: An updated checklist. *Trop Plant Res*, 1(1). 8-13.

Alam, A., V. Sharma, S.C. Sharma and P. Kumari. 2012. Antibacterial activity of the alcoholic extracts of *Entodon nepalensis* Mizush. against some pathogenic bacteria. *Report and Opinion* 4(10): 44-47.

Ando, H. 1957. Notes on useful bryophytes. *Bull. Biol. Soc*., 7(2): 23-26.

Aruna, K.B. and K.C. Krishnappa. 2014. *Distribution of Bryophytes in Malnad Regions Chikmangalur District, Karnataka, The Western Ghats*. Ph.D Thesis, Kuvambo University, Karnataka.

Asthana, A.K. and A. Srivastava, A., 2015. A study on genus *Fissidens* Hedw. in Meghalaya (North-Eastern Hills), India. *Taiwania*, 60(3).

Asthana, A.K. and S.C. Srivastava. 1986. A new *Folioceros* from Silent Valley. *Cryptogamic. Bryol. et Lichenol.* 7(2): 149-1 53.

Asthana, A.K. and S.C. Srivastava. 1991. lndian Hornworts (A taxonomic study) *Bryophytorum Bibliotheca* (Germany) 42: 1-1 58.

Asthana, A.K. and V.Sahu. 2013. Bryophyte diversity in Mukteshwar (Uttarakhand): an overview. *Archive for Bryology.*154:1-11.

Asthana, G., S.C. Srivastava and A.K. Asthana. 1995. The genus *Cheilolejeunea* in India. *Lindbergia* 20: 125-143.

Asthana, A. K. and V. Nath. 2007. Hepatics and Anthocerotes (Bryophyta) of Tamia and Patalkot valley (district Chhindwara), Madhya Pradesh. *J. Bombay Nat. Hist. Soc*, 104(3).275-287.

Awasthi, U.S. 1984. *Acrolejeunea sikkimensis* (Mizut.) Gradst. in Kerala. *J. lndian Bot, Soc.* 163: 30.

Awasthi, U.S. and R. Udar. 1984. The genus *Mastigolejeunea* (Spruce) Schiffn. in India. *Proc. lndian Acad. Sci. (PI. Sci.)*93: 485-494.

Awasthi, U.S. and S.C. Srivastava. 1985. Observations on *Acrolejeunea sikkimensis* (Mizut.) Gradst. from Kerala, South India. *Lindbergia* 1l: 83-85.

Awasthi, U.S., S.C. Srivastava and D. Sharma. 2000. *Lopholejeunea* (Spruce) Schiffn. in India. *Geophytology* 29: 35-60.

Bagawan, S.A. and B. A. Kore. 2012. Liverworts and hornworts of Kas Plateau. The Bioscan 7(2): 289-290.

Bahuguna, Y. M., S. Gairola, D. P. Semwal, P. L. Uniyal and A. B. Bhatt. 2013. *Bryophytes and ecosystem. Biodiversity of lower plants.* IK International Publishing House Pvt. Ltd. 279-296.

Bahuguna, Y.M., S. Gairola, P.L. Uniyal, and A.B.Bhatt. 2016. Moss Flora of Kedarnath Wildlife Sanctuary (KWLS), Garhwal Himalaya, India. *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences*, 86(4).931-943.

Banerjee, R. D. 2001. *Antimicrobial activities of bryophytes- A review*. *In:* V. Nath & A. K. Asthana (eds.) *Perspectives in lndian Bryology.* Bishen Singh Mahendrapal Singh, Dehra Dun. 55-74.

Banerji, M. L. 1958. Notes on the livewort flora of East Nepal. *J. Bombay Nat. Hist. Soc*. 55: 37- 41.

Bansal, P., V. Nath and S.K. Chaturvedi. 2011. Epiphytic bryophytes on Thuja orientalis in Nagaland, North-eastern India. *Bangladesh Journal of Plant Taxonomy*, 18(2).163-67.

Bapna, K. R. 1958. A note on Hepatic flora of Mt. Abu. *Curr. Sci.* 7: 259-260.

Bapna, K.R. and P. Kachroo. 1999a. *Hepaticology in lndia* I. Himanshu Publications, Udaipur.

Bapna, K.R. and P. Kachroo. 1999b. *Hepaticology in lndia* 11. Himanshu Publications, Udaipur.

Bapna, K.R. and P.Kachroo. 2000. *Hepaticology in India*. Himanshu Publications.

Barbhuiya, H.A. and S.K. Singh. 2012. Liverwort and Hornwort of Borail Wild Life Sanctuary, Assam, India. *Archive for Bryology.*134: 1-12.

Bargali, R., V. Awasthi and N. Pande. 2014. Ecological study of bryophytes on Platanus orientalis L. trees in Nainital (Western Himalaya). *American Journal of Plant Sciences*, *5*(26).3880.

Bartram, E. B. 1955. North-Western Himalayan mosses 1. *Bull. Torrey. Bot. Club* 82: 22-29.

Bartram, E.B. 1960. North-Western Himalayan mosses II. Rev. *Bryol. et Lichenol*. 29: 165-172.

Belcik, F.P. and N. Wiegner. 1980. Antimicrobial activities or antibiosis of certain eastern U. S. liverwort, lichen and moss extracts. *J. Elisha Mitchell Sci. Soc*. 96:94.

Bhardwaj, D.C. 1950. Studies in lndian Anthocerotaceae-I. The morphology of *Anthoceros crispulus* (Montin) Douin. *J. lndian Bot. Soc*. 29: 145-163.

Bhardwaj, D.C. 1960. Studies in lndian Anthocerotaceae-II. The morphology of *Anthoceros* cf. *gemmulosus* (Hattori) Pande. *J. lndian Bot. Soc.* 37: 75-92.

Bhardwaj, D.C. 1965 a. Studies in lndian Anthocerotaceae. IV. On the morphology of *Anthoceros mammilisporus* D. C. Bhardwaj and *A. dixitians* (Mahabale) Prosk. *J. lndian Bot. Soc.* 44: 347-364.

Bhardwaj, D.C. 1965 b. Studies in lndian Anthocerotaceae.VI. Some aspects of morphology of *Phaceros* Prosk. *Phytomorphology* 1 5: 1 40-1 45.

Bir, S.S. 1970. Thallose liverworts from Nainital, Western Himalayas. *Bryologist*. 395-396.

Bischler, H. 1989. *'Marchantia' L.: the Asiatic and Oceanic taxa*. Stuttgart: J. Cramer.

Bland, J. 1971. *Forests of Lilliput*. Prentice-Hall, Inc. Engle wood Cliffs, pp. 210.

Blatter, E. 1929. Mosses of the Bombay Presidency, the High Wavy Mountain and Mt. Abu. *J. Bombay Nat. Hist. Soc*. 33: 869-879.

Braun, R. 1864. Uebersicht des naturlichen in: P. Ascherson, Flora der Provinz Brandenburg, Berlin.

Briggs, A.1972. Report of the Committee on Nursing. Cmnd 5115. HMSO, London.

Brijithlal, N.D., J.L. Mabel and A.E.D. Daniels. 2008. Additions to the moss flora of peninsular India from the Neyyar Wildlife Sanctuary, Kerala, India. *Indian Journal of Forestry*, 31.643-646.

Brotherus, V.F. 1898. Contributions to the Bryological flora of the Northern Western Himalayas. *Acta Soc. Sci. Fenn*. 24(2): 1-46.

Brotherus, V.F. 1899. Contributions to the Bryological flora of Southern India. *Rec. Bot. Surv. India* 1: 311-392.

Bruehl, P. 1931. A census of Indian mosses with Analytical Genera referred to in the Census as well as all the Keys to the Genera dealt with in the second edition of Prof. Broterus account of the Musci Veri in Engler and Prantl's P flanzenfamilien. *Rec. Bot. Surv. India* 13: 1-135 and (2) 1-152.

Buck, W. R. and B. Goffinet. 2000. Morphology and classification of mosses. In *Bryophyte Biology*. ed. A.J.Shaw & B.Goffinet, pp.71-123.Cambridge: Cambridge University Press.

Cargill, D. C., C.N. Manju, K.M. Deepa, V.K.Chandini and K.P. Rajesh. 2019. A New Indian Species of *Riccia* with connections to Northern Australia. *Journal of Bryology* 41(3): 1-7.

Chandra, S., D. Chandra, B. Anupam, Pankaj, R. K. Pandey and I.P. Sharma. 2017. Bryophytes: Hoard of remedies, an ethno-medicinal review. *Journal of Traditional and Complementary Medicine* 7: 94-98.

Chaudhary, B. L. and G. S. Deora. 2001. The mosses of Mt. Abu (India)-l. *In:* V. Nath & A. K. Asthana (eds.) *Perspectives in lndian Bryology*. Bishen Singh Mahendrapal Singh, Dehra Dun. 87-126.

Chaudhary, B.L., T.P.Sharma, and C. Sanadhya. 2006. Bryophyte flora of Gujarat. Himanshu Publications, New Delhi.1-196.

Chaudhary, B.L., T. P.Sharma, and F.S.Bhagora. 2008. *Bryophyte Flora of North Konkan, Maharashtra (India)*. Himanshu Publications, New Delhi.

Chen, X. Q. and J. B. Xiao. 2005.RP-HPLC-DAD determination of flavonoids: separation of quercetin, luteolin and apigenin in Marchantia convolute. *Iranian Journal of Pharmaceutical Research*, 4: 175–181.

Chopra, R.N. and V. Kanta. 1966. Some mosses from Delhi, India. *Phytomorphology* 69: 509-510.

Chopra, R.S. 1938 a. Notes on lndian Hepatics. I. South India. *Proc. lndian Acad. Sci. Ser.* 78.5: 239-251.

Chopra, R.S. 1938b. Notes on lndian Hepatics. 11. *Proc. lndian Acad. Sci. Ser.* B8: 427-439.

Chopra, R.S. 1943. A census of lndian Hepatics. *J. lndian Bot. Soc.* 22: 237-259.

Chopra, R.S. 1975. *Taxonomy of lndian Mosses.* Botanical Monograph. No. 10. CSIR, New Delhi.

Chopra, R.S., B.K. Abroland and M. S. Banga. 1956. A preliminary list of the mosses of Mussoorie (Himalayas*). Res. Bull. Punjab Univ. N. S. Sci. Sec*. 85: 21-30.

Chopra, R.S. and S.S. Kumar. 1981. Mosses of the Western Himalayas and adjacent plains*. Annales Crypt. et Phyfopath.* Vol. 5. The Cronica Botanica Co. New Delhi. 140.

Dandotiya, D., H. Govindapyari, S. Shantanu and P.L.Uniyal. 2011. Checklist of the Bryophytes of India. *Archive for Bryology*. 88:1-126.

Daniels, A.E.D. 1998. Ecological adaptations of some bryophytes of the Western Ghats. *J. Eco biol.* 10 (3): 261 -270.

Daniels, A.E.D. 2001. *Cololejeunea furcilobulata* (Berrie *et* Jones) Schuster and *Heteroscyphus argutus* (Reinw. *et al.)* Schiffn. From Mahendragiri hills of Kanyakumari district of South India. *In*: V. Nath & A. K. Asthana (eds.) Perspectives in lndian Bryology, Bishen Singh Mahendrapal Singh, Dehra Dun. 301-307.

Daniels, A.E.D. 2010. Checklist of the bryophytes of Tamil Nadu, India, *Archiv Bryol*. 65: 1-118.

Daniels, A.E.D., J.L.Mabel and P.Daniel. 2012. The Erpodiaceae (Bryophyta: Isobryales) of India. *Taiwania*, 57(2).168-182.

Daniels, A.E.D., J.L. Mabel and S. Sreeji. 2011. Mosses new to the Bryoflora of the Western Ghats from the Agasthyamalai Biosphere Reserve, *Nelumbo*. 53:145-154.

Daniels, A.E.D and K.C. Kariyappa. 2012. The Liverworts *Mastigophora diclados* and *Plagiochilion oppositum* – New to the Hepatic flora of Peninsular India. *Nelumbo*. 54: 207 – 212.

Daniels, A.E.D. and K.C.Kariyappa. 2012b. Notes on a little known moss from the Western Ghats. *Nelumbo*, 54.213-217.

Daniels, A.E.D., K.C. Kariyappa and P. Daniel. 2011. Two species of *Daltonia* Hook. & Tailor (Daltoniaceae: Bryophyta) new to the moss flora of India. *Nelumbo* 53: 133 – 139.

Daniels, A.E.D., K.C. Kariyappa and R. Sreebha. 2014. On the occurrence of *Calycularia crispula* Mitt. (Calyculariaceae) in the WesternGhats, India. *Acta Bot. Hung*. 56(3-4):293-297.

Daniels, A.E.D., M.M. Preetha, V. Asha and P.M. Biju. 2018a. Genus *Symphysodontella* M. Fleisch. (Pterobryaceae: Bryophyta) - new to the moss flora of the Eastern Ghats. Plant Sci. Today 5(1): 19-23.

Daniels, A.E.D. and N.D. Brijithlat, 2012. Three Mosses added to the Bryoflora of the Western Ghats from the Neyyar Wild Life Sanctuary. Kerala . *Indian Journal of Forestry*, *35*(4).507-510.

Daniels, A.E.D and P. Daniel. 2003a. *Fissidens gfiffithii* Gangulee (Musci: Fissidenta1es) - An addition to the bryoflora of India. *lndian J. For*. 26(2): 193-194.

Daniels, A.E.D and P. Daniel. 2003b. Addition to the bryoflora of Peninsular India. *lndian J. For*. 26(4): 389-396.

Daniels, A.E.D. and P. Daniel. 2013. *The bryoflora of the southernmost Western Ghats, India*. Bishen Singh Mahendra Pal Singh. Dehra Dun.1-352.

Daniels, A.E.D., R. Sreebha and K.C. Kariyappa. 2018. *Bryoflora of Indira Gandhi National Park in Anamalai Hills, India.* Dehra Dun: Bishen Singh Mahendra Pal Singh.1–513.

Das, S. And D.K. Singh. 2011. A new species of *Calypogeia* Raddi (Marchantiophyta: Calypogeiaceae) from Eastern Himalaya, India. *Nelumbo*, 53.194-196.

Das, S. and G.D. Sharma. 2013. Inventorization of Marchantiophyta in Barali Wildlife Sanctuary, Assam, India with special reference to their microhabitat. *Arch. Bry.*166:1-27.

Das, S. and G.D.Sharma. 2016. Some noteworthy and new records of liverworts from Barail Wildlife Sanctuary, Assam, India. *Plant Science Today*, *3*(2). 100-108.

Dash, P.K. and D.K. Saxena. 2009. Bryoflora of Khandadhar hill ranges, Orissa, India. *Geobios*, 36 (2).113.

Deepa K.M. and C.N. Manju. 2016. *Clevea pusilla* (Steph.) Rubasinghe & D.G. Long (Cleveaceae; Marchantiophyta) a rare species from the Western Ghats of Tamil Nadu, India. Cryptogam Biodiversity and Assessment Vol 1(1): 52-54. e-ISSN-2456-0251.

Deepa, K.M., B.Mufeed and C.N. Manju. 2019. *Wiesnerella denudata* (Mitt.) Steph.(Marchantiales; Marchantiophyta) a rare species in the Western Ghats of India. *Lindbergia*, 2019(1).

Dey, M. and D.K.Singh. 2011. A new *Lopholejeunea* (Spruce) Schiffn.(Hepaticae: Lejeuneaceae) from India. *Nelumbo*, 53.197-200.

Dey, M. and D.K.Singh. 2012. Epiphyllous Liverworts of Eastern Himalaya, Botanical Survey of India.1-415.

Dillenius, J. J. 1741. *Historia Muscorum*. Oxford.

Ding, H. 1982. Medicinal spore bearing plants of China, Shanghai. 1-409.

Dixon, H.N. 1909 a. *Brachymenium turgidum*. Broth, n. sp. *J. Bombay Nat. Hist. Soc*. 1 9: 536- 537.

Dixon, H.N. 1909 b. Mosses from the Western Ghats. *J. Bot.* London 47: 157-164.

Dixon, H.N. 1910. *Merceyopsis*, a new genus of mosses, with further contribution to the bryology of India. *J. Bot.* London 48: 297-310.

Dixon, H.N. 1914 a. Report on the mosses of the Abor Expedition, 191 1-1912. *Rec. Bot. Surv.lndia* 6: 56-59.

Dixon, H.N. 1914 b. Report on the mosses collected by C.E.C. Fischer and others from South lndia and Ceylon. *Rec. Bot. SUN. lndia* 6: 75-89.

Dixon, H.N. 1921. On a collection of mosses from the Kanara district. *J. lndian Bot*. 2: 174-188.

Dixon, H.N. 1922. Some new genera of mosses. *J. lndian Bot*. 60: 101-1 10.

Dixon, H.N. 1930. Addition to the moss-flora of North-Westem Himalayas. *Annls. Bryol.* 3: 51- 70.

Dixon, H.N. 1931. New genera of Asiatic mosses. J. *Bombay Nat. Hist. Soc.* 69: 1-7.

Dixon, H.N. 1937. Mosses collected in Assam. *J. Bombay Nat. Hist. Soc.* 39: 769-795.

Dixon, H.N. 1942. *Some new species of acrocarpous mosses from North-West Himalayan flora.* 150th Ann. Vol. Roy, Bot. Gdn. Calcutta, Part 11: 173-1 82.

Dixon, H.N. and R. L. Badhwar. 1938. Some new North-West Himalayan mosses. *Rec. Bot. Surv. India* 12: 163-179.

Easa, P.S. 2003. *Biodiversity documentation for Kerala, Part 1V: Bryophytes.* KFRl Hand book No.17. Kerala Forest Research Institute, Peechi.

Ekalavya, C. 1987. Cytochemical studies on the developing sporophyte in the moss *Physcomitrium cyathicarpum. Phytomorphology* 37: 1 7-28.

Ellis, L.T. 1989. Taxonomic revision of *Calymperes* in Southern lndia and neighboring Islands. *J. Bryol*. 15: 697-732.

Ellis, L.T. 1992. *Fissidens ceylonensis* Dozy & Molk eb. (Musci: Fissidentaceae) and some allied taxa from Southern India. *Bull. Brit. Mus. Nat. Hist. (Bot.)* 22: 153-156.

Ellis, L.T., L.A. Almeida, D.F. Peralta, M. Bačkor, E.Z. Baisheva, H. Bednarek-Ochyra, M. Burghardt, I.V. Czernyadjeva, S. S. Kholod, A. D. Potemkin, A. Erdağ, M. Kırmacı, V.E. Fedosov, M. S. Ignatov, D.E. Koltysheva, J.R. Flores, E. Fuertes, M. Goga, S.-L. Guo, W.K. Hofbauer, M. Kurzthaler, H. Kürschner, O.I. Kuznetsova, M. Lebouvier, D.G. Long, Yu. S. Mamontov, K.M. Manjula, C.N. Manju, B. Mufeed, F. Müller, M.C. Nair, M. Nobis, N. Norhazrina, M. Aisyah, G.E. Lee, M. Philippe, D.A. Philippov, V. Plášek, Z. Komínková, R.D. Porley, Yu. A. Rebriev, M.S. Sabovljević, A.M. de Souza,

E.B. Valente, D. Spitale, P. Srivastava, V. Sahu, A.K. Asthana, S. Ştefănuţ, G. M. Suárez, A.A. Vilnet, K.-Y. Yao & J.Ch. Zhao (2019): New national and regional bryophyte records, 59, *Journal of Bryology*, 41(2): DOI: 10.1080/03736687.2019.1613112.

Ellis, L.T., O.M. Afonina,A.K. Asthana,R. Gupta,V. Sahu, V. Nath, N. Batan, H. Bednarek-Ochyra, A. Benitez, P. Erzberger and V.E. Fedosov. 2014. New national and regional bryophyte records, 39. *Journal of bryology*, *36*(2). 134-151.

Foreau, G. 1930. Notes on Bryological Geography for the Presidency of Madras. *J. Madras Univ.* 2: 238-250

Foreau, G. 1931. Notes on Bryological Geography for the Presidency of Madras. *J. Madras Univ*. 3: 118-126.

Foreau, G. 1961. The moss flora of the Palni hills. J. *Bombay Nat. Hist. Soc.* 58: 13-47.

Foreau, G. 1964. Some South Indian mosses. *J. Bombay Nat. Hist. Soc.* 61: 223-226.

Furuki, T., K., S. Yamada, Hattori and N. Nishimura.1993. Hepaticae collected from Pakistan in 1991. In: Nakaike, T. & Malik, S. Cryptogamic Flora of Pakistan 2: 221–229.

Gagnon, Z. E. and D. E. Karnosky. 1992. Physiological response of three species of *Sphagnum* to ozone exposure. *J. Bryol.*17: 81-91.

Gangulee, H. C. 1957. Mosses of Eastern India. I. Eubryinales. Series I. Fissidentales. *Bull. Bot. Soc. Bengal* 11: 59-84.

Gangulee, H. C. 1959. Mosses of Eastern India. II. Eubryiidae. Series II. Dicranales, Family: Ditrichaceae. *Bull. Bot. Soc. Bengal* 13: 1-9.

Gangulee, H.C. 1960. Mosses of Eastern India. Eubryiidae. Series II. Dicranales (contd.) Family: Dicranaceae.*Bull. Bot. Soc. Bengal* 14: 10-57.

Gangulee, H. C. 1961. Mosses of Eastern India. Eubryiidae. Series II. Dicranales (contd.) Family: Leucobryaceae and series Ill. Pottiales: Family Calymperaceae. *J. Bombay Nat. Hist. Soc.* 60(3): 606-637.

Gangulee, H. C. 1969-1980. *Mosses of Eastern India and adjacent regions.* Vol. 1-111, (Fasc. 1- 8), Botanical Survey of India, Calcutta.

Gangulee, H. C. 1985. *Handbook of lndian Mosses.* Amerind Publishing Co., New Delhi.

Gautam, S. P. and M.K.Thakur. 1981. A note on the distribution of Hepaticae in Jabalpur, Madhya Pradesh (India). *Journal of Economic and Taxonomic Botany*, 2. 195-196.

Gaur, R. D. and S. Nautiyal, 1981. Thallose liverworts from Srinagar and adjacent areas-l. *lndian J. For.* 4: 75-76.

Ghosh, A. K. and A. K. Chakravarty. 1943. On the occurrence of the genus *Pallavicinia* (thallose Anacrogynous Jungermanniales) at Dacca, East Bengal. *Sci* & *Cuff.* 8: 497.

Glime, J. M. 2007. Economic and ethenic uses of Bryophytes. *In*: Flora of North America. Editorial committee, eds., 1993, Flora of North America North of Mexico 15 vol. New York and Oxford. 27:14-41.

Glime, J.M. 2017. *Bryophyte Ecology*. E-book-Michigan Tech. Univ., Bot. Soc. America, Inter. Ass. Bryologists.

Goffinet, B. 2000. Origin and phylogenetic relationships of bryophytes. In: A.J. Shaw & B.Goffinet (eds.), *Bryophyte Biology*. 124-149. Cambridge.

Goffinet, B., Shaw A.J. and W. Buck. 2009. Morphology and classification of the Bryophyta, Bryophyte Biology, 2nd ed. Cambridge University Press.

Gola, G. 1914. Hepatichae del Kashmir raccolte dalla Spedizione Piacenza. *Atti Accad. Torino*. 49: 513-517.

Govndapyari, H., 2014. Habitat preference in pleurocarpus mosses of Imphal district, manipur, India. *Evansia*, 31(3).99-109.

Griffith, W. 1842. Muscologia ltineris Assamici. *Calcutta J. Nat. Hist*. 2: 65-512.

Gupta, R., V.VNath and A.K. Asthana. 2013. Present scenario of moss diversity at Tamia hills and Patalkot valley (Madhya Pradesh) India. *National Academy Science Letters*, 36(6).629-634.

Gupta, R., V. Nath and A.K. Asthana. 2016. Present Status of Family Dicranaceae (Bryophyta) in Pachmarhi Wildlife Sanctuary, Central India. *Taiwania*, 61(3).

Halle, T.G. 1916. A fossil sporogonium from the lower Devonian of Roragen in Norway. *Bot. Notiser.* 76-91.

Hattori, S. 1966. Anthocerotae and Hepaticae. In: Hara H, ed. *The Flora of Eastern Himalaya.* Tokyo: University of Tokyo Press, 501 – 536.

Hattori, S. 1967. Studies on the Asiatic species of the genus *Porella* (Hepaticae) I. *J. Hattori Bot. Lab.* 30: 129-151.

Hattori, S. 1969. Studies on the Asiatic species of the genus *Porella* (Hepaticae) II. *J. Hatton Bot. Lab.* 32: 31 9-359

Hattori, S. 1970. Studies on the Asiatic species of the genus *Porella* (Hepaticae) Ill. *J. Hatton Bot.* Lab. 33: 41-87.

Hattori, S. 1971 a. Studies on the Asiatic species of the genus *Porella* (Hepaticae) IV. *J. Hattori Bot. Lab.*34: 41 1-428.

Hattori, S. 1971b. Hepaticae in Hara (ed.) Flora of the eastern Himalayas 2nd report. *Univ. Mus. Univ. Tokyo Bull.* 222-240.

Hattori, S. 1975a. Anthocerotae and Hepaticae in H. Ohashi (ed.) Flora of the Eastern Himalaya 3rd report. *Mus. Niv. Tokyo. Bull*. 8: 206-242.

Hattori, S. 1975 b. Notes on Asiatic species of the genus *Frullania,* Hepaticae.VI1. *J. Hatton Bot. Lab.* 39: 277-313.

Hattori, S. 1975 c. Notes on Asiatic species of the genus *Frullania,* Hepaticae.VIII. *Bull. Natn. Sci, Mus. Ser. B(Bot.)* 1: 141-163.

Hattori, S. 1975 d. A revision of Indian species of *Frullania* (Hepaticae) published by W. Mitten in 1861. *Bull. Natn. Sci, Mus. Ser. B (Bot.)*11: 73-81.

Hattori, S. 1975 e. *Bryophyta, Anthocerotae & Hepaticae. In:* H. Ohahi (ed.), The Flora of Eastern Himalaya. Third Report. *Univ. Mus. Univ. Tokyo Bull.* 8: 206-242.

Hattori, S. 1975 f. Studies on the Asiatic species of the genus *Porella* (Hepaticae) V. *J. Hattori Bot. Lab.* 39: 269-276.

Hedenas, L. 1991. Ekonomisk bryologi-en oversikt over mossornas praktiska anvandbarhet. *Svensk Bot. Tidskr*. 85: 347-354.

Hofmeister, W.1851.*Vergleichende Untersuchungen der Keimung, Entfaltung Und Fruchtbildung hoeherer Kryptogamen (Moose, Farne, Equisetaceenm, Rhizocarpeen Und Lycopodiaceen) Und der Samenbildung der Coniferen*. Leipzig: F. Hofmeister.

Hooker, W. J. 1808. *Musci Nepalensis*. Trans. Linn. Soc. Lond. (Bot.). 9: 307-322.

Hooker, W. J. 1818-20. *Musci Exotici*. Vols. 1-11. London.

Hooker, W. J. and R. K. Greville. 1825. On the genus Hookeria of Smith of the order Musci. *Edinb. J. Sci*. 2: 221 -236.

Inoue, H. 1960. Contributions to the knowledge of the Plagiochilaceae of South-eastern Asia. II. On some Himalayan species of *Plagiochila. J.Hattori Bot. Lab.* 23: 29-36.

Inoue, H. 1965. Contributions to the knowledge of the Plagiochilaceae of South eastern Asia.VII. Synopsis of *Plagiochila* Dumort. in the Himalayan region. *Bull. Nat. Sci. Mus. Tokyo.* 8(3): 375-403.

Inoue H. 1980. Koke engei no subete (all about the moss Horticulture). Tokyo. 215.

Issac, S. 2013. Economic importance of Bryophytes. *Bioteck Articles*.

Joshy, D. Y. 2001. A floristic analysis of the liverworts from Andaman Islands, India. *In:* V. Nath & A.K. Asthana (eds.) *Perspectives in Indian Bryology.* Bishen Singh Mahendrapal Singh, Dehra Dun. 135-148.

Jyothilakshmi, G. R., C. N. Manju., V. Mithun and V. K. Chandini. 2016. Bryophyte diversity in the Sacred Groves, with special reference to Vallikattukavu of Kozhikode district in Western Ghats. *Plant Science Today*. 3(2):135-141.

Kachroo, P. 1954. Distribution of the Rebouliaceae in India. *Byologist* 56: 159-166.

Kachroo, P. 1956. Morphology of *Pallavicinia* with reference to its species problem and the individuality of Pallaviciniaceae. *J. Univ. Gauhati* 22: 6-21.

Kachroo, P. 1958. Morphology of Rebouliaceae-Ill. Development of sex organs, sporogonium and inter- relationship of the various genera. *J. Hattori Bot. Lab.* 19: 1-24.

Kachroo, P. 1967. A new *Anthoceros* from Kerala. *Curr. Sci.* 36: 353.

Kachroo, P. and K. R. Bapna. 1963. On some recently described species of *Riccia* from India. *Proc. Natl. Inst. Sci.* India 20: 244-256.

Kapoor, S. And S.C. Bhatla. 2001. Biochemical regulation of protonema differentiation in *Funaria hygrometrica. In:* V. Nath & A. K. Asthana (eds.) *Perspectives in lndian Bryology.*Bishen Singh Mahendrapal Singh, Dehra Dun. 149-154.

Kashyap, S. R. 1914. Morphological and biological notes on new and little-known West Himalayan liverworts, 1. *New Phytol*. 13: 206-236.

Kashyap, S. R. 1915. Morphological and biological notes on new and little known West Himalayan Liverworts, Ill. *New Phytol*. 14: 1-18.

Kashyap, S. R. 1917. Liverworts of the western Himalays and the Punjab with notes on known species and description of new species. II. *J. Bombay Nat. Hist. Soc*. 25: 279-281

Kashyap, S. R. 1929-1932. *Liverworts of the Western Himalayas and the Punjab Plain*, Part I & II (Reprint 1972). Research CO. Publications, Trinagar, Delhi.

Kashyap, S.R. and R.S.Chopra. 1932. *Liverworts of the Western Himalayas and the Punjab Plain* II. The University of the Punjab, Lahore.

KB, A. and M.Krishnappa. 2014. Distribution of bryophytes in Malnad regions of Chikmagalur District, Karnataka, The Western Ghats. *Life Sciences Leaflets*, 49.

Khanna, L. P. 1936. On lndian species of the genus *Anthoceros* Linn. with a description of new species from Travancore. *J. lndian Bot. Soc.* 25: 235-240.

Kour, A., A. Rao and S. Kapila.2018. Bryodiversity of District Budgam (Jammu & Kashmir) Diplolipdea Pleurocarpe III.vol 5, 2018.

Krassilov, V.A. and R.M.Schuster. 1984. Paleozoic and Mesozoic fossils. *New Manual of Bryology* 2: 1170–1193.

Langer, A. and M. Tanwir. 2002. Liverwort and hornwort flora of Tehsil Mendhar (North-West Himalaya), India. *Geophytology*, 30(142). 81-84.

Lavate, R. A., S. B. Patil, V. B. Shimpale, M. M. Dongare and S. M. Patil. 2014. *Marchantia linearis* Lehm. et Linenb.(Marchantiophyta, Marchantiaceae): A new report from the Western Ghats of Maharashtra, India. *DAV Int Jou Sci*, *3*(1).42-46.

Lavate, R., S. Patil, M. Dongare, S. Sathe and S. Magdum. 2015. *Pallavicinia lyellii* (Hook.) Gray,(Pallaviciniaceae): an addition to the hepatic flora of Maharashtra, India. *Plant Science Today*, *2*(4).192-196.

Linnaeus, C. 1753. *Species Plantarum.* Ed. 2. Vol. II. Musci. Holmiae.

Low, K. S., C. K. Lee, S.T. Lol and Azhar phoon. 1985. The use of the moss, *Calymperes delessertii* Besch., as a bioindicator to airborne heavy metals. *Pertanika* 8(1). 109-114.

Madhusoodanan, P.V. and M.C. Nair. 2003. *Ricciocarpos natans (L.) Corda (Ricciaceae) and Notothylas levieri* Schiffn. ex Steph. (Notothylaceae), two new bryophyte records for South India. *Indian J. Forestry* 26(3): 295-298.

Madhusoodanan, P.V. and M. C. Nair. 2004. Pleurocarpic mosses of Eravikulam National Park, Kerala-1. J. Econ. Taxon. Bot. 28: 338-346.

Madhusoodanan, P.V., M.C. Nair and P.S. Easa. 2007. *Diversity of Bryophytes in Eravikulam National park, Kerala, South India*. *In*: V. Nath and A.K. Asthana (eds.), *Current trends in Bryology.* Bishen Singh Mahendra Pal Singh, Dehra Dun, India. 255-267.

Magdum, S.M., Patil, S.M., Lavate, R.A. and Dongare, M.M., 2017. Checklist of mosses from the Western Ghats of Maharashtra, India. *Bioscience Discovery*, *8*(1).73-81.

Majumdar, S. and D.K. Singh. 2015. A note on the genus *Neolepidozia* (Lepidozioideae,Lepidoziaceae,Marchantiophyta) in India. *Nelumbo*, 57.106-111.

Makinde, A.M., S.A. Adebola and M.O. Isa. 2015. Phytochemical screening and antimicrobial potential of *Philonotis hastata* (Duby) Wijk & Margad. *Journal of Pharmacy and Biological Sciences*, 10: 7-11.

Manju, C.N. and K. P. Rajesh. 2010. *Leptohymenium* Schwegr. (Hylocomiaceae: Bryopsida) a new generic record for Western Ghats, Peninsular India. *J.Econ. Tax. Bot.*34:391-393.

Manju, C.N. and K.P. Rajesh. 2011 Contribution of the Bryophyte flora of India: The Parambikulam Tiger Reserve in the Western Ghats. *Archive for Bryology* 42: 1-10.

Manju, C.N. and K.P. Rajesh. 2012. *Symphysodontella madhusoodananii* (Pterobyaceae, Moss) a new species from the Western Ghats of India. *Phyto Keys* 18: 39-44.

Manju, C.N. and K. P. Rajesh. 2017. *Bryophytes of Kerala Liverworts* CRIKSC, Vol, 1.

Manju, C.N., K.P. Rajesh and P.V. Madhusoodanan. 2008a. Bryophytes of Kakkayam forests in the Western Ghats and conservation. *Geophytology* 37: 59-63.

Manju, C.N., K. P. Rajesh and P. V. Madhusoodanan. 2008b. Checklist of the bryophytes of Kerala, India. *Trop. Bryol. Res. Reports*, No. 7.

Manju, C.N., K. P. Rajesh and P.V. Madhusoodanan. 2009a. Contribution to the Bryophyte flora of India: Agasthyamalai biosphere reserve in Western Ghats. *Taiwania*. 54(1): 57-68.

Manju, C.N., K. P. Rajesh and P. V. Madhusoodanan. 2009b. Contribution to the bryophyte flora of India: the Aralam Wildlife sanctuary in the Western Ghats. *Archive for Bryology*. 42.

Manju, C. N., K. P. Rajesh, S. Jitha, P. K. Reshma and R. Prakashkumar. 2011. Bryophyte diversity of Kakkavayal Reserve Forest in the Western Ghats, Kerala. *Archive for Bryology*. 108: 1-7.

Manju, C.N., K.P. Rajesh and P.V. Madhusoodanan. 2011. *Chiloscypus chinnarensis* (Lophocoleaceae, Hepaticae): A new species from the Western Ghats of India. *Acta Bot. Hungarica* 53: 151-157.

Manju, C.N., R. Prakashkumar, B. Prajitha, V. K. Rajilesh and K. P. Anoop. 2012. *Trichosteleum stigmosum* Mitt. (Sematephyllaceae) from Sient Valley National park, a new record for India. *Taiwania*. 57(2): 222-224.

Manju, C.N., T. Aswathy, K.V. Pournami and K.P. Rajesh. 2017. Asian Journal of Biological and Life Sciences Short Communication.

Manju, C.N., T.Pocs, K.P.Rajesh and R.Prakashkumar. 2012. Lejeuneaceae (Marchantiophyta) of the Western Ghats, India. *Acta Biologica Plantarum Agriensis* 2:125-129.

Manju C.N., V.K. Chandini and B.Mufeed. 2017. *Physcomitrium immersum* (Funariales; Bryophyta) an addition to the bryoflora of Western Ghats. *Geophytology* 47(1): 45-47.

Manju, C.N., V.K. Chandini and K.P. Rajesh. 2017 *Cololejeunea manilalia* (Lejeuneaceae, Marchantiophyta), A new species from the Western Ghats of India. *Acta Bot. Hung*. 59(1-2):261-268.

Manju, C.N.,V.K.Chandini and K.P. Rajesh. 2019. *Micromitrium vazhanicum* (Micromitriaceae; Bryophyta) a new species from the Western Ghats of India. *Bryologist* 122(2): 297-306.

Manju, C.N.,V.K. Chandini, K.P. Rajesh and Sabarish Sivaprakasam. 2019. Rediscovery of *Oreoweisia brevidens* Herzog (Dicranaceae; Bryophyta) an Indian endemic species from Western Ghats after 75 years. *Lindbergia* 42: (*in press*).

Manju, C.N., V.K. Rajilesh, B.Prajitha, R.Prakashkumar and K.P. Rajesh. 2014. Contribution to the Bryophyte flora of India: SilentValley National Park in the Western Ghats, India. *Acta Biol. Pl. Agriensis* 1: 73-98.

Manju, C.N., V.K. Rajilesh, K.M. Deepa and R. Prakashkumar. 2015. The genus *Calycularia* (Marchantiophyta) in Kerala part of the Western Ghats. *Acta Botanica Hungarica*. 57 (3-4): 401-406.

Manju, C.N., T.P.Aswathy, K.V. Pournami and K.P.Rajesh. 2017. *Amblystegium serpens* (Hedw.) Schimp. (Amblystegiaceae: Bryophyta) from Indian Peninsula. *Asian Journal of Biological and Life Sciences* 6: 412-413.

Manjula, K. M., C.N. Manju, V.K. Rajilesh and V.K. Chandini 2015. *Fissidens linearis* Fissidentaceae: Bryophyta) a new record for India. *Acta Bot. Hung*. 57(1):165-168.

Manjula, K.M. and C.N. Manju. 2016. Genus *Fissidens* Hedw. (Fissidentaceae; Bryophyta) from Eastern Ghats of Andhra Pradesh, India. *Cryptogam Biodiversity and Assessment*, *1*(2).49-63.

Manjula, K.M., V.Vidya and C.N. Manju. 2013. The genus *Bazzania* (Marchantiophyta) in Kerala (India). *Samagra*, 9.23-27.

Manjula, K. M., V. Vidya, C. N. Manju and R. Prakshkumar. 2013. Systematic studies on the family Geocalycaceae (Marchantiophyta) of Kerala, India. *Arch. Bryol.*176: 1-11

Martin, V.A., S. Gyovai, I. Peter, M. Zupko, B. C. Marschall, P. Loffler, A. Berdi, C. Vecsernyes, E. L. Attila, E. Busa, and D. Csupor. 2018. Antiproliferative and Antimicrobial Activities of Selected Bryophytes. *Molecules,* 23:1-15.

Mehra, P.N. and O.N. Handoo. 1953. Morphology of *Anthoceros erectus* and *A. himalayensis* and the phylogeny of the Anthocerotales. *Bot. Gaz.* 114: 371-382.

Miller, N.G. and H. Miller. 1979. Make the Bryophytes. *Horticulture* 57(1): 40-47.

Mishra, M., P.K. Dash, A. Alam, S. Sahoo and R. Das. 2016. Current status of diversity and distribution of Bryophytes of Odisha. *Plant Science Today*, *3*(2), pp.186-194.

Mithun, V. and C.N. Manju. 2017. Bryophyte diversity of Thamarassery pass Wayanad in the Western Ghats of Kerala. *Plant science Today*. 4(1): 41-48.

Mitra, G. C. 1995. Moss protonema-its morphological features. *In*: S.S. Kumar (ed.), Recent studies on Indian bryophytes. Bishen Singh Mahendrapal Singh, Dehra Dun. 17-49.

Mitten, W. 1859. Musci lndiae Orientalis, an enumeration of the mosses of East Indies. *J. Linn. Soc. Bot. Suppl.* 1:1-71.

Mitten, W. 1860. Hepaticae lndiae Orientale, an enumeration of the Hepaticae of the East Indies. *J. Proc. Linn. Soc. Bot*. 5: 89-108.

Mitten, W. 1861. Hepaticae lndiae Orientale, an enumeration of the Hepaticae of the East Indies. *J. Proc. Linn. Soc. Bot*. 5: 109-128SOC. Bat. SUPPI. 1: 1-171.

Mizutani, M. 1963. On some Indian species of the family Lejeuneaceae described by W. Mitten. - J. Hattori Bot. Lab. 26: 171-184.

Mizutani, M. 1967. Studies of the Himalayan species of Bauania. *J. Haftori Bot. Lab.* 30: 71-90.

Mizutani, M. 1968. Studies of little known Asiatic species of Hepaticae in the Stephani Herbarium. 5. On some flagelliform species of *Lepidezea. J. Haffori Bot. Lab.* 31: 152-158.

Mizutani, M.1971. *Lejeunea* from the Himalayan region. *Hattori Bot Lab J.*

Mohamed, M.A. H., N.V. Biradar and J.G. Vaidya. 1986. A contribution to the moss flora of North Western Ghats, India. *J. Bombay Nat. Hist Soc.* 83: 689-691.

Mueller, C. 1853. *Musci Neilgherienses* I. Bot. Zeit. Regensburg 11: 17-21, 33-40, 57-62.

Mueller, C. 1854 a. *Musci Neilgherienses* II. Bot. Zeit. Regensburg 556-559, 569-574.

Mueller, C. 1854b. *Hypnum pseudostramineum*. Bot. Zeit. Regensburg 1 2: 500-503.

Mueller, C. 1871. Musci lndici Novi. *Linnaea* 37: 163-182.

Mueller, C. 1878. Decas Muscorum lndicon novor Flora.

Mueller, K. 1901. Scapaniae lndiae Orientalis Curante Cl. Gollan.

Mufeed, B and C.N. Manju. 2018. New distribution record of a rare taxa *Gottschelia schizopleura* (Spruce) Grolle, of Jungermanniales occurring in Anamudi shola National Park in the Western Ghats of Kerala. *Plant Science Today*. 5(1): 29-31.

Mufeed, B. and C.N. Manju. 2017. *Porella perrottetiana* (Mont.) Trevis. (Jungermanniales) a species from Western Ghats of Kerala. *Acta Botanica Hungarica.* 59 (1-2): 269-272.

Mufeed, B., K. M. Deepa, P. Haripriya and C. N. Manju. 2014. Moss (Bryophyta) diversity of Thusharagiri Hills, Kerala, India. *Frahmia* 6:1-9.

Mufeed, B., V.K.Chandini, C.N. Manju and K.P. Rajesh. 2018. *Colura calyptrifolia* (Hook.) Dumort. (Lejeuneaceae;Marchantiophyta) a rare leafy liverwort from the Western Ghats of India. *Nelumbo* Vol. 60. 147-152.

Nair, M.C., K.P. Rajesh and P.V. Madhusoodanan. 2004. *Bryum tuberosum* Mohamed *&* Damanhuri, a new record for India. *Indian J. Forestry* 27: 39-40.

Nair, M.C., K. P. Rajesh and P. V. Madhusoodanan. 2005 a. *Bryophytes of Wayand in Western Ghats.* MNHS.

Nair, M.C., K.P. Rajesh and P.V. Madhusoodanan. 2005 b. Little known *Plagiochila* (Dumort.) Dumort. (Plagiochilaceae: Hepaticae) from India. *Geophytology* 35: 39. -44.

Nair, M.C., K.P. Rajesh and P.V. Madhusoodanan. 2006. Bryophytes of Chinnar wildlife sanctuary (South India) -A preliminary account. *Geophytology*. 36 (1&2): 7-15.

Nair, M.C., K. P. Rajesh and P.V. Madhusoodanan. 2007. Three new Bryophyte records for Peninsular India. *Indian J. Forest.* 30(3): 349-352.

Nair, M.C. and P.V. Madhusoodanan. 2001. Contribution to the bryophyte flora of Eravikulam National Park, Kerala. *J. Econ. Taxon. Bot.* 25: 569-574.

Nair, M.C. and P.V. Madhusoodanan. 2002. Studies on the bryophyte flora of Kerala (South India) -An Introduction. *J. Econ. Taxon. Bot*. 26(3): 697-708.

Nair, M.C. and P.V. Madhusoodanan. 2003a. Bryophyte diversity of Wayanad district, Kerala-preliminary report.13th Swadeshi Science Congress, November 7-9, MSSRF, Kalpetta, Wayanad.

Nair, M.C. and P.V. Madhusoodanan. 2003b. Bryophyte Diversity of Wayanad District, Kerala. *Crop Diversity and Tribal Empowerment*.174.

Nair, M.C. and P.V. Madhusoodanan. 2006. A preliminary checklist of Bryophytes of Vellarimala in the Western Ghats of Kerala. *Ind. J. For.* 29(2): 191-196.

Narayan, B., P.V. Karunakaran and D. K. Singh. 2001. Contribution to the Bryoflora of Great Himalayan National Park, Kullu, Himachal Pradesh-l. *lndian J. Forest.*24: 265-278.

Nash, E. 1972. *Effect of effluents from a zinc smelter on mosses*. Ph.D. Thesis, Rutgers University.

Nath, V. and A.K. Asthana. 1998. Diversity and distribution of genus *Frullania* Raddi in South India. *J. Hattori Bot. Lab.* 85: 63-82.

Nath, V., A.K. Asthana and R. Kapoor. 2007. Enumeration of the Mosses in Amarkantak (Madhya Pradesh), India. *Taiwania*, *52*(2), pp.168-176.

Nath, V., N. Pande, A.K. Asthana and R.Gupta. 2012. Epiphytic moss flora of Pachmarhi Biosphere Reserve (MP): An important aspect of Bryophyte diversity. *National Academy Science Letters*, *35*(3), pp.195-200.

Negi, H. R. and M. Gadgil. 1997. Species diversity and community ecology of mosses: A case study from Garhwali Himalaya. *Int. J. Ecol. & Envt. Sci.* 23: 445-462.

Negi, H. R. and M. Gadgil. 2001. Ecological Niche of certain terricolous liverworts from some selected localities of Garhwal Himalaya: A preliminary study. *In:* V. Nath & A.K. Asthana (eds.) *Perspectives in lndian Bryology.* Bishen Singh Mahendrapal Singh, Dehra Dun, pp. 23-34.

Nicolson, D. E., C. R. Suresh and K. S. Manilal. 1988. *An interpretation of Rheed's Hortus Malaharicus*. Koeltz Scientific Book, FRG.

Noguchi, A. 1958. A small collection of mosses from southern India. Kumamoto. *J. Sci. Ser. B. Sec. 4:* 1 -4.

Ochi, H. 1964. Notes on Asiatic moss flora II. Mosses of the family Bryaceae and Bartrarniaceae collected by the members of the Univ. Tokyo Bot. Exped. to Eastern India 1960. *J. Jap. Bot.* 39: 49-55.

Oechel, W.C., and B. Sveinbjornsson. 1974.The microenvironment of arctic bryophytes at Barrow, Alaska. *U.S. Tundra Biome Data Rep,* pp. 74-25.

Ohta, Y., N.H. Andersen and C.B. Liu. 1977. Sesquiterpene constituents of two liverworts of genus *Diplophyllum*. Novel eudesmanolides and cytotoxicity studies for enantiomeric methylene lactones. *Tetrahedron* 33: 617-628.

Palani, R.,S.S. Sathish, T. Thamizharasi and P.Vijayakanth. 2017. Checklist of Mosses (Bryophyta) of Bodamalai Hills in Eastern Ghats, Tamil Nadu. *Plant Science Today*, *4*(1), pp.49-54.

Pande, S. K. and R. N. Misra. 1943. On the epiphyllous liverworts of lndia and Ceylon. I. *J. Indian bot. Soc.* 22: 159-169.

Pande, N and P. Joshi. 2004. Phytosociology, biomass and net primary production of bryophyte community growing on decaying logs in silver fir forest of Central Himalaya. *Geophytology* 32: 19-23.

Pande, S.K. 1936. Studies in lndian liverworts: A review. *J. lndian Bot. Soc.* 15: 221-233.

Pande, S.K. and K.P. Srivastava.1952. *The hepatic vegetation of Pachmarhi (Madhya Pradesh): A preliminary survey*.

Pande, S.K. and K.P. Srivastava. 1953. The genus *Pallavicinia* Gray in India-l. *Pallavicinia canarus* St. *J. lndian Bot. Soc.* 32: 179-1 85.

Pande, S.K. and K.P. Srivastava. 1958. The genus *Riccardia* Gray in India. I. *Riccardia levieri* Schiff. *J. lndian Bot. Soc.* 37: 417-421.

Pande, S. K., K.P. Srivastava and S. A. Khan.1954. On some little known lndian species of Asterella Beauv. *J. Hattori Bot. Lab.* 11: 1-1 0.

Pande, S.K., R. Udar and V.B. Singh. 1960. Genus *Chiloscyphus* (Corda) Schiffn. And *Heteroscyphus* Schiffn. in India. *Proc. Natl. Inst. Sci. India* 268: 137-147.

Pande, S. K. and T. N. Srivastava. 1942. Studies in lndian Hepaticae Ill. On a new species of *Nowellia N. Indica* from the Western Himalayas. *Proc. lndian Acad.Sci.* 16: 175-179.

Pandey, D.C., A. Kumar and A.K. Sinha. 2001. Bryophyte from River Ganga banks concentration of heavy metals. In: V. Nath & A. K. Asthana (eds.) Perspectives in lndian Bryology. Bishen Singh Mahendrapal Singh, Dehra Dun. 285-290.

Pant, G. 2001. Bryophyte diversity of Kumaon Himalaya-changes, challenges, hopes and fears. In: V. Nath & A. K. Asthana (eds.) Perspectives in lndian Bryology, Bishen Singh Mahendrapal Singh, Dehra Dun. 7-22.

Pant, G. and S. D. Tewari. 1990. Bryophytes and mankind. *Ethnobotany* 2, 97-103.

Pant, G., S. D., Tewari, M.C. Pargaien and L.S. Bisht. 1986. Bryological activities in North-West Himalaya – II. A bryophyte foray in the Askot region of district Pithoragarh (Kumaun Himalayas). *Bryol. Times* 39: 2-3.

Perin, F. 1962. Woodland mosses-a little used growing medium. *Am. Orchid Soc. Bull.* 31: 988.

Phatak, S., M. N. Vijayan and C. Samuel. 2007. Biodiversity and Distribution of Bryophytes of Goa - A Preliminary Study: In Nath, V. & Asthana, A.K. (ed.), Current Trends in Bryology. Bishen Singh Mahendra Pal Singh, Dehradun, India. 149-160

Pocs, T., M.C. Nair, K.P. Rajesh and P.V. Madhusoodanan. 2007. Liverwort (Marchantiopsida) records from the Western Ghats (Kerala State, Peninsular India). *Acta Botanica Hungarica* 49(1-2): 121-129.

Prajitha, B., C.N. Manju and R. Prakashkumar. 2013. *Aerobryopsis wallichi* (Moss; Bryophyta) a new record for India. *Geophytology* 42(2): 147-149.

Prajitha, B., C.N. Manju and R. Prakashkumar. 2017. New record of two mosses from Malabar Wildlife Sanctuary in the Western Ghats of India. *Geophytology*. 47(2):155-159.

Prajitha, B., V.K. Rajilesh, P.V. Madhusoodanan and R. Prakashkumar. 2017. *Nardia assamica* (Mitt.) Amakava (Jungermanniaceae) from Malabar Wild life Sanctuary, a new record for Peninsular India. *Res. Rev. J. Bot*. 6(3): 11-13.

Proskeur, J. 1957. Studies in Anthocerotales. V. *Phytomorphology.* 7: 1 13-1 35.

Qian, L., W. You-Fang and Z. Qin, 2010. Notes on Brachytheciaceae (Bryophyta) of China. *J. Wuhan Bot. Res.* 28(1): 10-15.

Rai, M., P. Srivastava and S.N.Srivastava. 2016. Observations on fertile populations of two Porella (Porellaceae, Marchantiophyta) species from Kumaun Region in the Western Himalaya, India. *Plant Science Today*, *3*(2).142-148.

Raja, R.D.A. and Daniels, A.E.D. 2012. The liverwort *Radula multiflora* Gottsche ex Schiffn.(Radulaceae) added to the bryoflora of India. *Indian Journal of Forestry*, *35*(2). 261-262.

Rajeevan, B. 1990. *Studies on the Bryophyete flora of the Idukki District, Kerala.* Ph.D. Thesis, Bharathiar University, Coimbatore.

Rajesh, K. P. and C.N. Manju, 2014. Bryophyte diversity of the lowlands and midlands of Kozhikode District, Kerala, India. *Frahmia*. 5: 1-10.

Rajilesh, V.K., C.N. Manju and R. Prakashkumar. 2016. Conservation of Bryophytes in Malabar Botanical Garden and Institute for Plant Sciences, India. In: Smitha, R.B., *et al.* (Eds.), Advances & Challenges in Plant Breeding, Biotechnology and Conservation. Malabar Botanical Garden and Institute for Plant Sciences, pp. 369-374.

Rajilesh, V.K., P.V. Madhusoodanan and R. Prakashkumar. 2018. *Plagiochila magna* Inoue. (Plagiochilaceae) from Mathikettan Shola National Park, Idukki-New record to Peninsular India. *Ann. Pl. Sci.* 7.1: 1946-1948.

Rajilesh, V.K. and R. Prakashkumar. 2017. The Genus *Entodon* (Entodontaceae: Bryophyta) from Mathikettan Shola National Park in Kerala, India. *Res. Rev. J. Bot*. 6(2): 1-8.

Rashid, A., R. Mishrad and A. Sharma. 2012. *Bryoflora of District Rajouri-Jammu and Kashmir State, India*. Univ.-Bibliothek. 1-11.

Rawat, K.K. and S.C.Srivastava. 2007. *Genus Plagiochila in Eastern Himalaya, India*. Bishen Singh Mahendra Pal Singh. Dehra Dun.258.

Rawat, K.K., A. Alam and P.K.Verma. 2015. Moss flora of Rajasthan and Punjab plains. *Plant Science Today*, *2*(4).154-158.

Rawat, K. K., A. Alam and P.K.Verma. 2016. Checklist of mosses (Bryophyta) of Gangetic Plains, India. *Bangladesh Journal of Plant Taxonomy*, *23*(2). 97-106.

Rawat, K.K.,V.I.N.A.Y. Sahu, C.P.Singh and P.K.Verma. 2017. Additions to the bryophyte flora of Tawang, Arunachal Pradesh, India. *Frahmia*, 14. 1-17.

Renzaglia, K.S. and K.C. Vaughn. 2000. Anatomy, development and classification of hornworts. In *Bryophyte Biology*, ed. A. J. Shaw & B. Goffinet, pp.1-35. Cambridge: Cambridge University Press.

Rheede, H. A. van. 1678-1703. *Hortus lndicus Malabaricus*. Amsterdam.

Richardson, J.B. 1985. Lower Palaeozoic sporomorphs: their stratigraphical distribution and possible affinities. *Philosoph. Trans. Royal Soc. London, Botany.* 309: 201-205.

Robinson, H. 1956. A small collection of bryophytes from Kashmir. *Bryologist* 68: 313 -320

Sahu, V. and A. K. Asthana. 2015. Bryophyte diversity in Terai regions of Uttar Pradesh, India with some new additions to the state. *Tropical Plant Research*, 2(3), 180-191.

Sandhya Rani, S., M. Sowghandhika, K. S. Nagesh, B. Susheela, and T. Pullaiah, 2014. *Bryophytes of Andhra Pradesh*. Bishen Singh Mahendra Pal Singh, Dehradun, India. 275.

Sathish, S.S., R. Kavitha and S.S.Kumar. 2013. Bryophytes in India-the current status. *Inter. J. Research in Engineering and Bioscience*, 1(4). 23-31.

Saxena, D. K., Harinder. 2004. Uses of bryophytes. *Resonance*. 9: 56–65.

Saxena, D.K., M.S. Arfeen and H.Kaur. 2009. Effect of Forest fire on Bryocommunity of Kausani, India. *Indian Journal of Forestry*, 32(1).13-22.

Schiffner, V. 1898. Conspectus Hepaticarum Archipelagi Indici. *Batavia*. 1-382.

Schiffner, V., S. K. Pande and K. P. Srivastava. 1959. The genus *Riccardia* Gray in India. II. *Riccardia palmatiformis* Schiff. And *R. decolyana* Schiff. *J. lndian Bot. Soc*. 38: 538-542.

Schofield, W.B. 1985. *Introduction to Bryology*. Macmillan publishing co., Newyork.

Schwaegrichen, F. 1811-1842. (Species Muswrum, Hedwig) Opus posthumurn supplementum primum scripturn. Leipzig. Suppl. 1 (I): 1811; (11) 1816. Suppl 2(1): 1826-27. Suppl. 3(1): 1827- 28; (11): 1829-30. Suppl. 4(1): 1842

Schwarz, U. 2013. An Updated Checklist of Bryophytes of Karnataka. *Archive for Bryology*.181:1-42.

Schwarz, U., 2014. *Fissidens brevinervis* Broth.—new to the Indian moss flora. *Frahmia*, 3.1-6.

Schwarz, U. and J.P. Frahm. 2013. A contribution to the bryoflora of the Western Ghats in Karnataka State, India. *Polish Botanical Journal*, 58(2).511-524.

Shaheen, F. and S.C. Srivastava. 1989. *Porella campylophylla* (Lehm. & Lindenb.) Trev. complex in India. *Geophytology*, 19(1).34-48.

Shantanu, S. 2010. *Mosses of Idukki In Western Ghats, India.* Ph.D Thesis, Delhi University, Delhi, India. (Unpublished).

Sharma, A., A. Langer and P.L. Uniyal. 2016. A Preliminary Report on the Mosses of Rajouri and Poonch Districts of Jammu & Kashmir, India. *Evansia*, *33*(1), pp.26-34.

Sharma, D. and A. Alam. 2011. Present status of liverwort diversity at Pachmarhi (Madhya Pradesh). *J. Indian bot. Soc*, *90*(3&4).332-338.

Sharma, D. and S.C. Srivastava. 1993. Indian Lepidoziineae.

Sharma, M. P., R. P. Raturi and R. D. Gaur. 1981. Palynological studies on some liverworts of Garhwal Himalayas. *Curr. Sci.* 50: 353-356.

Sharma, O.P. 2014. *Series on the Diversity of Microbes and Cryptogams Bryophyta* Mc Graw Hill Education (India) Private Limited, New Delhi.1.

Shaw, A.J. and B. Goffinet. 2000. (eds.), *Bryophyte Biology,* Cambridge.

Singh, A.P. and V. Nath. 2007. *Hepaticae of Khasi and Jaintia Hills: Eastern Himalaya*. Bishen Singh Mahendrapal Singh, Dehradun, India. 382.

Singh, A.P. and V. Nath. 2004. *Frullania rotundistipula* Steph.- an addition to the bryoflora. *Geophytology* 32: 73-77.

Singh, A.P., V. Nath and A. K. Asthana. 2001. An addition to the bryoflora of eastern Himalaya: *Porella hattori* Udar & Shaheen. *Phytotaxonomy* 1: 95-97.

Singh, D and D.K.Singh. 2011. *Ptilidium pulcherrimum* (G. Weber) Vainio (Hepaticae: Ptilidiaceae)—an addition to Indian bryoflora. *Nelumbo*. *53*.205-210.

Singh, D.K. 2001. Diversity in lndian liverworts: Their status, vulnerability and Conservation. *In:* V. Nath & A. K. Asthana (eds.) *Perspectives in lndian Bryology.* Bishen SinghMahendrapal Singh, Dehra Dun. 325-354.

Singh, D.K. and B. Narayan. 2002. *Folioceros glandulosus* Lehm. & Lindenb. Bhard. (Bryophyta) from Arunachal Pradesh, India. *Phytomorphology* 2: 16-19.

Singh, D.K., S.K. Singh and S.K. Singh. 2015. *Manual of Liverworts and Hornworts of Himachal Pradesh.* Bishen Singh Mahendra Pal Singh, Dehradun.205.

Singh, S.K., A.K. Bag and S.G.Bhattacharya. 2010. *Riccia* (Hepaticae: Ricciaceae) of West Bengal. *Taiwania* 55(2) 99-109.

Singh, S. K. and D. K. Singh. 2004. *Lejeunea flava* (Swartz) Nees-an addition to the bryoflora of Western Himalaya. *Geophytology* 32: 11 5-1 17.

Singh, S.K. and D.K. Singh. 2009. *Hepaticae and anthocerotae of Great Himalayan National Park and its environs (HP), India*. Dehra Dun. 465.

Singh,S.K. and H.A. Barbhuiya. 2012. A Compendium to Marchantiophyta and Anthocerotophyta of Assam, India. *Archive for Bryology* 149: 1-30.

So, M. L. and R. Grolle. 2001. On several little known species of *Plagiochila* (Hepaticae) in Asia. *J. Bryol,* 23: 123-132.

Soderstrom, L., Hagborg, A., von Konrat, M., Bartholomew-Began, S. E., Bell, D., Briscoe, L., Brown, A., Cargill, D.C., da Costa, D. P., Crandall-Stotler, B. J., Cooper, E. D., Dauphin López, G., Engel, J., Feldberg, K., Glenny, D.S., Gradstein, S.R., He, X.-L., Heinrichs, J., Hentschel, J., Ilkiu-Borges, A. L., Katagiri, T., Konstantinova, N. A., Larraín, J., Long, D.G., Nebel, M., Pocs, T., Puche, F., Reiner-Drehwald, M. E., Renner, M.A.M., Gyarmati, A. A., Schafer-Verwimp, A., Segarra-Moragues, J.G., Stotler, R.E., Sukkharak, P., Thiers, B.M. Uribe, J.C., Váňa, J., Villarreal, J. C., Wigginton, M. J., Zhang, L. and Zhu, R.-L. 2016. World checklist of hornworts and liverworts. *PhytoKeys* 59(1–2): 1–828.

Soderstrom, L., S. R. Gradstein and A. Hagborg. 2010. Checklist of the Hornworts and Liverworts of Java. Phytotaxa 9: 53-149.

Sreebha, R., K.C. Kariyappa and A.E.D. Daniels. 2015. New records of two Himalayan liverworts in the Western Ghats. *Nelumbo*, *57*.100-105.

Srinivasan, C. 1974. *Mosses of South India,* Annamalai University, Annamalai Nagar.

Srinivasan, K.S. 1968. An ecological and distributional resume of the liverworts and mosses of India. *Bot. Sum. India* 10: 377-380.

Srivastava, A. and S.C. Srivastava. 2002. *Indian Geocalycaceae–a taxonomic monograph.* Bishen Singh Mahendra Pal Singh, Dehradun.1-246.

Srivastava, J.P. 1966. Mosses of Kumaon. I. *Proc. Natl. Acad. Sci. lndia* 36: 385-396.

Srivastava, K.P. 1960. Studies in lndian Metzgerineae-IV. *Riccardia levieri* Schiff. *J. lndian Bot.Soc.* 39: 537-547.

Srivastava, K.P. 1961. Studies in lndian Metzgerineae-V. *Pallavicinia lyellii* (Hook.) Gray. *Bull. Bot. Soc. Bengal* 1 3: 83-101 .

Srivastava, S.C. and A. K. Asthana. 1987. Morphology of *Anthoceros crispulus* (Montin) Douin from South India. *Proc. lndian Acad. Sci.* 97: 385-389.

Srivastava, S.C., A. Srivastava and R. Dixit. 1994. Epiphytic liverworts on Tea plantations in Darjeeling. *Geophytology* 24: 63-72.

Srivastava, S.C. and D. Sharma. 2000. A preliminary study on the liverwort and hornwort flora of Silent Valley (Kerala). In: m Chauhan (ed.), Prof. D.D. Nautiyal Commemoration Volume recent Trends in Botanical Researches. 55-75.

Srivastava, S. C. and G. Srivastava. 1989. Two *Cololejeunea* from South India. *Proc. Indian Acad. Sci.* 99: 83-90.

Srivastava, S. C. and P. K. Verma. 2004 . Exploration of liverwort diversity on Cinchona plantation in Dodabetta, Nilgiri hills, India. *Geophytology* 32: 1-18.

Srivastava, S.C. and R.Udar. 1976. Indian Aneuraceae a monographic study. *Biological memoirs*.

Srivastava, S. C. and R. Udar. 1979. Distribution of Metzgeriales in India. *J. lndian Bot. Soc.* 58: 33-39.

Srivastava, S.C. and R. Udar. 1995. Genus *Chiloscyphus* Corda in Eastern Himalaya. *In*: S. S. Kumar (ed.), Recent Studies on lndian Bryophytes. Bishen Singh Mahendrapal Singh, Dehra Dun. 189-195.

Stephani, F. 1906-1924. Species Hepaticarum 2-6: Geneva.

Stotler, C.B. and R. Stotler. 2000. Morphology and classification of the Marchantiophyta. In *Bryophyte Biology*. ed. A. J. Shaw & B. Goffinet, pp. 21-70. Cambridge: Cambridge University Press.

Stotler, C. B., R.E. Stotler and D.G.Long. 2009. Phylogeny and classification of the Marchantiophyta. *Edinburgh journal of botany*, *66*(1).155-198.

Subhisha, S. and A. Subramoniam. 2005. Antifungal activities of a steroid from *Pallavicinia lyellii*, a liverwort, *Indian J Pharmacol* .37: 304-308.

Sugawa, S. 1960. Nutritive values of mosses as a food for domestic animals and fowls. *Hikobia* 2: 119-124.

Thamizharasi, T., S. Sahaya Sathish, R. Palani, A. Vimala and P.Vijayakanth. 2018. Enumeration and phytogeographical pattern of mosses (Bryopsida) in Kalrayan Hills of Eastern Ghats of Tamilnadu, India. *International Journal of Development Research*, *8*(1).18212-18216.

Thomas W.1984. Statistical models for the accumulation of PAH, chlorinated hydrocarbons and trace metals in epiphytic *Hypnum cupressiforme*. *Water Air Soil Pollut*. 22: 351 – 371

Udar, R. 1976. *Bryology in India.* Cronica Botanica. New Delhi.

Udar, R. And A. Gupta.1981. Differentiation of the genus *Targionia* L. in India. I. The West Himalayan complex. *Geophytology*.

Udar, R. and A. Jain. 1984. Liverworts of Kerala-l. Marchantiales. *lndian J. For.* 7: 300-304.

Udar, R. and A. Kumar. 1980. A new *Cephaloziella* from India. *Misc. Bryol. Lichenol*. 8: 137-139.

Udar, R. and A. Kumar. 1981. *Jackiella javanica* Schiffn.- a rare and interesting taxon from India. *J. lndian Bot. Soc.* 60: 105-1 1 1.

Udar, R. and A. Kumar. 1982. Studies in eastern Himalayan Hepaticae-ll. The genus *Chandonanthus* Mitt. *Geophytology* 1 2: 59-64.

Udar, R. and A. Kumar. 1985. Family Cephaloziellaceae in South India. *Geophytology* 15: 141-145.

Udar, R. and D. Kumar. 1983. *Radula pandei,* a new hepatic from South India. *Lindbergia* 9: 133-136.

Udar, R. and D.K. Singh. 1979a. *Notothylas dissects*, a homwort new to India. *Bryologist* 82: 625-628.

Udar, R. and D.K. Singh. 1979b. *Notothylas pfleiderensp.nov*. from Mangalore, India. *Lindbergia* 5: 28.

Udar, R. and F. Shaheen. 1982a. The status of some species of *Porella* in Herb.G. *Geophytology* 12: 342.

Udar, R. and F. Shaheen. 1982b. *Marchantia kashyapiisp. nov*. from South India. *lndian*J. *Bot.* 5: 1-6.

Udar, R. and F. Shaheen. 1982c. A new *Folioceros* from South India. *Geophytology* 12: 78-80.

Udar, R. and F. Shaheen. 1985. The genus Ceratolejeunea in India. *J. lndian Bot. Soc*. 64: 400-402.

Udar, R. and G. Srivastava. 1982. Two new species of *Cololejeunea* from Peninsular India. *J. Bryol.* 12: 227-231.

Udar, R. and G. Srivastava. 1983a. A new *Cololejeunea* from India. *Misc. Bryol. Lichenol*. 9: 137-139.

Udar, R. and G. Srivastava. 1983b. Scanning electron microscopy of spores of *Targionia* and *Cyathodium* from India. *J.Indian Bot.Soc*.62:220-222.

Udar, R., S. C. Srivastava and D. Kumar. 1970. Oil bodies in lndian Liverworts. *Curr. Sci.* 39: 458-459.

Udar, R. and U. S. Awasthi. 1983. The genus *Leucolejeunea* Evans in India. *J. lndian Natl. Sci. Acad. B.* 49: 249-256.

Udar, R. and U.S. Awasthi. 1984. *Schiffnerolejeunea indica* (St.) Udar & Awasthi, in Kerala. *J. lndian Bot. Soc.* 63: 460-461.

Udar, R., U.S. Awasthi, and F. Shaheen. 1982. A new *Caudolejeunea* from India. *Bryologist.* 85: 329-331.

Udar, R., U.S. Awasthi and F. Shaheen. 1983. A new species of *Lopholejeunea* (Spruce) Schiffn. from India. *Lindbergia* 9: 34-36.

Udar, R. and V. Chandra. 1964. On some anomalous female receptacles of Reboulia hemispherica (L.) Raddi. *J Indian Bot Soc*, 43.521-528.

Udar, R. and V. Nath. 1971. Oil bodies in South lndian livemorts. *Cur. Sci.* 40: 638-640.

Udar, R. and V. Nath. 1973. Studies in South lndian Hepaticae: 3. *Cephalozia siamensis* Kitagawa- a new record from India. *Bull. Bot. Sum. lndia*15: 145-1 51.

Udar, R. and V. Nath. 1975. Studies in South lndian Hepaticae- 4. *Leucolejeunea xanthocarpa* (Lehm. *et* Lindenb.) Evans- new to lndian flora. *Bull. Bot. Sum. lndia*17: 180-182.

Udar, R. and V. Nath. 1976. Oil-bodies in west Himalayan Livemorts. *J. lndian Bot. Soc.* 55: 80-83.

Udar, R. and V. Nath. 1977. Oil-bodies in South lndian livemorts. *Geophytology* 7: 50-53.

Vana, J. 1972. Miscellaneous notes on the Asiatic Jungermannioideae. *Journal of the Hattori Botanical Laboratory* 35: 312–318.

Varde, R. Potier De La. 1922. Musci Madurenses (contribution a la flore bryologique de I' lnde meridionale. *Rev. Bryol.* 49: 33-34.

Varde, R. Potier De La. 1923a. Musci maderenses. *Rev. Bryol.* 50: 172-177.

Varde, R. Potier De La. 1923b. Musci maderenses. *Rev. Bryol.* 50: 72-79.

Varde, R. Potier De La. 1924. Musci maderenses.*Rev. Bryol.* 51: 10-14.

Varde, R. Potier De La. 1925. Nouvellesher borisations dans la sud de 1' Inde. *Rev. Bryol.* 52: 37-43.

Verma, P. K., A. Alam and K. K. Rawat. 2013. Assessment of liverwort and hornwort flora of Nilgiri hills, Western Ghats (India). *Polish Botanical Journal.* 58(2): 525-537.

Verma, P.K., A. Alam and S.C. Srivastava. 2011. *Status of Mosses in Nilgiri Hills (Western Ghats), India*. Univ.-Bibliothek. *stry*, *35*(4), pp.507-510.

Vitt, D. H. 1990. Growth and production dynamics of boreal mosses over climatic, chemical and topographic gradients. Bot. J. Linn. Soc. 104:35–59.

Vohra, J.N. 1969a. A new species of *Habrodon* and some unrecorded species of mosses from India. *Bull. Bot. Surv. lndia* 11: 70-75.

Vohra, J.N. 1969 b. A contribution to the moss flora of Western Himalayas I. *Bull. Bot. Surv. lndia* 11 : 41 -50.

Vohra, J.N. 1970. A contribution to the moss flora of western Himalayas -11. *Bull. Bot. Surv. India* 12: 97.

Vohra, J.N. 1981 a. *Pogonatum hexagonum* Mitt., an endemic moss to lndia from Silent Valley, Kerala. *B.S.I. News Letter* 7(1): 8.

Vohra, J.N. 1981b. 250 mosses collected from Mullaperiyar and its catchment area in ldukki dist. of Kerala. B.S.I. News Letter 7(1): 2.

Vohra, J.N. 1983. Hypnobtyales suborder Leskeineae of the Himalayas. *Rec. Bot. Surv. India.* 23: 1-336.

Vohra, J. N. and B. M. Wadhwa. 1964. Mosses collected during Nilkanth and Chowkhamba expedition, 1959. *Bull. Bot. Sum. lndia*6: 43-46.

Vohra, J. N., K. N. Roychoudhaty, K. N. Gosh, R. K. Kar, B. D. Singh and R. K. Singh. 1982. Observations on the cryptogamic flora of Silent Valley. *In:*

Botanical Studies on SilentValley. Special Bulletin. Botanical Survey of India, Howrah. 1-40.

Vohra, J.N., K.N. Roychoudhary, K.N. Gosh, R.K. Kar, B.D. Singh and R.K. Singh. 1982. Observations on the cryptogamic flora of Silent Valley. *In*: *Botanical Studies on Silent Valley*. Special Bulletin, pp. 1-40, Botanical Survey of India, Howrah.

Vohra, V.N. and B.D.Kar. 1996. On a collection of mosses from Arunachal Pradesh. *Nelumbo*, 38(1-4). 46-54.

Wadhwa, B. M. and J. N. Vohra. 1965. On a collection of bryophytes made by the Indian cho Oyu Expedition, 1958. J. *Bombay Nat. Hist, Soc.* 62: 259-265.

Wallich, N. 1828-1832. A numerical list of dried specimens of plants in the East lndia company's Museum (Calcutta) collected under supervision of Dr. Wallich. (Mosses- Nos. 7545-7582).

Wallich, N. 1841. Musci Indicae: Mosses collected in East lndies by Dr. N. Wallich. *J. Bot.* 2: 1-21.

Yamada, K. 1979. A revision of Asian taxa of Radula, hepaticae. *J. Hattori Bot.Labo.*45: 201-322.

Yepsen, R.G. 1984. Soap. *The encyclopedia of natural insect & disease control*. Rodale Press, Emmaus, Pa.

Zhu, R., D. Wang, L. Xu and M. Zheng. 2006. Antibacterial activity in extracts of some Bryophytes from China and Mangolia. *Journal- Hattori Botanical Laboratory:* 603-615.

INDEX

Fissidens pellucidus Hornsch.
Floribundaria walkeri (Renauld & Cardot) Broth.
Foreauella orthothecia (Schwgr.) Dixon & P. dela Varde
Garckea flexuosa (Griff.) Margad. & Nork.
Heteroscyphus argutus (Nees) Schiffner
Heteroscyphus perfoliatus (Mont.) Schiffner
Homalia trichomanoides (Hedw.) Schimp.
Homaliodendrum flabellatum (Sm.) M. Fleisch.
Hookeriopsis secunda (Griff.) Broth.
Hookeriopsis utacamundiana (Mont.) Broth.
Hymenostomum edentulam (Mitt.) Besch.
Hypopterygium favolimbatum Mull.
Hypopterygium tamarisci (Sw.) Brid. ex Mull.
Isopterygium albescens (Hook.) A. Jaeger
Isopterygium serrulatum M. Fleisch.
Jungermannia comata (S. Hatt.) Amak.
Jungermannia rubripunctata (S. Hatt.) Amak.
Jungermannia shinii Amakaw
Lejeunea eifrigii Mizut.
Lejeunea cavifolia (Ehrh.) Lindb.
Lejeunea obscura Mitt.
Lejeunea tuberculosa Steph.
Lejeunea wightii Lindenb.
Leptohymenium tenue (Hook.) Schwagr.
Leptopterigynandrum decolor (Mitt.) M. Fleisch.
Leucobryum javense (Brid.) Mitt.
Leucoloma amoene virens Mitt.
Macromitrium sulcatum (Hook.) Brid.
Marchantia linearis Lehm. & Lindenb.
Meiothecium microcarpum (Harv.) Mitt.
Meteoriopsis reclinata (Mull. Hal.) M. Fleisch.
Metzgeria lindbergii Schiffn.
Pallavicinia lyellii (Hook.) Gray
Pelekium velatum Mitt.
Philonotis hastata (Duby) Wijk & Margad.
Philonotis mollis (Dozy & Molk.) Mitt.
Philonotis thwaitessi Mitt.

Plagiochasma ruprestre (G. Forst.) Stephani
Plagiochila arbuscula Lindenb.
Plagiochila fruiticosa Mitt.
Plagiochila sciophila Nees ex Lindenb.
Plagiomnium rhynchophorum (Hook.) T.J. Kop.
Pogonatum microstomum (R. Br.ex Schwagr.) Brid.
Porella acutifolia (Lehm. & Lindenb.) Trevis.
Porella campylophylla (Lehm. & Lindenb.) Trevis.
Pterobryopsis acuminata (Hook.) M. Fleisch.
Pterobryopsis auriculata Dixon
Pterobryopsis frondosa (Mitt.) M. Fleisch.
Pterobryopsis pilifolia (Dixon) Magill
Pyrrobryum spiniforme (Hedw.) Mitt.
Racopilum orthocarpum Wilson ex Mitt.
Radula javanica Gottsche.
Reboulia hemisphaerica (L.) Raddi.
Regmatodon orthostegius Mont.
Rhodobryum roseum (Hedw.) Limpr.
Rhynchostegiella scabriseta (Schwagr.) Broth.
Rhynchostegiella menadensis (Sande Lac.) E.B.Bartram
Rhynchostegium herbaceum (Mitt.) A. Jaeger
Riccardia levieri Schiffn.
Riccardia tenuicostata Schiffn.
Schoenobryum concavifolium (Griff.) Gangulee.
Sematophyllum micans (Mitt.) Braithw.
Targionia hypophylla L.
Taxiphyllum maniae (Renauld & Paris) M. Fleisch.
Thuidium cymbifolium (Dozy &Molk) Dozy & Molk.
Thuidium pristocalyx (Mull. Hal.) A. Jaeger
Trachypodopsis serrulata (P. Beauv.) M. Fleisch
Vesicularia montagnei (Schimp.) Broth.
Wijkia deflexifolia (Ren. & Card.) Crum

APPENDIX

a. List of paper published

A. List of Publications based on data presented in Thesis

Rajilesh, V. K., Madhusoodanan P.V. and R. Prakashkumar. 2018. *Plagiochila magna* Inoue. (Plagiochilaceae) from Mathikettan Shola National Park, Idukki- New record to Peninsular India. *Ann. Pl. Sci.* 7.1: 1946-1948.

Rajilesh, V. K. and R. Prakashkumar. 2017. The Genus *Entodon* (Entodontaceae: Bryophyta) from Mathikettan Shola National Park in Kerala, India. *Res. Rev. J. Bot*. 6(2): 1-8.

Prajitha, B., Rajilesh, V.K., P.V. Madhusoodanan and R. Prakashkumar. 2017. *Nardia assamica* (Mitt.) Amakava (Jungermanniaceae) from Malabar Wild life Sanctuary, a new record for Peninsular India. *Res. Rev. J. Bot*. 6(3): 11-13.

Manju, C.N., V.K. Rajilesh, K.M. Deepa and R.Prakashkumar. 2015. The genus *Calycularia* (Marchantiophyta) in Kerala part of the Western Ghats. *Acta Botanica Hungarica*. 57 (3-4): 401-406.

B. Other Publications Authored / Co-authored by candidate during his Ph.D.Programme.

Rajilesh V. K., P.S.,Udayan and R. Prakashkumar.2018. *Thottea sasidharaiana* Robi (Aristolochiaceae): A Rare and Little Known Endemic Plant from Ambayathode Forests of Kottiyoor Wild Life Sanctuary, Kannur, Western Ghats, Kerala, India. *Res. Rev. J. Bot. 6(3):17-19.*

Rajilesh, V. K., Manju, C. N. and R. Prakashkumar. 2016. Conservation of Bryophytes in Malabar Botanical Garden and Institute for Plant Sciences, India. In: Smitha, R.B., *et al.* (Eds.), Advances & Challenges in Plant Breeding, Biotechnology and Conservation. Malabar Botanical Garden and Institute for Plant Sciences, pp. 369-374.

Rajilesh, V.K., K.P.Anoop, P.V. Madhusoodanan, R. Ansari and R.Prakashkumar.2016. A Floristic Analysis of the Aquatic, Marshy &Wetland plants of Idukki District,Kerala, India. *International Journal of Plants, Animal and Environmental Sciences.* 6:55-64.

Manjula, K. M., Manju. C. N., Rajilesh V.K. and Chandini V.K. 2015. *Fissidens linearis* Fissidentaceae: Bryophyta) a new record for India. *Acta Bot. Hungarica* 57(1):165-168.

Manju, C.N., V.K. Rajilesh, B. Prajitha, R. Prakashkumar and K.P. Rajesh. 2014. Contribution to the Bryophyte flora of India: SilentValley National Park in the Western Ghats, India. *Acta Biol. Pl. Agriensis* 1: 73-98.

Rajilesh,V.K., K.P Anoop, P.V. Madhusoodanan and R. Prakashkumar.2013. A Little Known Species of *Potamogeton(P.perfoliatus L*. Potamogetonaceae) from Kerala, S. India. *J. Indian Bot. Soc.* 92(12):56-60

Manju, C.N., R. Prakashkumar, B. Prajitha, V.K. Rajilesh and K. P. Anoop. 2012. *Trichosteleum stigmosum* Mitt. (Sematephyllaceae) from Sient Valley National park, a new record for India. *Taiwania*. 57(2): 222-224.

Anoop, K.P., M.M. Swapna, V.K. Rajilesh and R. Prakashkumar. 2012. Taxonomy and Distribution of the Aquatic family Pontederaceae Kunth in South India. *J. Econ. Taxon. Bot*. 36 :64-68.

Swapna, M.M., V.K. Rajilesh, K.P. Anoop, R. Ansari & R.Prakashkumar. ****** A Floristic Analysis of the Wetlands of Wayanad District, Kerala, South India. *J. Econ. Taxon. Bot*. 36 : 310-319m.

C. Papers presented

Rajilesh, V. K., Manju, C. N. and R. Prakashkumar. 2016. Conservation of Bryophytes in Malabar Botanical Garden and Institute for Plant Sciences, India. In: Smitha, R.B., *et al.* (Eds.), Advances & Challenges in Plant Breeding, Biotechnology and Conservation. Malabar Botanical Garden and Institute for Plant Sciences, pp. 369-374.

Rajilesh, V.K. and R. Prakashkumar.2017. *Acrocarpic Moss Flora of Mathikettan Shola National Park, Idukki, Kerala*. Importance of taxonomy, National Seminar Organised by St Marys College, Sulthan Bathery, Wayanad, 8-10 March 2017.

Rajilesh, V.K., P.V.Madhusoodanan and R.Prakashkumar. 2017. *Stidies on the Leafy Liverworts of Mathikettan Shola National Park, Idukki, Kerala, India*. GMF National Seminar on Modern Trends in Conservation, Utilisation and Improvement of Plant genetic Resources, Organised by University of Kerala & Calicut University.