

**PRELIMINARY STUDIES ON
THE MOSS FLORA OF ST. TERESA'S COLLEGE ERNAKULAM**

Dissertation submitted in partial fulfilment of the
requirements for the award of the Degree of Bachelor of
Science in
BOTANY

By

NAME: JIYA P. JOJU

Reg No: AB20BOT019



**DEPARTMENT OF BOTANY AND CENTRE FOR RESERCH
ST. TERESA'S COLLEGE (AUTONOMOUS)
ERNAKULAM**

APRIL 2023

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CERTIFICATE

This is to certify that the dissertation entitled "Preliminary studies on the Moss flora of St. Teresa's College Campus, Ernakulam" is an authentic record of research work carried out by Ms. JIYA P. JOJU (Reg. No. AB20BOT007) under the supervision and guidance of Dr. Chandini V. K., Department of Botany and Centre for Research, St. Teresa's College (Autonomous), Ernakulam in partial fulfilment of the award of the degree of Bachelor of Science (B.Sc.) in Botany. I further certify that no part of this work embodied in this project has been submitted for the award of any degree or diploma.



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I wish to express here my grateful thanks to Dr. Liza Jacob, Head of the Department of Botany, St. Teresa's College (Autonomous), Ernakulam for providing all necessary facilities for the work.

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I express my love and heartfelt gratitude towards my parents and beloved ones for their constant encouragement and prayers.

I extend my sincere thanks to all my friends for their help, cooperation and encouragement to complete this project successfully.

JIYA P. JOJU

DECLARATION

I hereby declare that the project entitled "**Preliminary studies on the Moss flora of St. Teresa's College Campus, Ernakulam**" submitted to Mahatma Gandhi University, Kottayam, in partial fulfilment of the requirement for the Degree of Bachelor of Science in Botany is an original project done by me under the supervision and guidance of Dr. Chandini V.K., Department of Botany and Centre for Research, St. Teresa's college (Autonomous), Ernakulam.

PLACE: Ernakulam

DATE: 24/04/2023



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INTRODUCTION

INTRODUCTION

The Bryophytes are a proposed taxonomic division containing three groups of non-vascular land plants (embryophytes): the liverworts, hornworts and mosses. They are characteristically limited in size and prefer moist habitats although they can survive in drier environments. Bryophytes produce enclosed reproductive structures (gametangia and sporangia), but they do not produce flowers or seeds. They reproduce sexually by spores and asexually by fragmentation or the production of gemmae. Though bryophytes were considered a paraphyletic group in recent years, almost all of the most recent phylogenetic evidence supports the monophyly of this group, as originally classified by Wilhelm Schimper in 1879. The term "Bryophyta " was first suggested by Braun in 1864. G.M. Smith placed this group between Algae and Pteridophytes. The defining features of bryophytes are; their life cycles are dominated by a multicellular gametophyte stage, their sporophytes are unbranched, they do not have a true vascular tissue containing lignin (although some have specialized tissues for the transport of water

Habitat

Bryophytes exist in a wide variety of habitats. They can be found growing in a range of temperatures (cold arctic and in hot deserts), elevations (sea-level to alpine), and moisture (dry deserts to wet rain forests). Bryophytes can grow where vascularized plants cannot because they do not depend on roots for uptake of nutrients from soil. Bryophytes can survive on rocks and bare soil.

Life cycle

The life cycle of bryophytes consists of an alternation of two stages called the sporophyte and the gametophyte. The gametophyte (haploid) structures are dominant, longer-lived plants and sporophyte (diploid) is dependent and remains nutritionally dependent on the gametophyte. In each cycle, a haploid gametophyte, each of whose cells contains a fixed number of unpaired chromosomes, alternates with a diploid sporophyte, whose cells contain two sets of paired chromosomes. Gametophytes produce haploid sperm and eggs which fuse to form diploid zygotes that grow into sporophytes. Sporophytes produce haploid spores by meiosis that grow into gametophytes. In bryophytes, the sporophytes are always unbranched and produce a single sporangium (spore producing capsule), but each gametophyte can give rise to several sporophytes at once.

The sporophyte develops differently in the three groups. Both mosses and hornworts have a meristem zone where cell division occurs. In hornworts, the meristem starts at the base where the foot ends, and the division of cells is pushing the sporophyte body upwards. In mosses, the meristem is located between the capsule and the top of the stalk (seta), and produces cells downward, elongating the stalk and elevating the capsule. In liverworts the meristem is absent and the elongation of the sporophyte is caused almost exclusively by cell expansion.

Liverworts, mosses and hornworts spend most of their lives as gametophytes. Gametangia (gamete-producing organs), archegonia and antheridia, are produced on the gametophytes, sometimes at the tips of shoots, in the axils of leaves or hidden under thalli. Some bryophytes, such as the liverwort *Marchantia*, create elaborate structures to bear the gametangia that are called gametangiophores. Sperm are flagellated and must swim from the antheridia that produce them to archegonia which may be on a different plant.

Fertilized eggs become zygotes, which develop into sporophyte embryos inside the archegonia. Mature sporophytes remain attached to the gametophyte. They consist of a stalk called a seta and a single sporangium or capsule. Inside the sporangium, haploid spores are produced by meiosis. These are dispersed, most commonly by wind, and if they land in a suitable environment can develop into a new gametophyte. Thus bryophytes disperse by a combination of swimming sperm and spores, in a manner similar to lycophytes, ferns and other cryptogams.

Sexuality

The arrangement of antheridia and archegonia on an individual bryophyte plant is usually constant within a species, although in some species it may depend on environmental conditions. The main division is between species in which the antheridia and archegonia occur on the same plant and those in which they occur on different plants. The term monoecious may be used where antheridia and archegonia occur on the same gametophyte and the term dioecious where they occur on different gametophytes.

Classification and phylogeny

The three bryophyte clades are the Marchantiophyta (liverworts), Bryophyta (mosses) and Anthocerotophyta (hornworts). However, it has been proposed that these clades are deranked to the classes Marchantiopsida, Bryopsida, and Anthocerotopsida, respectively.

Mosses

Mosses are small, non-vascular flowerless plants in the taxonomic division that may also refer to the parent group bryophytes, which comprise liverworts, mosses, and hornworts. Mosses typically form dense green clumps or mats, often in damp or shady locations. The individual plants are usually composed of simple leaves that are generally only one cell thick, attached to a stem that may be branched or unbranched and has only a limited role in conducting water and nutrients. Although some species have conducting tissues, these are generally poorly developed and structurally different from similar tissue found in vascular plants. Mosses do not have seeds and after fertilisation develop sporophytes with unbranched stalks topped with single capsules containing spores. They are typically 0.2–10 cm (0.1–3.9 in) tall, though some species are much larger. *Dawsonia*, the tallest moss in the world, can grow to 50 cm (20 in) in height.

Mosses are commonly confused with liverworts, hornworts and lichens. Although often described as non-vascular plants, many mosses have advanced vascular systems. Like liverworts and hornworts, the haploid gametophyte generation of mosses is the dominant phase of the life cycle. This contrasts with the pattern in all vascular plants (seed plants and pteridophytes), where the diploid sporophyte generation is dominant. The main commercial significance of mosses is as the main constituent of peat (mostly the genus *Sphagnum*), although they are also used for decorative purposes, such as in gardens and in the florist trade. Traditional uses of mosses included as insulation and for the ability to absorb liquids up to 20 times their weight.

Evolution

There have probably been several different terrestrialization events, in which originally aquatic organisms colonized the land, just within the lineage of the Viridiplantae. Between 510 - 630 million years ago, however, land plants emerged within the green algae.

Molecular phylogenetic studies conclude that bryophytes are the earliest diverging lineages of the extant land plants. They provide insights into the migration of plants from aquatic environments to land. A number of physical features link bryophytes to both land plants and aquatic plants

Uses

Environmental: Soil Conditioning, Bioindicators, Moss gardens, Pesticides

Characteristics of bryophytes make them useful to the environment. Depending on the specific plant texture, bryophytes have been shown to help improve the water retention and air space within soil. Bryophytes are used in pollution studies to indicate soil pollution (such as the presence of heavy metals), air pollution, and UV-B radiation. Gardens in Japan are designed with moss to create peaceful sanctuaries. Some bryophytes have been found to produce natural pesticides. The liverwort, *Plagiochila*, produces a chemical that is poisonous to mice. Other bryophytes produce chemicals that are antifeeds which protect them from being eaten by slugs. When *Sphagnum* is sprinkled on the soil of germinating seeds, it inhibits growth of "damping off fungus" caused by *Pythium* which would otherwise kill young seedlings.

Commercial: Fuel, Packaging, Wound Dressing

Peat is a fuel produced from dried bryophytes, typically *Sphagnum*. Bryophytes' antibiotic properties and ability to retain water make them a useful packaging material for vegetables, flowers, and bulbs. Also, because of its antibiotic properties, *Sphagnum* was used as a surgical dressing in World War I.

This present study attempted to make a floristic account on the Mosses of St.Teresa's college campus and this survey revealed the presence of 11 species from the study area.

OBJECTIVES

1. Exploration of the Liverworts of St. Teresa's College campus
2. Preparation of taxonomic account of the Bryophytes collected from the study area along with critical notes
3. Description giving anatomical and morphological details of all the species
4. Photographic documentation of all the species
5. Enrichment of the Bryophyte collection of Botany department herbarium of St. Teresa's College Ernakulam

STUDY AREA

STUDY AREA

The present study is conducted in St. Teresa's College of the Ernakulam district. It is the seventh district in the state of Kerala. Ernakulam is the Central Business District of the city of Kochi in Kerala, India and has lent its name to the Ernakulam district. Ernakulam bordering the district of Thrissur in the north, Idukki in the East, Alappuzha and Kottayam in the south, Lakshadweep Sea in the west is an amalgam of a hoary heritage and global growth of industry and commerce. For the outside world, Ernakulam is part of Kochi, referred to in the history of Kerala as the Queen of Arabian Sea.

The densely populated Ernakulam District embodies the achievements of the Kerala State in literacy, industry, trade and commerce. Many major establishments, including the Kerala High Court, the office of the Kochi Municipal Corporation and the Cochin Shipyard are situated here. The Ernakulam District is situated in Central Kerala in India. Ernakulam is located at 9.98°N 76.28°E. It has an average elevation of 4 m (13 ft).

Under the Köppen climate classification, the city of Ernakulam features a Tropical monsoon climate. Since the region lies in the south western coastal state of Kerala, the climate is tropical, with only minor differences in temperatures between day and night, as well as over the year. Summer lasts from March to May, and is followed by the South-west monsoon from June to September. October and November form the post monsoon or retreating monsoon season. Winter from December through February is slightly cooler, and windy, due to winds from the Western Ghats.

The Ernakulam district covers an area of 3,068 km² (1,185 sq mi) on the Western Coastal Plains of India. It is surrounded by the Thrissur District to the north, the Idukki District to the east, Alappuzha and Kottayam districts to the south and the Laccadive Sea to the west. The Anamalais occupy a large part of the district, consisting of the forest areas around Pooyamkutty and the Idamalayar Dam. The range also extends into Thrissur, Palakkad, and Idukki districts, as well as Coimbatore and Tiruppur districts of Tamil Nadu.

The district is divided geographically into highland, midland, and coastal areas. The altitude of the highlands is about 300 m (980 ft). The Periyar River, Kerala's longest, flows through all the taluks except Muvattupuzha. The Muvattupuzha River and a branch of the Chalakudy River also flow through the district. The average yearly rainfall in the district is 3,432 mm (135.1 in). The district has a moderate climate and mostly falls within the Malabar Coast moist forests ecoregion, while the highlands are part of the South Western Ghats moist deciduous forests ecoregion.

The present study involves the collection of bryophyte specimens from the St. Teresa's College of Ernakulam district. St. Teresa's College (Autonomous) Ernakulam, Kerala, a pioneering institution committed to the cause of higher learning of women and their empowerment through excellence in teaching, learning and research, was established on 15th June 1925 by the Carmelite Sisters of St. Teresa under the leadership of the visionary foundress Mother Teresa of St. Rose of Lima – a legend who opened up a glorious page for the empowerment of women, and who was declared as Servant of God on 29 January 2016. This 98 year old premier Minority Institution provides education in line with the mission of the foundress, aimed at the integral formation of intellectually creative, emotionally mature, morally responsible, spiritually enlightened, socially committed and truly liberated women who will reposition themselves as self-reliant and responsible individuals and agents of

change who will transform society. St. Teresa's College is the first women's College in Kochi and the second in the state of Kerala. It holds the honour of being the first aided College for women in the state. It was first affiliated to Madras University then to Kerala University. In 1983 it became one of the affiliated colleges of Mahatma Gandhi University. It was accredited by the NAAC at 'five star' level in 1999, re-accredited at 'A- level' in 2006 and reaccredited at 'A' level in 2012. The autonomous status was granted in 2014 recognizing its potential to become the first Deemed Women's University in the state of Kerala. Recognizing its academic excellence, the college was granted an extension for two years by the NAAC.(Plate 1)

The campus is situated in the heart of Kochi city in three different locations separated by a distance of roughly half a kilometre. The Arts Block is on the Park Avenue road occupying two acres and 65 cents. The Science Block on T.D road is situated in an area of one acre and 34 cents and the New Central block situated right in between both Arts and Science Campus at Convent road. Each block has many buildings with an adequate number of classrooms for different programmes offered by the college. The Topography, flora of the campus mainly represented with *Albizia saman*, *Annona squamosa*, *Artocarpus heterophyllu*, *Azadirachta indica*, *Mangifera indica*, *Borassus flabellifer L*, *Saracaashoka*. The present study involves the collection of bryophyte specimens from different habitats of college campus.



Fig 1. Ernakulam District map



Fig 2. Cochin Corporation map



Fig 3. St. Teresa's College map

Plate 1. Map of the study area

REVIEW OF LITERATURE

REVIEW OF LITERATURE

India is richly contributed with bryophyte flora, the floristic studies on bryophytes has got very little attention earlier. Major contributions on studies on bryophytes were made by European and north Indian bryologists. Rheede (1678-1703) in his monumental work Hortus Indicus Malabaricus has described one bryophyte as 'Poovan – Peda' which later was assumed as *Bryum dichotomum* Dickson (Nicolson et al., 1988). Uses of different bryophytes were studied by Dillenius (1741) and Ando (1957). Dixon (1914) reported 58 species of mosses including 40 genera collected by C.E.C. Fischer and others from South India and Ceylon. In this they reported three new species such as *Campylopus pseudogracilis*, *Taxithelium vivicolor*, *Barbellaquestei*. Nichols (1918) gave a detailed account on uses of bryophytes. Uses of *Sphagnum* in surgical dressing was reported by Hotson (1921). Major contribution to Indian Bryoflora done by Gangulee (1957, 1959, 1960, 1961) he described the mosses of Eastern India in a series of papers. He described the members of the order Fissidentales in 1957, order Dicranales and family Ditrichaceae (1959), Dicranaceae (1960) and Leucobryaceae (1960). Mahabale (1958) published a paper on the Taxonomy of liverworts and mosses. Regeneration experiments on four species of *Atrichum* have been carried out by Chopra in 1960 and gave a preliminary list of mosses from Nainital proper and its nearby localities.

The state of Kerala is blessed with unique climatic conditions for bryophyte diversity. However, comparing its diversity, the exploration of bryophytes is very less, and it has gained several interesting findings and documentation in the last 20 years. The studies are in progressive state by the contributions Nair *et al.* (2005-2008) and Manju *et al.* (2008-2020). A preliminary exploration made by Nair and Madhusoodanan (2001) for bryophytes in the Eravikulam National Park reported 19 species including liverworts and mosses of which six were new records to Kerala. Madhusoodanan and Nair (2003) reported *Ricciocarpus natans* (L) corda and *Notothylaslevieri* Schiffn ex Steph from the Western Ghats of Kerala, as new records for South India.

This species is later synonymised under *Bryumbicolor*. Srivastava and Alam (2004) reported *Frullaniariojancirensis* Raddi, for the first time from India from Gudalur region of Nilgiri Hills. A preliminary account on the diversity of the bryophytes of Kerala with brief history, its importance and implications of conservation are discussed by Nair and Madhusoodanan (2004).

Nair *et al.* (2005) issued a book which is the first comprehensive taxonomic treatment of South Indian Bryophytes named 'Bryophytes of Wayanad in Western Ghats'. It comprises the taxonomic account of 171 species and two new species viz, *Trichostomum wayanadense* Manju *et al.* and *Amphidium gangulii*. Many of them were new distribution records of phytogeographical significance.

Nair *et al.* (2006) were the first ones to explore the bryophytic flora of the Chinnar Wildlife Sanctuary. Overall 60 taxa were listed including 19 liverworts, 40 mosses and one hornwort. Among these 18 are new records to Kerala and *Fissidens asperisetus* is a new record to Peninsular India. Nair *et al.* exemplified an account of *Lejeunea axilis* (Reinw *et al.*) Grolle of Lejeuneaceae and reported for the first time in India. Nair *et al.*

(2007) identified three pleurocarpic mosses viz. *Fabroniaschensiana* Muell. (Fabroniaceae), *Calyptothecium wightii* (Mitt.) M. Fleish (Neckeraceae) and *Pelekium gratum* (P. Beauv.) Touw. (Thuidiaceae) for the first time from Peninsular India

Pocset *al.* (2007) recorded 33 hepatic taxa collected from the Kerala state by Manju from 2001- 2007, of which *Mastigolejeunea indica* Steph., *Leptolejeunea abalansae* Steph., *Heteroscyphus splendens* Lehm. et Lindenb., *Lejeunea aefrigii* Mizut., *L. pallide-virens* S. Hatt. are new for the whole of India. Records of *Jubulahutchinsiae* subsp. *Javanica* Steph., *Plagiochilasemidecurrens* Lehm. et Lindenb., *Jungermannia truncata* Nees. and *Bazzaniapearsonii* Steph. are new to Peninsular India, previously known from the Himalayas or Khasia mountains. Manju *et al.* (2007) reported eleven species of the genus *Philonotis* from Peninsular India. Among these *Philonotis turneriana* (Schwaegr) Mitt., *P. angusta* Mitt. and *P. seriata* Mitt., are new records for Peninsular India and *P. falcata* (Hook) Mitt. is a new record for the Kerala state.

Manju *et al.* (2008) examined the ecological features of the bryophytes of Eravikulam National Park. A total of 136 Bryophytes including liverworts and mosses are present in the community, out of the 126 species about 39% are epiphyte, 27% are terrestrial, 12% are saxicolous about 10% occur both as terrestrial and saxicolous; 6% are epiphytic and saxicolous and 1% is epiphytic and terrestrial and 6% in all form. Several new records of species of Kerala are mentioned. A narrow endemic species of Nilgiri Mountains, *Thrysananthus rotundistipulus*, could also be collected during the study. Savitha *et al.* (2008) reported *Schiffneriojeunea pulopenangensis* (Gott.) Gradst. of Lejeuneaceae and *Cololejeunea latilobula* (Herzog) Tixier as new records for Kerala state. Manju *et al.* presented a checklist of the bryophytes for the first time from Kerala. A total of 465 bryophyte taxa are accepted, comprising 307 taxa of mosses, 148 taxa of liverworts and 10 taxa of hornworts. Manju *et al.* (2008), published a checklist of Kerala state which contains a total of 465 bryophytes which includes 307 species of mosses.

Manju *et al.* (2009) described a new record for India *Jungermannia obliquifolia* (Schiffn) Vana, from the Wet Evergreen Forests of Aralam Wildlife Sanctuary in Kannur district of Kerala state. Manju *et al.* (2009) reported the genus *Lindbergia* Kind. as a new record of the genus with the species *L. koelzii* R.S. Williams. An endemic species of pandey viz., *Notoscypus pandei* Udar & Ad. Kumar is reported by Manju *et al.* (2009) from the Western Ghats of Kerala state. The materials were collected from Kakkayam in Kozhikode district and Chandanathode of Wayanad district. Alam (2009) studied in detail about 29 species of rare and endangered terrestrial hepaticae of Nilgiri and Palni hills of Tamil Nadu in detail. Manju *et al.* for the first time reported about *Groutiella tomentosa* (Hornsch) Wijk & Margad. of Orthotrichaceae from the Peninsular India. Manju *et al.* reported a new species *Chiloscyphus chinnarensis* from the Western Ghats of India, an autoicous, epiphytic leafy liverwort described from the tropical wet evergreen forests of Chinnar Wildlife Sanctuary. 29 species of rare and endangered terrestrial hepaticae of Nilgiri and Palni hills of Tamil Nadu was studied detailed by Alam (2009) *Groutiella tomentosa* (Hornsch), Wijk & Margad. of Orthotrichaceae for the first time from the peninsular India are reported by Manju *et al.*, (2009). Rajan and Murugan (2009) carried out work with the objective of surveying the moss flora along the hill station, Ponnudi. Taxonomic survey was carried out to identify the mosses seasonally. The present study reports 29 species of mosses, belonging to 13 genera and 9 families.

Manju *et al.*, (2010) reported *Chiloscyphus chinnarensis* Manju *et al.* a new species from the western Ghats of India, an autoicous, epiphytic leafy liverwort described from the tropical wet evergreen forests of Chinnar wildlife sanctuary. Manju *et al.*, (2011) made a

report of a checklist of the bryophyte flora of the parambikulam Tiger reserve in the western Ghats. the report consists of 58 taxa, 39 mosses, one horn worts and 18 liverworts of which *Grimmiafunalis* (schwagr) Bruch & schimp and *Thuidiumdelicatum* has reported as new record for India (Manyu& Rajesh 2011). For the mainland of India *Leucophones glaucum* (Schwaegr) mitt is newly reported and for the peninsular India 10 species were newly reported. And for the Kerala state. *Schiffneriolejeunea polycarpa* (nees). Gradst, *Hypnum imponens* (Hedw) Boulay, where New record. *Exormothecatuberifera* Kasyap a rare liverwort from Kerala part of the western Ghats of India as a new record was reported by Manju *et al.* (2011) . Association of 46 populations of *Conocephalum conicum* (L) Dumort. and 25 populations of *Dumortierahirsuta* sw. (Nees) with diverse organisms, including fungi, pteridophytes, gymnosperms, angiosperms and an insect was described by Iqbal *et al.*, (2011). Manju *et al.*, (2011) described an account of 40 species of bryophytes. including 24 mosses and 16 liverworts of kakkavayal reserve forest in the western Ghats. *Cololejeunea appressa* (Evans) Benedix, *C. follicola* Srivastava & Srivastava, (*udarii* Asthana & Srivastava) and *Pallavicinahimalayensis* schiffn were included as four new records of phytogeographical significance to Kerala viz.

The bryophyte diversity of Malabar wildlife Sanctuary in Kerala was recorded by Deepa *et al.*, (2012). They reported 79 species of bryophytes including 35 liverworts, one hornwort and 43 mosses. Different life forms of bryophytes of western Ghats based on their habit structure was recorded by Manju *et al* (2012). A new species of pleurocarpic moss, *Aerobryopsis*, was described by Manju *et al.* (2012). *A. eravikulamensis* Manju *et al.* from Eravikulam National park and RAPD analysis is done for this species and compared with the related species of *Aerobryopsis* of India. Manju *et al.*, (2012) recorded a new rare moss *Trichosteleum stigmosum* mitt from silent valley National park in the Western Ghats

Symphyodon complanatus of the family Symphyodontaceae as a new record for Kerala was described by Rajesh *et al.*, (2013). The genus *Bazzania* of Lepidoziaceae represented in kerala was studied by Manjula *et al* (2013). The genus includes four Species viz. *B. Pearsonii* St., *B. praerupta* (Reinw. Bl et Nees) Tree, *B. sumbavensis* (Gott. ex St.) St. and *B. tridens* (Reinw. Bl et Nees) Trev, Among these *B. praerupta* (Reinw, Bt et Nees) Trev. is recorded as a new record for peninsular India. A New Species of *Phycolepidozia* with the species *P. indica* from the Western Ghats of Karnataka was reported by Gradstein *et al.* (2014). A highly specialized liverwort without vegetative leaves Bryophyte diversity of low land and midland areas of Kozhikode district of kerala was described by Rajesh and Manju (2014) and also reported 57 Species of bryophytes from the thickly populated areas.

Manjula, *et al.*, (2015) reported a new record of occurrence of *fissidens linearis* (Fissidentaceae: Bryophyte) to India from the Western Ghats of Kerala. Subramanian(2016) conducted a taxonomical study on Indian mosses. Important morphological characters of some of the rarely occurring Mosses of South India have been described. Singh *et al.*,(2017) conducted a study on Assessment of accumulation of some heavy metals in mosses of Idukki District. The metal contents of Zn, Cu, Pb and Cd). These metal *et al* ions are mainly accumulated by passive ion exchange in mosses. The metals spread fast into the adjacent areas by runoff and other anthropogenic activities causing environmental pollution.

Benny and Mathew (2020) conducted taxonomic studies on leafy liverworts and Bryopsida from Ernakulam district. Among the 28 bryophytes identified, 17 of them

belong to mosses and the rest belong to leafy liverworts. Members belonging to Neckeraceae, Pottiaceae, Hypnaceae, Leucobryaceae, Calymperaceae, Fissidentaceae, Bryaceae, Batramiaceae, Sematophyllaceae, Funariaceae, Dicranaceae, Splachnaceae, and Mniaceae were identified from mosses. Mufeed *et al.*, (2021) published a book Bryophytes of Anamudishola National Park in the Western Ghats of Kerala recorded a total of 153 taxa including 57 liverworts, 2 hornworts and 94 mosses. Manju *et al.*, (2023) reported two rare moss species from western Ghats of Kerala *Physcomitrium eurystomum* Sendtn. and *Splachnobryum obtusum* (Brid.) Mull. Hal.

MATERIALS AND METHODS

MATERIALS AND METHODS

The taxonomic study heavily depends on the type, quality and condition of the preserved material in the herbarium. Bryophytes are a diverse group of distantly related non-vascular plants usually inhabiting the amphibious habitat, ranging from soil, rocks, barks, logs, twigs and leaves. The life cycle consists of two distinct phases-gametophyte and sporophyte, hence a complete bryophyte herbarium needs vegetative as well as reproductive phase for perfect identification. The materials for the present study were collected during October 2022 to February 2023

Collection

A systemic collection provides the basis for taxonomic research. Careful examination of a limited area is more fruitful than visiting different places, since the species is distributed in specific areas. These plants are very delicate and small hence were handled carefully. Plants were scraped out from the substratum with the help of a sharp edged knife. The bulk of the soil attached to the material was removed, leaving a thin layer attached. Two or more species may grow together, hence were collected together by giving the same field number and separated later into different packets assigning the same number with serial numbers. The plants were dried keeping them in between the blotting papers or newspapers. The field data including date, locality, altitude, family, habit, habitat, name of collector, notes etc. were also noted down. The name of genera/species and their associates were added after careful examination.

Preservation

The preservation technique for mosses and liverworts varies. Mosses were preserved as dried specimens in paper packets; they regained their original shape and size, and to some extent colour also. The materials kept in paper packets will remain fresh and alive for some days so that it can be examined alive, which later may be dried and stored in the herbarium cabinet in Botany department of St. Teresa's College.

Investigation and Identification

Fresh materials were subjected to study, whenever possible, for identification. External morphological features were studied under a simple dissection microscope and internal features by a compound microscope (Olympus CX31) Size of leaves, cells and capsule were measured by micrometry. Identification of specimens was done with the help of our research guide Dr. Chandini V. K and by referring authentic literatures (Mufeedet *al.*, 2021, Manju & Rajesh, 2017, Daniels, 2013, Gangulee, 1967-74: Nair *et al.* 2005; Singh & Nath, 2007). Photographs of the habitat were taken using Mobile Camera and microphotographs under the microscope were taken using digital camera model Magnus pro attached with a microscope.

Taxonomic description

Detailed descriptions were given for each genus and species whenever it was needed. Authors of plant names are abbreviated based on Brummitt and Powell (1992) and titles journals were

based on taxonomic literature (Stafle and Cowan, 1976-1994). The taxa are arranged according to the classification of Shaw and Goffinet (2000) All the genera and species under the family are arranged alphabetically each species is described with up to date nomenclature, brief description of available characters such as leaves, cells, capsule, etc. The citations are limited to the publications relevant to Indian context. Dichotomous keys have been provided for species on the basis of reliable characters. Photographs of habit and habitat of each species were also provided as far as possible.

Plan of the Dissertation

The dissertation is divided into six sections as Introduction, Study area, Review of Literature, Materials and Methods, Results, Discussion and summary appended with Bibliography.

Introduction- includes general characters of bryophytes, characteristics of mosses, importance of bryophytes, objectives of the present studies and relevance.

Study Area -gives detailed description of its geography, climate, vegetation, and is supported with the map

Review of Literature- includes a general introduction on the work on bryophytes in India and Kerala and a special mention is given on review of work done on Kerala

Materials and Methods- describe the methodology adopted for collection of herbarium, processing and general outline on how the descriptions were prepared.

Result- The results are summarized as 11 different species of mosses. It is followed by a brief discussion on the habitat preference of the mosses the study area

Discussion and Summary - Discusses the general aspects of bryophytes of St. Teresa's college, Ernakulam, much as the species distribution.

RESULTS

RESULT

Systematic treatment of the mosses of the urban area of Ernakulam St. Teresa's College, Arts block/Central block/Science block, Kerala.

Subkingdom: **BRYOPHYTINA OR BRYOBIOPHYTINA**

Plants free living, enjoy wide range of habitats. 1 mm to 40 m long, thallose, foliose or erect thalli prostrate, dorsiventral, in foliose form leaves uniseriate, midrib absent; in erect forms leaves uniseriate, midrib present or absent, when present multiseriate; shows alternation of generations, antheridia club shaped, archegonia flask shaped, sporophyte dependant on gametophyte for nutrition, usually differentiated into foot, seta and capsule, elaters present in liverworts and absent in mosses.

Division: **BRYOPHYTA (MOSES)**

Plants foliose, leaves usually spirally arranged, rarely distichous, costate or ecostate, seta short or long; capsule with mouth, operculum and peristome teeth. Mosses are the most specious group among bryophytes.

Family: **FISSIDENTACEAE** Schimp.

Plants yellowish to greenish; leaves distichous, vertically placed, equitant with a characteristic sheathing or vaginat lamina, complanate; capsule, lateral or terminal, calyptra conical.

Genus: *Fissidens* Hedw., Sp. Musc. 152.1801

Plants green to yellowish-green, small to medium sized, simple or dimorphic, vertically placed, leaves distichous, differentiated into sheathing lamina, dorsal lamina (behind the costa) and apical lamina (above the sheathing lamina); capsule terminal or lateral, erect to inclined, peristome single, spores spherical, smooth to lightly papillose.

Fissidens crispulus Brid.

Plants yellowish green, curved when dry, 0.6-1 mm wide, 5-8 pairs of leaves; leaves lanceolate in the upper part, margin smooth at tip, base of dorsal laminae rounded, costa prominent, excurrent, sheathing lamina open and unequal; cells of apical lamina and dorsal lamina rounded, quadrate to rounded-hexagonal, thick walled mamilllose, cells of extreme base of sheathing lamina larger, limbidium absent (Plate.2)

Habitat: On pot and land cuttings

Specimen examined: Ernakulam, St. Teresa's college, 11/11/22 *Abhirami 3, Jiya 21, Siyan 37*.

Distribution: India (Himalaya, Kerala); China and Philippines.



Plate 2. *Fissidens crispulus*. A. Habit, B Entire plant (4x), C. Leaf (10x), D. Leaf tip (40x), E. Leaf with vaginant lamina (40x), F. Leaf base (40x), G. Enlarged portion (40x)

Family: **CALYMPERACEAE** Kindb.

Plants small to medium-sized, mostly erect, in tufts, cushions, or gregarious, rarely single or in tufts of a few; dark green to yellowish-brown, clasping leaf bases with cancellinae, lack of stem central strand, usually thickened and toothed leaf margins, mainly tropical-subtropical range and corticolous habitat.

Genus: **Calymperes** Sw., F. Webber, Tab, Exhib. Calyptr. Operc. Musc. Frond. Gen. 2: 1813

Plants small to medium sized, mostly tufted, green to yellowish-brown, rarely with pink to purple tinge. Stems erect. Leaves often dimorphic with vegetative leaves mostly grading into gemmiferous leaves, teniolate or teniolae absent; margins of distal lamina without elongate hyaline cells, mostly thickened and toothed, rarely 1-stratose and entire; costa mostly showing two bands of stereid cells or stereids rarely absent; medial cells of leaves isodiametric, Capsule mostly well-exserted, sometimes more or less immersed, cylindrical; peristome absent.

Calympereserosum C. Muell.

Plants green to yellowish or blackish, occasionally with a pinkish tinge, to 10 mm tall, in low dense tufts or turfs. Stems erect, often curved, simple or forked. Rhizoids are reddish brown. Leaves somewhat dimorphic, mostly 3–4 mm long, contorted-curved to nearly straight when dry, ascending when moist, lanceolate to acuminate above a broader base; margins slightly thickened, finely serrate; cells of limb minutely papillose abaxially, bulging adaxially; teniolae usually distinct, occasionally weak or lacking in some leaves or entire plants; cancellinae mostly rounded above, the distal cells mammillose adjacent to the green cells of the limb, or at least toward the margins (Plate. 3)

Habitat: Rocks

Specimen examined: Ernakulam, St. Teresa's college, 11.11.22 *Abhirami* 12. *Jiya* 5.

Distribution: India (Assam, Arunachal Pradesh, West Bengal, Kerala, Karnataka, Tamil Nadu) U.S.A. (Florida); southern Mexico; Central America; West Indies; northern South America.



Plate 3., *Calymperes erosum*, A. A portion of plant (4x), B. Single plant with rhizoid (4x), C. Entire leaf (10x), D. Leaf base (40x), E. Leaf tip (40x), F. Leaf base enlarged (40x), G. Leaf middle cells(40x), H.. Leaf middle portion (40x).

Family: **BRYACEAE** Schwang

Plants yellowish to dark greenish or silvery, size varies, usually tufted, terial or rupestrine, sometimes epiphytic stem erect, radiculose, often with wal innovation; leaves thin, lanceolate, at lower half small and distantly placed upper larger usually forming comal tufts, shrunk when dry, mostly bordered by 2 or 3 layers of elongated cells; costa ending near apex or excurrent cells; costa near loaf base quadrate to rectangular, above base rhomboid to hexagonal or linearly vermiform not in oblique rows seta long, smooth, capsule pendulous , erect in some, calyptra narrow, cucullate, smooth.

Genus: *Bryum* Hedw., Sp. Musc. 178. 1801.

Plants small to robust, densely tufted, stem tomentose, mostly with spcal innovations, simple or branched: rhizoids numerous, tubers present s leaves large, bordered or non bordered, ovate or ovate lanceolate, minate, lower leaves smaller, distant, upper larger; cells sub rectangular at narrow rhomboidal above but not linear, smooth; seta long, erect mostly acute at tip, capsule clavate.

Bryum coronatum Schwaegr.

Plant dull greenish, densely tufted, 3.8-12 mm long, leaves at the basal region reduced and narrow, usually branched and lower leaves lower leaves smaller, $\pm 3 \times 1$ mm, erect spreading when moist, contorted when dry, acuminate; costa strong, reddish, ex current; cells at upper part thin, rhomboid to hexagonal, basal cells shorter, rectangular, thin walled, one layer of elongated cells as marginal border, tip serrated; sporophyte not observed (Plate.4).

Habitat: on soil

Specimen examined: Ernakulam, St. Teresa's college, 7.11.22 Jiya 2, 11.11.22 Jiya 27.

Distribution: India (Western Himalayas, Kerala, Tamil Nadu, Karnataka, Assam), Myanmar, China, Japan, Sumatra, Java, Philippines, Taiwan, Europe, North and Central Africa and America.



Plate4 , *Bryum coronatum*, A. Habit, B. Entire plant (4x), C. Entire leaf (10x), D. Leaf base (40x), E. Leaf tip (40x), F. Leaf size (40x)

Family: **SPLACHNOBRYACEAE** A. Kop.

Plants are acrocarpous. Stems mostly simple; in section showing a few layers of large cells with slightly thickened walls surrounding a few layers of cells with thinner walls, both layers chlorophyllose and with yellowish walls; at the center a field of thin-walled cells with a central strand undifferentiated to present and distinct, the medial cells of the stem sometimes disintegrating and leaving a void; axillary hairs 2-3-celled, proximal cell(s) short, with faintly yellowish walls, distal cell much larger. Leaves oblong to ovate-spatulate, rarely bordered with elongate cells; costa single, sometimes with short lateral spurs or forked, in cross section showing 0-2 guide cells and 1-5 substereid cells; medial cells of leaves oblong, smooth or occasionally distinctly mammillose on one or both surfaces. Specialized asexual reproduction by gemmae on axillary rhizoids and by rhizoid tubers. Sexual condition dioicous; perigonia terminal, becoming lateral by innovations, antheridia sometimes solitary in leaf axils proximal to the perigonial; perichaetial absent, archegonia clustered at stem tip, becoming solitary in leaf axils by elongation of stem apex, paraphyses absent. Seta single, short, smooth. Capsule exerted, erect, symmetric; annulus of several rows of thick-walled isodiametric to horizontally elongated cells; operculum conic-apiculate; peristome a single circle of 16 teeth. Calyptra elongate, narrowly conical-cylindrical, split from base on one side about half its length. Spores spheric, yellowish.

Genus: *Splachnobryum* Mull. Hal. Verh. K. K. Zool.-Bot. Ges. Wien. 19: 503. 1869.

Plants gregarious to tufted, mostly small and soft. Stems erect. Leaves with margins plane to recurved, mostly crenulate distally, sometimes entire, apex rounded; costa short to elongate, ending at midleaf to percurrent or shortly excurrent; distal cells of leaf in ascending rows diverging from costa. Sexual condition antheridia ripening asynchronously within each perigonium, surrounded by a few short broad bracts, or the bracts not much differentiated from vegetative leaves; perichaetial leaves not differentiated. Capsule short-cylindric to obpyriform, with scanty phaneropore stomata at base; peristome set deep inside capsule mouth, the teeth wide-spreading when dry, connivent over the mouth of the capsule when moist. Calyptra scarcely cucullate.

Splachnobryum obtusum (Brid.) Mull. Hal.

Plants small, 0.7–15 mm long, pale green or Yellowish-green, stems simple, numerous rhizoids arise from the base. Leaves erect to spreading, ovate lanceolate to Spathulate, upper leaves longer than the lower, apex Broadly rounded or obtuse, costa ending near the apex; Leaf margin plane, crenulate at apex with overlapping Leaf cells. Leaf cells smooth, thin walled, upper cells Shorter, nearly quadrate, lower cells long and Wider, rectangular, Leaf cells at middle oblong-hexagonal, variable in size, Reproductive structures not observed(Plate.5).

Habitat: On pot and garden soil. This species shows very rare distribution in Kerala

Specimen examined: Ernakulam, St. Teresa's college, 11.11.22, *Jiya 17, Siyan 25*.

Distribution: India (North eastern India & Kerala); Africa; Australia; Cuba; Indonesia; Jamaica; Myanmar; Mexico; Malaya; the Philippines; Papua New Guinea; Thailand; USA; West Indies; and Europe (France Germany, Hungary, United Kingdom & Macaronesia)

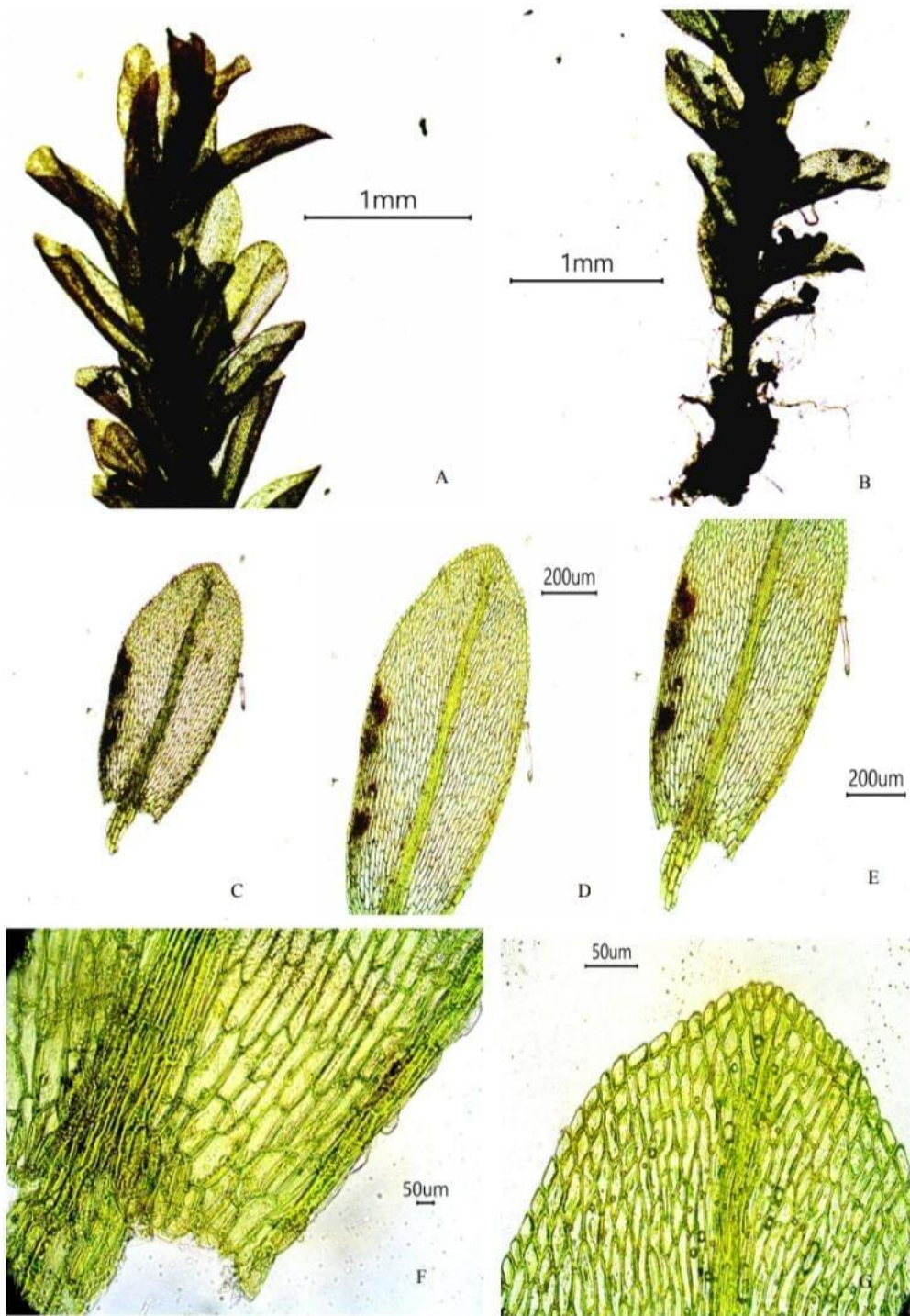


Plate 5. *Splachnobryum obtusum*, A. A portion of plant (4x), B. Plant with rhizoids (4x), C & D. Entire leaf (4x), E. Leaf base (10x), F. Leaf base (40x), G. Leaf tip (40x).

Family: **BARTRAMIACEAE**Schwaegr.

Plants densely tufted, usually robust; leaves lanceolate, acuminate, denate or serrate; costa percurrent or excurrent, often toothed on back; cells narrow, rectangular, usually mamilllose or papillose; seta lateral or terminal; capsule subglobose, mostly furrowed.

Genus: *Philonotis* Brid., Bryol. Univ.2:15.1827.

Plants light yellowish to greenish, very slender in dense tufts, interwoven with sooth or faintly papillose rhizoids, dichotomously branched, with whorled subfloral innovations, leaves elongate-linear, acuminate, serrate or denticulate often by means of paired papillae; costa percurrent to excurrent; cells near the apex elongate to shortly rectangular, 5-6 sided, basal cells large, thin walled, mamilllose on the upper or on both ends; seta elongate, erect, capsule inclined to horizontal, nearly globose, striate, mostly compressed in the middle.

Philonotishastata(Duby) wijk& Marg.

Plants pale greenish, leaves curled and appressed to stem when dry, plant 1-1.2 mm long, 5-8 mm wide with leaves, yellowish brown in colour, leaves linear lanceolate-lingulate, shortly acuminate, narrow, small, marginal cells serrated and projecting out, cells hexagonal-rhomboidal, costa prominent and vanishes much below the tip, leaf tip rounded, costa having 2 rows of cells, cells contains chloroplast, cells thin walled, apical cells hexagonal in nature, cells adjacent to the costa are elongated than marginal cells, leaf marginal serration not prominent in the base of the cells (Plate.6).

Habitat: On soil and on garden pot

Specimen examined: Ernakulam, St. Teresa's college, 11.11.22 *Siyam 9, Abhirami 35, Jiya 40.*

Distribution: India (North-east India; Calcutta, Assam, Sikkim, Kerala); Sri-lanka, Borneo, Bolivia, Java, Thailand, Celebes. Philippines, Japan, Taiwan, Chile, Oceanic Island, Peru, Venezuela, Africa, South America and Australia.

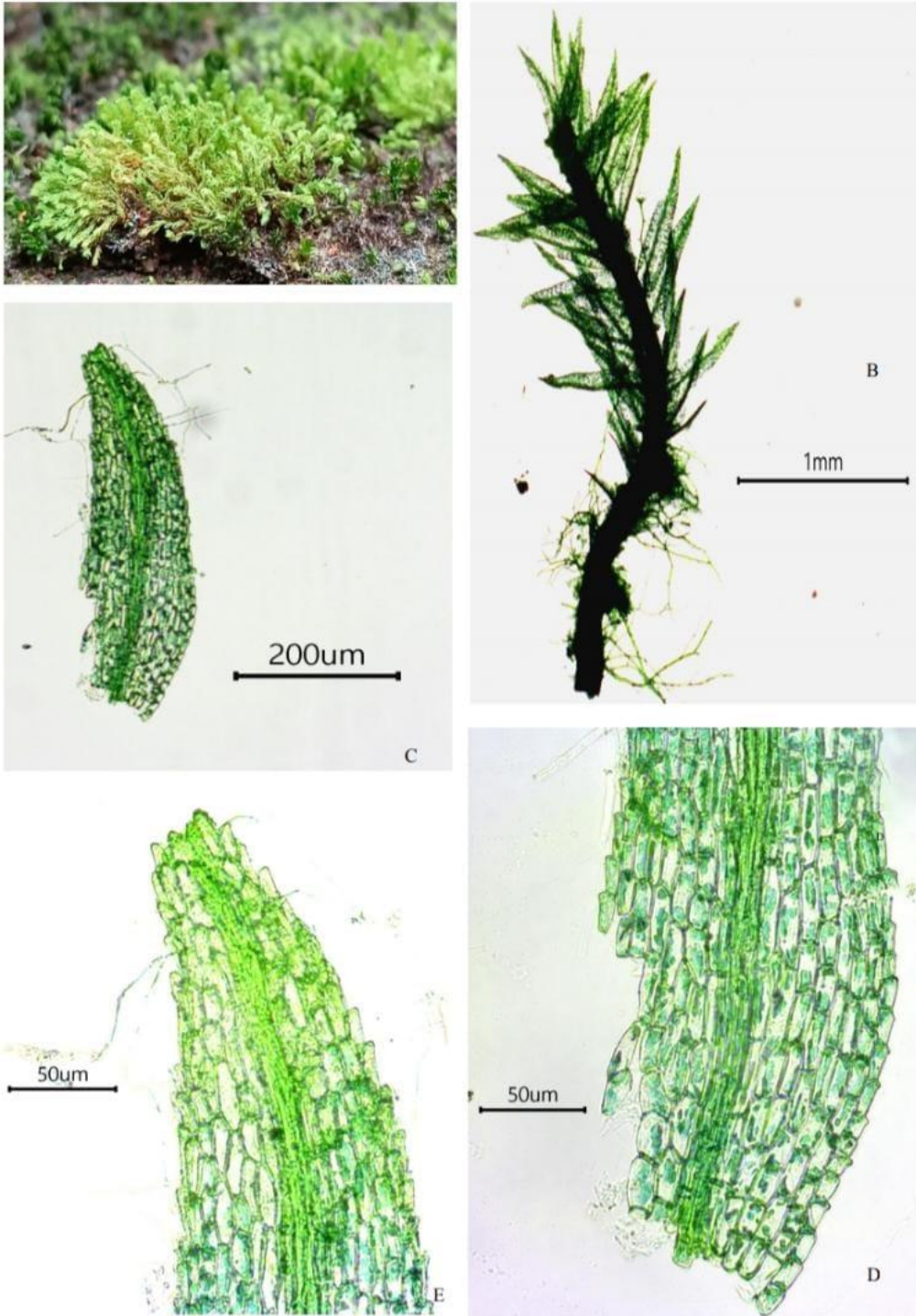


Plate 6, *Philonotis hastata*. A. Habit, B. Entire plant (4x), C. Entire leaf (10x), D. Leaf base (40x), E. Leaf tip (40x).

***Philonotisseriata* Mitt.**

Plants robust, greenish, 0.6 m-20 mm long, branched, leaves spirally arranged on stem, margin denticulate, costa strong vanishing below the tip, leaf ovate-lanceolate, sharply apiculate, leaf cells narrow, sub-rectangular at tip, mamillae on upper or lower ends or borders of cells at extreme tip, but most of the mamillae are located at the centre of cells lower down (plate.7).

Habitat: on soil.

Specimen examined: Ernakulam St. Teresa's college, 11.11.22 *Jiya 26, Abhirami 33(b)*.

Distribution: India (N.W. Himalaya, Kashmir, South India; Kerala); Canada, California, North Africa, Japan, Europe, Mongolia and Korea.

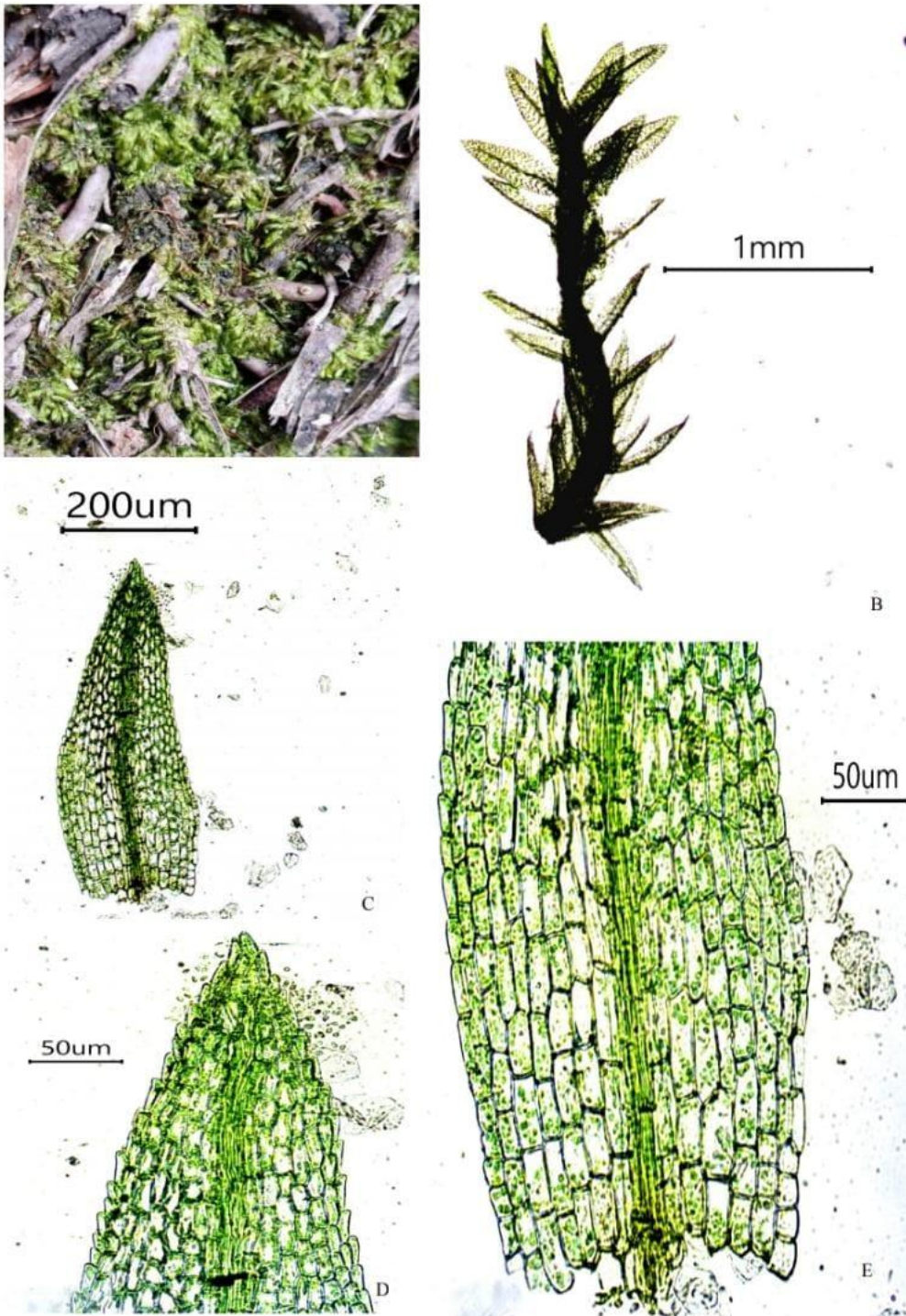


Plate 7. *Philonotis seriata*, A. Habit, B. Entire plant (4x), C. Entire leaf (10x), D. Leaf tip (40x), E. Leaf base (40x).

Family: **POTTIACEAE**Schimp.

Plants yellowish-green, erect, usually small, \pm 1.-5 mm, densely tufted; leaves linear-lanceolate to spatulate, crowded, mostly crispate when dry; costa single, strong, percurrent; cells usually thin walled, rectangular, hyaline at base small, papillose, often obscure above, alar cells, absent; seta usually long, erect; capsule erect, cylindrical to ovate-cylindrical, calyptra narrow, cucullate, peristome usually absent.

Genus: *Barbula*Hedw., Ep.musc.115.1801.nom.cons

Plants green to brownish, small, slender to very robust; leaves ovate or ovate-oblong to lanceolate, obtuse or acuminate, margin revolute; costa strong, percurrent or sub-percurrent, smooth or only papillose at the back; cells at upper half small, more or less thick walled, densely papillose, basal cells widened, quadrate to rectangular, hyaline, smooth; capsule erect, rarely inclined, ovate-oblong to cylindric, calyptra cucullate.

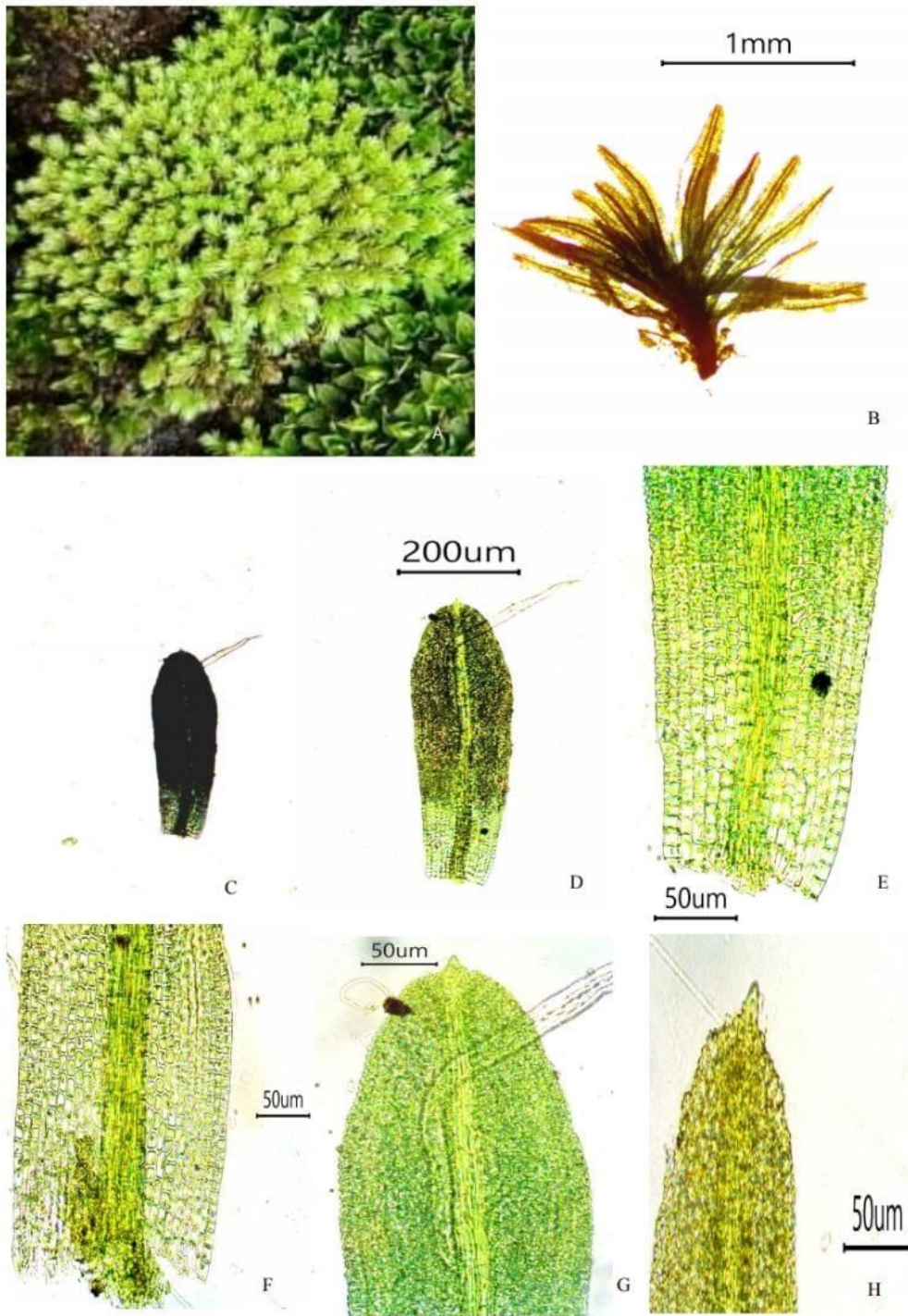
Barbula indica(Hook.) Spreng.

Plants pale greenish, leaves much curled on herbarium and appressed on stem when dry, 0.45-15 mm long; leaves ovate or ovate oblong to spatulate, costa prominent and strong, percurrent, densely papillose, hyaline cells smooth, rectangular in shape, margin entire, upper cells small with horse shoe shaped mamillae. (Plate.8).

Habitat: On wall

Specimen examined: Ernakulam, St. Teresa's college, 11.11.22 *Abhirami 1 & 18, Jiya 11, Siyan 33(a)*.

Distribution: India (Kerala, Tamil Nadu); China, Japan, Korea, Mynamar, Malaysia, Paa, New Guinea, Philippines, Colombia, Mexico, Africa and America.



Genus: *Gymnostomiella* M. Fleisch. Musci Buitenzorg 1: 309.1904

Plants minute, in dense, dull, green or brownish tufts. Stems simple or branched, radiculose only at the base, ellipsoidal to cylindrical, septate brood bodies on stems or radicals. Leaves very small, erect to wide-spreading, \pm larger and more crowded above, obovate to oblong-obovate, rounded at the apex; margins plane, papillose-crenulate above; costa homogeneous in structure, slender and ending near the leaf middle or stronger and disappearing near the apex; upper cells laxly hexagonal, pellucid, with several low, blunt papillae; basal cells rectangular, smooth. Dioicous. Perichaetial leaves pale, enlarged, spatulate, sheathing, the innermost serrulate at the apex, with cells nearly smooth. Setae elongate, smooth; capsules erect, ovoid, smooth; annulus not well differentiated; operculum obliquely subulate from a low-conic base; peristome none. Calyptrae smooth, naked.

Gymnostomiellavernicosa (Harv. in Hook.) Fleisch.

Plants very small, delicate, light-green, in tufts or mats, 1–3 mm high. Stems simple, rhizoids sparse only at base. Leaves spatulate, oblong-obovate or elliptic, erect to spreading at base, somewhat shriveled when dry, erect-spreading when wet; apices broadly rounded to obtuse; lamina unistratose; margins papillose-crenulate, plane; costa slender, ending well below the apex, cells homogeneous; upper cells irregularly hexagonal, subquadrate to short-rectangular, basal cells long-rectangular, hyaline, smooth (Plate.9).

Habitat: On concrete brick wall

Specimen examined: Ernakulam, St. Teresa's college, 11.11.22 Siyan 4, Abhirami 10.

Distribution: India (Kerala, Tamil Nadu, Andhra Pradesh), Saudi Arabia, Yemen, Oman, United Arab Emirates, Kuwait, Socotra, Qatar and Bahrain.

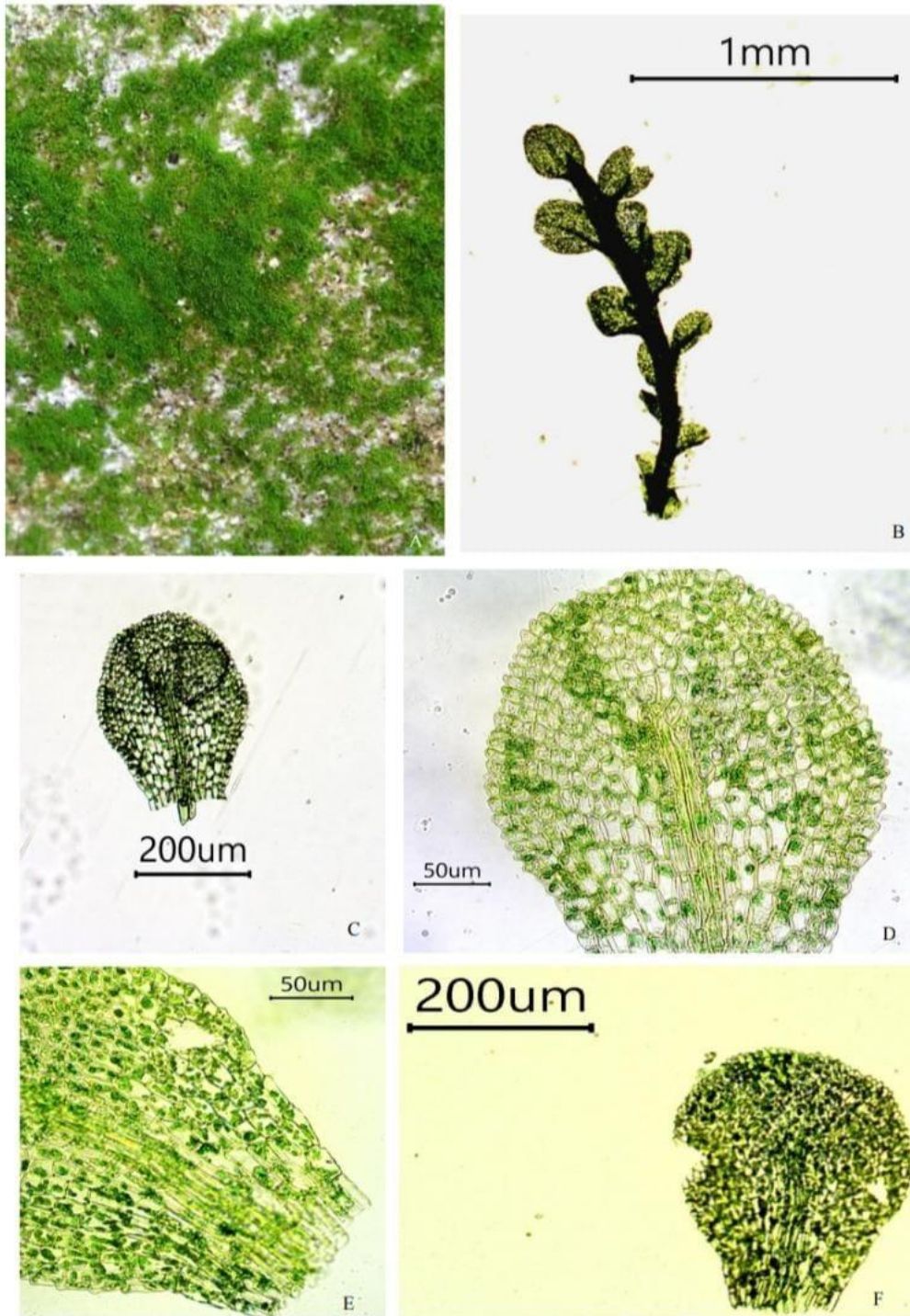


Plate 9. *Gymnostomiella vernicosa*, A. Habit , B. Entire plant (4x), C & F. Entire leaf (10x), D. Entire leaf (40x) , G. Entire leaf (40x).

Genus:*Hyophila* Brid., Bryol. Univ. 1:760.1827

Plants small to medium sized, forming mats; leaves oblong-lingulate, broad, apiculate, margin flat when moist, inrolled when dry, apex obtuse, often toothed at apex; cells at basal part rectangular, hyaline, upper cells small, rounded chlorophyllose, papillose; costa excurrent, seta apical, erect, capsule erect.

Hyophilainvoluta(Hook) A. Jaeger, Ber. SenckenbergNaturf. Ges. 72: 356. 1873.

Plants greenish, 0.4-7.5 mm long, leaves appressed when dry, leaves oblong to lingulate, leaves inrolled when dry, apex obtuse, toothed at apex, basal hyaline cells, rectangular in shape, upper cells rounded, papillose, chlorophyllose, leaf tip acuminate, costa strong percurrent; capsule erect, reddish brown in colour, seta elongate, up to 0.8-1.5 mm (Plate.10 & 11).

Habitat: On tree, on land cuttings and on brick walls

Specimens examined: Ernakulam, St. Teresa's college, 11.11.22 *Abhirami* 5, 13, 19, *Jiya* 22, 24, *Siyon* 31,53,56,31.

Distribution: A widely distributed species. India (Kerala, Karnataka, Mysore, Tamil Nadu, Palni hills, Nilgiri hills, Gujarat, Madhya Pradesh, Orissa), North east India (Assam, Arunachal Pradesh, Bengal, Bihar, Darjeeling, Western Himalayas); Sri Lanka, Nepal, China, Japan, Java, Korea, Myanmar New Guinea, Philippines, Sumatra Taiwan, North & South Vietnam, North Central & South America and Europe.

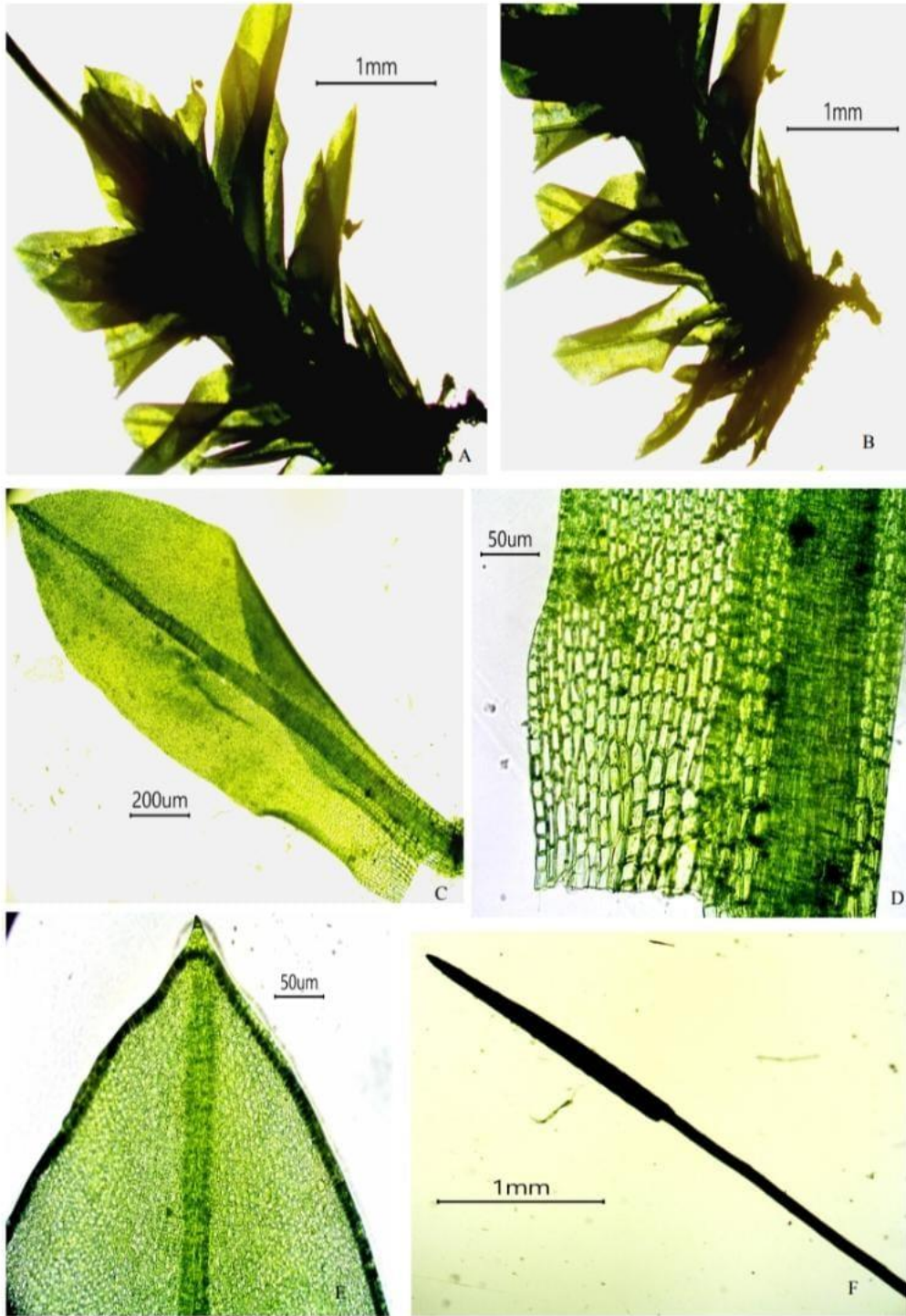


Plate 10 . *Hyophila involuta*, A & B. A portion of plant (4x), C. Entire leaf (10x), D. Leaf base (40x), E. Leaf tip (40x), F. Capsule (40x).

Family: **SEMATOPHYLLACEAE** Broth.

Plants slender to robust, glossy, stem prostrate or erect, irregularly or pinnately branched; leaves ovate, acuminate; costa short, double or absent, cells linear, smooth papillose, alar cells few, large vesicular and differentiated, mostly coloured; seta long, smooth or papillose, capsule small, horizontal to inclined, operculum rostrate, calyptra cucullate, smooth.

Genus: *Sematophyllum* Mitt., J. Linn. Soc. Bot. 8:5. 1864.

Plants small to robust, glossy in dense mats, stem creeping, branching crowded, densely foliate; leaves erect to spreading, ovate to oblong-elliptic, obtuse, apiculate gradually or abruptly long acuminate, sometimes hair pointed, weakly toothed above; costa absent; cells rhombic, alar cells large, oblong inflated, coloured; seta usually elongated reddish; capsule erect to horizontal, ovoid to oblong.

Sematophyllum caespitosum (Hedw) Mitt., J. Linn. Soc. Bot, 12:479. 1869

Plants light greenish, tufted, main stem creeping, 0.5-25 mm long, branching irregularly, leaves appressed on stem when dry, spirally arranged on stem, axillary branched short, leaves 0.2-0.6 mm long, broadly ovate lanceolate, apex usually narrow, leaf tip narrow, acute, base broad, middle bulged, margin serrated, leaf cells narrow rhomboid at apex, middle cells larger, cells show papillose development on tips; alar differentiated at base at an angle by a row, inflated oblong cells at base, another row of shorter cells on top of them (Plate.12).

Habitat: On tree (*Mangifera indica*).

Specimen examined: Ernakulam, St. Teresa's college, 30.1.23 *Jiya 6 (ep)*.

Distribution: In India (Western Himalayas, Eastern Himalayas) South India (Kerala, Karnataka, Tamil Nadu); Sri Lanka, Japan, Korea, Europe and the United States of America.



Plate 12 . *Sematophyllum caespitosum*, A. A portion of plant (4x), B. Entire leaf (10x), C. Leaf base (40x), D. Leaf tip (40x).

Genus: *Taxithelium* Spruc. Ex Mitt ., Linn. Soc. Bot. 12:496.1869.

Plants yellowish-green, corticolous, non-glossy plants in dense flat mats, main stem creeping, usually regularly pinnately branched, ultimate branches small, mostly companulate; branch leaves ovate or ovate lanceolate, lateral rows often slightly asymmetrical, usually contracted at top; leaf cells linear, usually senate-papillate, rarely smooth, alar usually differentiated; seta long, mostly smooth, capsule horizontal, globose, ovate, annulus persistent, operculum conical, short.

Taxithelium nepalense (Schwagr.) Broth.

Plants robust green in colour, 5-20 mm long, leaves appressed on stem when dry, irregularly branched, main stem stepping, branch length up to 2-5 mm, leaf margin denticulate at tip; costa absent, leaf cells spindle shaped with one row of papillae, alar cells smooth, cells large somewhat rectangular in shape. (Plate.13)

Habitat: On the roots of coconut.

Specimen examined: Ernakulam, St. Teresa's college, 12.11.22 *Siyan 30, Jiya 38*.

Distribution: Bangladesh, Nepal and India (Eastern Himalaya, North-East India: E. Ghats (Orissa) and W. Ghats of Kerala, Tamil Nadu (Kanyakumari & Madurai).



Plate 13, *Taxithelium nepalense*, A. A portion of plant (4x), B. Entire leaf (10x), C. Leaf tip (40x), D. Leaf base (40x), E. Leaf tip cells (40x).

DISCUSSION

DISCUSSION

Bryophyte

studies in Kerala are very small compared to the diversity of topography, vegetation, region and climate. The number of researchers and research centres working on this group is also small. A regional approach, with a more intensive study of smaller regions, is probably the best way to develop anational database. The present work is significant in this aspect. The present study is aimed mainly to document the Moss diversity of St. Teresa's college, Ernakulam. The critical study of about 62 specimens of bryophytes collected from the St. Teresa's college during October 2022 to February 2023 the area is divided into three blocks: Arts block, Science block and Central block. Among them 53 mosses specimens are identified up to species level. Some of the specimens are needed for further detailed analysis for confirmation.

The present collection of 11 taxa belongs to 10 genera and 7 families. The family Fissidentaceae, Calymperaceae, Bryaceae and Splachnobryaceae are reported with single genus. Pottiaceae represented by three species in the St. Teresa's college. The frequency of occurrence of *Hyophilainvoluta* is high compared to other taxa. The collection of *Splachnobryum obtusum* is one of the significant observations during the study because this species is one of the rare occurrences and poorly known in the Western Ghats. But it is widely distributed on college campus. The distribution of the family Pottiaceae is followed by Bartramiaceae with a single genus with two species and the family Bryaceae possessing single species *Bryum coronatum*. Members from the family of Bryaceae, Fissidentaceae, and Pottiaceae are widely distributed in St. Teresa's college.

Among the 11 mosses, two species are Pleurocarpic and nine species are Acrocarpic. The Pleurocarpic mosses prefer to grow epiphytic habitats, which are mostly appressed to substratum. Pleurocarpic mosses are usually monopodially branches, often pinnately so, and tend to form spreading carpets rather than erect tufts. The Acrocarpic mosses are distributed in different microhabitats (Plate 14); they usually show little or no branching and typically grow in erect tufts.

The habitat of all the species varies. Terrestrial species are most common in the study area. Among the terrestrial habitat soil harbours most species followed by land cuttings and on brick walls. *Hyophilainvoluta* and *Fissidens crispulus* are the widely distributed species and prefer to grow in a wide range of habitats. *Philonotishastata* and *Philonotisseriata* prefers to show up spontaneously on the water surface or on things sticking out of the water, like driftwood, filter mats, on Brick walls etc. They also grow on tree trunks and on logs. *Taxithelium nepalense* prefers to grow in roots for higher plants.

As we all know bryophytes prefer to grow in pollution free areas, but St. Teresa's college is situated at the Centre of city Ernakulam which is a densely polluted area. Still, we could find 53 specimens of bryophytes. This indicates that some of them have evolved to overcome pollution or have adapted to such environmental conditions. A detailed exploration could reveal more on the bryophyte diversity in St. Teresa's college.

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