

MOSSES

Mosses or **Bryophyta** are always leafy. They may be acrocarpous (sporophytes in terminal position), usually erect, tufted and sparingly branched or pleurocarpous (sporophytes are lateral in position), prostrate, matted and profusely branched. Leaves in majority of the species are arranged in spiral manner, never lobed (except in *Takakia*), usually rounded or ovate-lanceolate. Capsule has thin and delicate covering (calyptra) that protects young capsule and at maturity the calyptra drops off, and the capsule lid (operculum) protects peristome teeth and spores. Capsule lacks sterile cells; dispersal of elaters and spores is by the peristome, consisting of one or two rows of teeth at the mouth of the mature capsule.



Anomobryum julaceum

Mnium laevinerve

Pogonatum microstomum

Pogonatum neesii

Mosses comprise of about 12,700 taxa in the world and in India represented by 1,786 taxa. Eastern Himalaya with 1030 taxa having maximum diversity of the mosses followed by Western Himalaya (751) and Western Ghats (682).

Bryaceae with 150 taxa are the most dominant family in India, followed by Dicranaceae (146), Pottiaceae (130) and Hypnaceae (92). The *Fissidens* with about 75 taxa is the most dominant genus in India, followed by *Bryum* (59) and *Campylopus* (41)

THREATS AND CONSERVATION

Bryophytes are facing threats due to overexploitation, especially the mosses are collected in large quantity for wrapping of flowers, fruits, young buds and orchids. The habitat destruction is considered to be another major threat besides pollution, forest fires, landslides and inherent biological impurities of the species. The drastic change in climatic condition across the world due to global warming will also pose significant effect on the distribution and diversity of bryophytes.

This ecologically sensitive plant group can be conserved by controlling fragmentation/alteration and destruction of its natural habitats, overexploitation (collection in large quantity to use them as packing material). Conservation can also be achieved by creating public awareness through educating the locals about the importance of conservation of bryophytes and their associated natural habitats. Designing of "in situ" and "ex situ" conservation strategies are prerequisite to effectively conserve and protect this important plant group.

USES AND IMPORTANCE

- Species of *Sphagnum* are used in dressing of wounds; species of *Fissidens* and *Hypnum* possess antibacterial properties; *Polytrichum commune* helpful in reducing inflammation; *Rhodobryum giganteum* used in the treatment of cardiovascular diseases; *Marchantia polymorpha* helpful in treating liver ailments, boils and abscesses; *Riccardia multifida* has anti-leukemic properties and mixture of *Conocephalum conicum* with vegetable oils useful in treating bites, boils, cuts and wounds.
- As bryophytes are very good accumulators of heavy metals, they are used in monitoring air and water pollution.
- Peat moss is capable of producing hydrogen, ethylene, natural gas and methanol.
- Bryophytes are used in making temporary huts, cushions, brooms, key rings, ear rings and also in house decoration; some aquatic species are used in aquaria.
- Mosses are used as packing material for packing fruits, vegetables, seed bulbs, live frogs, worms and other delicate items.

BSI ENVIS Team

Dr. P. Singh, Director, BSI
Dr. V. Sampath Kumar, Scientist-in-Charge
Dr. S. Gantait, Programme Officer
Sri T. Chakraborty, Information Officer
Sri S. Nandi, IT Officer

© BSI ENVIS 2018

1	2	
3	4	5
6	7	8

Front page photo legends

1. *Marchantia paleacea*
2. *Reboulia hemisphaerica*
3. *Riccia beyrichiana*
4. *Marchantia polymorpha*
5. *Aneura maxima*
6. *Schistochilopsis setosa*
7. *Folioceros assamicus*
8. *Bartramia halleriana*



BRYOPHYTES OF INDIA



ENVIS Resource Partner on Biodiversity
Botanical Survey of India
<http://www.bsienvs.in>

Text and Photos: Dr. D.K. Singh, Former Scientist 'G', Botanical Survey of India (BSI), Kolkata; Dr. S.K. Singh, Eastern Regional Centre, BSI, Shillong; Dr. D. Singh and Ms. Pamela Saha, Cryptogamic Section, BSI, Howrah.

Bryophytes, "the Amphibians of the Plant Kingdom", and the second largest group of green plants next only to angiosperms, constitute a fascinating component of biodiversity. They are broadly categorised into three distinct groups, viz., Marchantiophyta (liverworts), Anthocerotophyta (hornworts) and Bryophyta (mosses). In India, bryophytes are represented by about 2750 taxa, represent 5.65% of the total flora of the country. They usually inhabit damp and shady conditions due to lack of true vascular system. Himalayas, Northeastern states, Western Ghats and Andaman & Nicobar Islands are rich in bryophyte diversity and are well-represented in these regions due to prevailing high rainfall and humidity. The genus *Sewardiella* and 182 taxa of liverworts, 19 species of hornworts and 547 species of mosses are endemic. Bryophytes provide vital ecosystem services such as soil formation, habitat modification and nutrient cycling. They are also useful in pollution detection and monitoring. The flavonoids and terpenoids present in majority of the bryophytes exhibit many biological activities of chemical and pharmaceutical significance.

LIVERWORTS

The **liverworts** or **Marchantiophyta** are autotrophic, except *Aneura mirabilis*, a non-photosynthetic, parasitic liverwort (not found in India) and have heteromorphic life cycle dominated by ecologically persistent and photosynthetically independent gametophytic or the haploid phase. The sporophyte or the diploid phase is comparatively short-living and fully dependent on the gametophyte. The gametophytes of liverworts are flattened and thalloid or foliose with the plant body differentiated into stem and leaves. However, the leaves in leafy liverworts are always arranged in rows and not spirally as in mosses.



Terricolous

Corticolous

Foliicolous

Aquatic

They may be terricolous, growing on soil (*Dumortiera*, *Marchantia*, *Solenostoma*, etc.), or corticolous, growing on tree trunks (*Frullania*, *Plagiochila*, *Porella*, etc.), or foliicolous, growing on upper surface of leaves (*Cololejeunea*, *Drepanolejeunea*, *Leptolejeunea*, etc.). Sometimes they are aquatic, either as floating forms (*Riccia fluitans* and *Ricciocarpus natans*) or benthic (species of *Riella*) in nature. They grow up to 5000 m elevation, and in Himalayas, bryophytes exhibit their best manifestation at elevations between 1000 and 3000 m.

Liverworts consist of about 9000 taxa in the world, and in India, this group is represented by 894 taxa. Eastern Himalaya with 666 taxa having the maximum diversity of liverworts in India followed by Western Ghats (369), Western Himalaya (288) and Andaman & Nicobar Islands (106).



Asterella khasyana

Conocephalum conicum

Dumortiera hirsuta



Lunularia cruciata

Mannia indica

Targionia hypophylla



Blasia pusilla

Calycularia crispula

Metzgeria leptoneura

Pellia endiviifolia

Lejeuneaceae with 233 taxa are the most prolific liverwort family in India, followed by Plagiochilaceae (87), Frullaniaceae (72) and Solenostomataceae (60). At generic level, *Plagiochila* with 82 taxa is the most prolific liverwort genus, followed by *Frullania* (72), *Cololejeunea* (57), *Solenostoma* (54) and *Lejeunea* (50). On the other hand, 52 genera are represented by only one species. Presently, Sikkim with 355 taxa is the state with richest bryoflora in India, followed by West Bengal (345).



Blepharostoma trichophyllum

Frullania hattoriantha

Haplomitrium blumei

Lejeunea flava



Metacalypogeia alternifolia

Plagiochila semidecurrans

Plicanthus hirtellus

Solenostoma faurianum

HORNWORTS

The plant body of **hornworts** or **Anthocerotophyta** is always thalloid, lacks internal differentiation, oil-bodies and ventral scales, and possesses single, large, plate-like chloroplast (except *Megaceros*, which has more than one). Gametangia are borne endogenously. The young sporophytes are enclosed within a protective sheath or involucre. The sporophyte has substantially large foot and sporangium, which grows acropetally from a basal meristem, hence indeterminate in growth. The epidermal layer of the capsule wall in *Anthoceros*, *Folioceros* and *Phaeoceros* has well-developed stomata. The sporogenous tissue is derived from amphithecial region except in *Notothylas levieri*, in which it is derived from endothelial tissue. The pseudoelaters are usually not well-developed except in *Megaceros*, where the elaters are bispiral.

Hornworts comprise of about 225 taxa in the world and 39 in India, of which almost 50% of the taxa are endemic. In India, the hornworts are represented by only three families, viz., Anthocerotaceae (21 spp.), Notothyladaceae (17 spp.) and Dendrocerotaceae (1 sp.). The *Folioceros* with 12 species is the most prolific genus, followed by *Notothylas* (11 spp.) and *Anthoceros* (9 spp.).



Anthoceros angustus

Folioceros glandulosus

Megaceros tjibodensis

Notothylas pflaenderi