

Diversity of Bryophytes in India - Special Reference to North-east India

Munmi Borkataky*, Toslima Nasrin and Dimonjyoti Bora

Department of Life Sciences, Dibrugarh University, Dibrugarh 786 004, Assam, India

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ABSTRACT

Bryophytes, the first non-vascular embryophytes, are an interesting component of phytodiversity. North-East India can be considered as a hub of bryo-floristic species due to its suitable climatic condition but ecological research on bryo-flora is in infancy. Therefore, to assess the diversity and distribution of bryophytes, we conducted a literature review. From our study, about 23000 species of bryophytes are recorded in world and nearly 2489 taxa are noted from India among which 340 species are endemic. In North-Eastern India, about 1786 of bryophytes are abundantly distributed and most of the endemic species have been recorded from Sikkim. Diversity of bryophytes acts as one of the important ecological indicators. A new vision of research has been provided by this review paper on the diversity of bryophytes and conservation of endemic species for future aspects.

Key words : Bryo-flora, Diversity of Bryophytes, Endemic, North-East India, Assam.

Introduction

Bryophytes, the first invaders of non-vascular land plants, are with a dominant gametophytic phase. It is a group of green plants linking the vascular plants to their algal ancestors (Patino *et al.*, 2018). About 470-551 million years ago, bryophytes are successfully colonized in land from aquatic algal ancestors. The key features for identification of bryophytes are shared by mosses, liverworts and hornworts, but there is a controversy whether these three lineages are monophyletic or not (Cox *et al.*, 2014; Morris *et al.* 2018). They are pioneers of the terrestrial vegetation. Due to high degree of soil binding capacity besides the water retention characteristics, they grow in variety of life forms contributing as the major component of mountain forest (Alam, 2001; Smith, 1982). Bryophytes are most abundant in climates that are constantly humid and equable. Although bryophytes are now largely replaced by angiosperms in

the extent flora today, yet they constitute a fairly prominent part of the present-day vegetation of the world. Though bryophytes are small in size but there are about 23000 different species of bryophytes in the world today and they form the most diverse group of terrestrial plants (Bahuguna *et al.*, 2013). India is considered as one of the eighteen mega diverse countries of the world by having North-Eastern Himalaya which is recognized as biodiversity hotspot. Due to variable climatic condition, geography, habitat, altitudinal variations and various other reasons, the flora wealth including bryophytes of India is diverse and rich. In many regions of India, bryophytes are considered as important components of the vegetation and in moist environments, wetlands, mountain ecosystem and many forest ecosystem, they form as a major part of the diversity. In India, bryophytes are dominantly distributed between the altitude of 1000-8000 meters (Mishra *et al.*, 2016). There are about 2489 taxa of bryophytes re-

corded from India out of which nearly 340 species are endemic to India. Among the total taxa of bryophytes, 1786 species in 355 genera of mosses, 675 species in 121 genera of liverworts and 25 species in 6 genera of hornworts are recorded in India of which many of these species are abundantly distributed in the North East India. (Dandotiya *et al.*, 2011).

Worldwide Distribution of Bryophytes

In worldwide, bryophytes are distributed from polar and alpine regions to the tropics. Tropical and sub-tropical latitudes are rich in diversity of bryophytes. In extensive areas of the cooler parts of the northern hemisphere, bryophytes dominate the vegetation of peatland (Bryophyta by Wilfred Borden Schofield). Among the seven continents of the world, *Lejeuneaceae* and *Sphagnaceae* are endemic to Brazil in South America (Costa *et al.*, 2015). *Crossomitrium patrisiae* is the only epiphyllous moss occurring regularly in the living leaves of southern part of central America (Lucking, 1997). According to FNA (Flora of North America), nearly 1900 species of bryophytes are recorded in North America [FNA Vol 27,28,29, 2014]. *Andreaeobryceae*, *pseudoditrichaceae* and *theliaceae* are some of the moss families endemic to North America (Schofield, 2004). According to Australian National Botanic Garden, *Dawsonia* and *Macromitrium* are the two genus of bryophytes endemic to Australia. According to FSA (Flora of Southern Africa), there are about 59 families, 217 genera and 555 species are recorded in southern Africa (Roy *et al.*, 2015). Bryoflora of Antarctica comprises 28 liverworts and 116 moss species. Among these, genus *Bryum* is highly scattered in Antarctica (Goga *et al.*, 2018; Camara *et al.*, 2021). About, 1892 species of bryophytes are recorded in Europe and among this, 187 are endemic. The family *Bryaceae* is highly diverse in Europe (Hodgetts *et al.*, 2020). *Porella aff. viridissima* is endemic to New Zealand in Oceania (Glenny *et al.*, 2011). The four genera of bryophytes namely *Taxiphyllopsis*, *Yakushimabyum*, *Cavicularia* and *Haddroa* are endemic to Japan and families like *Bryaceae*, *Hypnaceae*, *Miniaceae* etc formed the largest components of bryo-flora of China in Asian continent (Higuchi, 2011; Shi *et al.*, 2021).

Diversity and Distribution of Bryophytes in India

India has a unique position among the biogeographical regions of the world with its varied climatic condition. Pande (1958) proposed 7 bryo-geo-

graphical zones of India to study the enormous bryo-floristic wealth of India. These division are:

Western Himalayan Territory: It lies mainly from the western boundary of Nepal to disputed Kashmir region. Bryo-flora of this region is rich in genus such as *Fissidens*, *Meteorium*, *Ditrichum*, *Atrichum*, *Brothera*, *Paleucobryum*, *Dicranum*, *Dicranoweisia*, *Anoetangium*, *Gymnostomum*, *Hymenostylium*, *Trichostomum*, *Coscinodom* etc. *Dicranum kashmirens*, *D. himalayanum*, *D. lorifolium* are considered as endemic to this zone (Vashishta *et al.*, 2016; Dandotiya *et al.*, 2011).

Eastern Himalaya Territory: It extends from eastern Nepal including eastern parts of mountains of Indian territory, separating India from Bhutan, Burma, Bangladesh and China. Genus such as *Physcomitrium*, *Erpodium*, *Barbula*, *Hyophila*, *Splachnobryum* etc are highly abundant in this zone. Many species like *Barbula gracilentia*, *Cyathodium mahramum*, *C. tuberculatum*, *Metzgeria crispula* (endangered), *Jubula hattori* (rare), *Lopholejeunea indica*, *Cephaloziella indica* are endemic to this region (Vashishta *et al.*, 2016; Dandotiya *et al.*, 2011).

Gangetic Plain: This region covers most of the state of Uttar Pradesh, adjacent portion of Uttarakhand, Bihar, Haryana and Madhya Pradesh. Genus like *Diplophyllum*, *Lophocolea*, *Chiloscyphus*, *Blepharostoma*, *Aitchisoniella* etc are highly scattered in the gangetic zone. *Funaria bilaspurens* is endemic to this region (Vashishta *et al.*, 2016; Dandotiya *et al.*, 2011).

Central India: Although this zone is not clearly defined but still it is commonly considered that this region includes some parts of Orissa, Madhya Pradesh, Gujrat and Maharashtra (Vashishta *et al.*, 2016). Some of the important families recorded from this zone are Dicranaceae, Funariaceae, Poppiaceae, Hypnaceae, Mateoriaceae, etc. *Funaria orishae*, *Garckea flexuosa*, *Erpodium mangiferae* etc are some endemic species in this region (Vashishta *et al.*, 2016; Dandotiya *et al.*, 2011).

The Punjab and West Rajasthan plains: This region represents the area of Western India. It includes some parts of Rajasthan, Punjab, Haryana and Delhi and this region receives comparatively low rainfall. Some species of genus *Physcomitrium*, *Entosthodon*, *Funaria*, *Tremapodon*, etc are generally abundant to this zone. Genus *Erpodium* is endemic to this region (Vashishta *et al.*, 2016; Dandotiya *et al.*, 2011).

Western Ghats: This region represents the total area

of Western Ghats. It includes Kerala, Karnataka, Goa and some parts of Maharashtra and Gujrat. This zone lies roughly parallel to the west coast of India. The commonly recorded genus in these regions are *Funaria*, *Trematodon*, *Erpodium*, *Aulacopilum*, *Solmsiella* etc. *Pogonatum leucopogon* and *Physcomitrium insigne* is endemic to this zone (Vashishta *et al.*, 2016; Dandotiya *et al.*, 2011).

Eastern Ghats and Deccan Plateau: The eastern ghats ranges from Northern Odisha passing through Andhra Pradesh and ending in Tamil Nadu. The Deccan Plateau includes the entire southern peninsula of India south of the Narmada River. Some *Funaria* sp. like *Funaria planifolia*, *Funaria pulchra*, *Funaria sinuato-limbata*, *Funaria subimmarginata* are endemic to this zone. Many species of genus *Physcomitrium* and *Ptychomitrium* are also endemic to this region (Vashishta *et al.*, 2016; Dandotiya *et al.*, 2011).



Fig. 1. Bryo-geographical territories of India proposed by Pande (1958) [Figure from "The Journal of the Indian Botanical Society. 37(1) : 10, 1958"].

Distribution of Bryophytes in North-east India

North-East India is gifted with a broad range of ecoclimatic and physiographic conditions. Therefore, it is considered as the geographical gateway for endemic flora as well as fauna (Roy *et al.*, 2015). It includes Assam along with its seven sisters (Manipur, Mizoram, Arunachal Pradesh, Nagaland, Meghalaya, Tripura and Sikkim). Though North East India is rich in bryo- floristic diversity, still the ecological studies of the bryo-flora, except for a few research works, are still in a very juvenile stage (Barukial, 2011).

From the survey report of "Bryophyte's diversity in Nagaland (district- Mokochung)" by Bansal *et al.*, 2011, the epiphytic bryo-flora is unexpectedly rich in this region. Based on his study, it has been revealed that there is occurrence of 12 species of mosses belonging to 8 families and 4 species of hepatics (liverworts) representing 2 families in this region which includes some genus like *Brachymenium*, *Entodon*, *Fabronia*, *Regmatodon*, *Erythrodontium*, *Entodontopsis*, *Plagiothecium*, *Hyophila*, etc. Nagaland is rich in thal- loid liverworts which includes 11 families belonging to 12 genera and 28 species; and *Marchantia* has highest diversity followed by *Riccia* and *Riccardia*. (Eshuo, 2013).

Meghalaya (mainly from Khasi Hills), is also rich in bryophytes and has 248 species belonging to 120 genera of mosses (Bansal *et al.* 2012). The genus *Bryum* has the highest diversity in Meghalaya. Bansal *et al.* 2012 reported the occurrence of *Bryum coronatum*, a new addition to the bryo-flora of Meghalaya. Asthana *et al.* 2013, has identified a new species *Homalothecium arenarium* in Meghalaya (Shillong), which is a new addition to the north east- ern bryo-flora. Some other genus distributed in Meghalaya are *Bazzania*, *Solenostoma*, *Cephalozia*, *Cheilolejeunea*, *Marchantia*, etc.

The State Tripura has 101 taxa out of which 95 species belongs to 3 sub-species and 2 varieties of liverworts and 1 species of hornworts with genus like *Lejeunea*, *Porella*, *Mastigolejeunea*, *Riccardia*, *Schiffneriolejeunea*, *Frullania* etc. (Singh *et al.*, 2016).

Singh *et al.*, 2016, recorded 111 species belonging to 46 genera and 20 families of liverworts and 7 species belonging to 3 genera in family *Anthocerotaceae* of hornworts in Manipur. Devi *et al.*, 2020, has reported 7 new thalloid liverworts belonging to 2 genera and 2 families in bryo- flora of Manipur. The two genera are *Marchantia* and *Riccia*. Govindaparyari *et al.*, 2021, has revealed 42 species belonging 30 genus and 16 families of pleurocarpous mosses from Manipur (Imphal district). Among the taxa found in Manipur, majority of them are epiphytic growing in tree bark and branches. Some widely spread genus are *Erpodium*, *Erythrodontium*, *Pterygynandrum*, *Fabronia*, etc.

Mizoram is also highly rich in the bryo-flora dis- tribution. The bryo-flora of Aizawl district has 41 taxa under 34 genera and 23 families. Out of which 23 species belonging to 20 genera and 14 families are mosses, while liverworts are represented by 15 species of 12 genera and 8 families and 3 species under

Table 1. List of bryophytes found in north-eastern region of India

State	Genus	Location	Status	Reference
Nagaland	<i>Rhynchostegium pellusidum</i>	Mokokchung, Naga Hills and Kohima district.	Endemic	Bansal <i>et al.</i> , 2011 Eshuo, 2013
	<i>Fabronia</i>		Endemic	
	<i>Regmatodon</i>			
	<i>Erythrodotium</i>			
	<i>Entodontopsis</i>			
	<i>Plagiochila</i>		Rare	
	<i>Hyophila</i>			
	<i>Dicranum</i>		Endemic	
Meghalaya	<i>Daltoniagemmipara</i>	Shillong, Garohills and Khasihills.	Endemic	Bansal <i>et al.</i> , 2012 Asthana <i>et al.</i> , 2013; Dandotiya <i>et al.</i> , 2011.
	<i>Syrrhopodon</i>		Endemic	
	<i>Hookeriopsis secunda</i>		Endemic	
	<i>Solenostoma</i>			
	<i>Hyophila</i>		Endemic	
	<i>Cheilolejeunea</i>			
	<i>Trematodon</i>		Endemic	
	<i>Oxystegus khasianus</i>		Endemic	
Tripura	<i>Lejeunea</i>	Dhalai	district,	Jampui Hills
	Singh <i>et al.</i> , 2016.			
	<i>Porella</i>			
	<i>Mastigolejeunea</i>			
	<i>Riccardia</i>		Endemic	
	<i>Schiffneriolejeunea</i>			
	<i>Frullania</i>			
	<i>Bryoerythrophyllum ferrugineum</i>		Endemic	
Manipur	<i>Plagiothecium</i>	Imphal district Corda from Loktak lake,	Endemic	Govindaparyi <i>et al.</i> , 2021 Singh <i>et al.</i> , 2010 Devietal, 2020
	<i>Erpodium</i>		Endemic	
	<i>Erythronotium</i>			
	<i>Hyophila</i>		Endemic	
	<i>Brachymenium</i>		Endemic	
	<i>Marchantia</i>		Abundant to this region.	
	<i>Sphagnum</i>			
	<i>Polytrichum</i>			
Mizoram	<i>Dumortiera</i>	Aizawl, Lungleiroad, Sheling-Champhairoad, Thenzal-Serchip road and Lunglei-Tlabungroad.		Laha <i>et al.</i> , 2015 Banerjee <i>et al.</i> , 2019
Arunachal Pradesh	<i>Anastrophyllum</i>	Tawang District West Kameng Mishmi Hills Debang Valley		Vohra <i>et al.</i> , 1996 Rawat <i>et al.</i> , 2017
	<i>Bazzania</i>			
	<i>Herbertus</i>			
	<i>Thyridium piluliferum</i>		Endemic	
	<i>Plagiochila</i>			
	<i>Daltonia perla xiretis</i>		Endemic	
	<i>Cyathophorella burkillii</i>		Endemic	
	<i>Tetralophozia</i>			
Sikkim	<i>Hydrogonium decolyi</i>	Ranipool, Gangtok, Ban Jhakri Falls, Darjeeling, Ray Khola etc	Endemic	Chetia <i>et al.</i> , 2021 Asthana <i>et al.</i> , 2013
	<i>Racomitrium</i>		Endemic	
	<i>Entodon</i>			
	<i>Atrichum</i>			
	<i>Ditrichum</i>		Endemic	
	<i>Zygodombrevisetus</i>		Endemic	
	<i>Ditrichopsis</i>		Endemic	
	<i>Hypnum</i>			
	<i>Oreoweisia</i>		Endemic	
	<i>Dicranoweisia</i>		Endemic	

Table 1. Continued ...

State	Genus	Location	Status	Reference
Assam	<i>Haplomitriumgrollei</i>	Golaghat, Jorhat, Sivasagar, Dibrugarh, Tinsukia, Lakhimpur, Dhemaji and Sonitpur.	Endemic,endangeredandrare	Barukial <i>et al.</i> , 2011
	<i>Leucobryum</i>		Endemic	
	<i>Ptychomitrium</i>		Endemic	
	<i>Pogonatum</i>		Endemic	
	<i>Ortholimmobium Borii</i>		Endemic	
	<i>Hyophila</i>		Endemic	
	<i>Homalothecium incompletum</i>		Endemic	
	<i>Monoselenium</i>		Vulnerable and rare	
	<i>Dicranoloma</i>		Endemic	
	<i>Dicranellamacrospora</i>		Endemic	
	<i>Splachnobryumassamicum</i>		Endemic	

2 genera belonging to 1 family are represented by hornworts. The most dominant families in bryoflora of Mizoram are Bryaceae, Dicranaceae, Marchantiaceae, Funariaceae, Anthocerotaceae, etc. Banerjee *et al.*, 2019, has reported 76 species of bryophytes distributed over 29 families in some hill roads of Mizoram. Among these 65 species, under 50 genera and 36 families has been recorded from Mamit district of Mizoram. Out of these, 37 species under 28 genera and 17 families represented by mosses, while liverworts are represented by 26 species belonging to 20 genera and 18 families. Some widely spread genera are *Marchantia*, *Sphagnum*, *Polytrichum*, *Dumortiera*, etc.

Arunachal Pradesh has recorded 82 species of mosses (Vohra *et al.*, 1996). From Tawang district, 23 species of liverworts both epiphytic and terrestrial are reported. A new liverworts *Blasia pusilla* has recorded to bryo-flora of Arunachal Pradesh (Rawat *et al.*, 2017). Rawat *et al.*, 2017, provides recent information on bryo-flora of Arunachal Pradesh. A sum of 67 bryophytes are known so far from this region according to their research investigation. Some commonly found taxa are *Anastrophyllum*, *Bazzania*, *Herbertus*, *Plagiochila*, *Tetralophozia*, etc.

Sikkim is one of the smallest mountainous states of India. The climatic condition of Sikkim favours the rich diversity of bryo-flora. Chetia *et al.*, 2021, reported 31 species of mosses from 22 selected location of Sikkim. Some widely spread genera are *Bryum*, *Entodon*, *Atrichum*, *Distichium*, *Funaria*, *Hypnum*, *Haplocladium*, *Leucobryum*, etc. *Ptychomitrium indicum*, *Racomitrium crispulum*, *Racomitrium fuscum*, etc. are endemic to this region. Asthana *et al.*, 2013, investigates on the bryo-flora of Darjeeling. They reported the occurrence of 12 spe-

cies of hornworts in these regions. *Anthoceros punctatus*, *Folioceros assamicus*, *Phaeoceros himalayensis*, etc. are widely spread to this region.

In Phyto diversity of Assam, bryophytes constitute one of the important components. The region has 162 taxa of bryophytes under 90 genera and 39 families. Some abundantly spread genera are *Porella*, *Jungaermannia*, *Plagiochila*, *Pogonatum*, etc. (Barukial *et al.*, 2011).

Bryo-flora of Assam

The wide variety of physical features and climatic condition of Assam favours the rich diversity of ecological habitats such as grassland, wetlands, forests nurture and sustain broad range of floral and faunal species placing. Phytogeographically, Assam has a peculiar identity due to its heterogenic physiography, which make possible flourishing growth of a number of phytoconstituents. Assam is described by many scholars as the Biological Gateway of North-East for its alignment of floristic composition. Although Assam is rich in floral diversity but a least amount of research has done on bryo-flora of Assam. The neoteric upsurge of interest in examining atmospheric pollution has revealed that bryophytes can be used as a climatic and pollution detector which can be favourable to management of a particular environment. Therefore, researchers have laid a conclusion that bryophytes are an elegant group of plant kingdom and this reason promoted the scholars to investigate the bryo-flora of Assam (Barukial, 2011; Rathoure, 2017).

Barukial, 2011, investigate on bryo-floristic diversity of Assam and recorded about 162 taxa of bryophytes (Liverworts, Hornworts and Mosses) belong-

Table 2. Bryo-flora of Assam with their habitat.

Family	Genus	Habitat	Reference
Calypogeiaceae	<i>Calypogeia</i>	Nonepilithic	Barukial <i>et al.</i> , 2011; Barukial, 2011.
Jungermanniaceae	<i>Plectocolea</i>	Drying (periodic)	
Geocalycaceae	<i>Chiloscyphus</i>	Corticolous / Non-corticolous / Dry / Wet.	
Jubulaceae	<i>Frullania</i>	Corticolous	
Lejeuneaceae	<i>Archilejeunea</i>	Corticolous / Non-corticolous	
	<i>Brachiolejeunea</i>	Corticolous	
	<i>Cololejeunea</i>	Non-corticolous	
	<i>Drepalolejeunea</i>	Corticolous / Non-corticolous	
	<i>Lejeunea</i>	Epilithic / Non-epilithic	
	<i>Leptolejeunea</i>	Corticolous	
	<i>Dumortiera</i>	Epilithic / Non-epilithic	
Marchantiaceae	<i>Marchantia</i>	Epilithic / Non-corticolous	
	<i>Monoselenium</i>	Epilithic	
	<i>Riccia</i>	Non-corticolous	
Ricciaceae	<i>Anthoceros</i>	Dry / Constantly wet.	
Anthocerotaceae	<i>Archidium</i>	Dry	
Archidiaceae	<i>Lyellia</i>	Nonepilithic / dry (periodic)	
Polytrichaceae	<i>Pogonatum</i>	Non-epilithic	
	<i>Polytrichum</i>	Non-epilithic	
	<i>Wilsoniella</i>	Non-epilithic	
Wilsoniellaceae	<i>Ceratodon</i>	Epilithic	
Ditrichaceae	<i>Distichium</i>	Non-epilithic	
	<i>Ditrichum</i>	Non-epilithic	
	<i>Garckea</i>	Non-epilithic	
	<i>Pleuridiella</i>	Non-epilithic	
	<i>Campylopus</i>	Epilithic	
	<i>Dichodontium</i>	Non-epilithic	
	<i>Dicranalla</i>	Non-epilithic	
Dicranaceae	<i>Dicranodontium</i>	Non-epilithic / Epilithic	
	<i>Dicranum</i>	Epilithic	
	<i>Trematodon</i>	Dry (periodic)	
	<i>Leucobryum</i>	Non-epilithic	
	<i>Leucophanes</i>	Corticolous	
Leucobryaceae	<i>Octoblepharum</i>	Corticolous	
	<i>Fissidens</i>	Non-epilithic / Dry / wet	
	<i>Calymperes</i>	Corticolous	
Fissidentaceae	<i>Syrrhopodon</i>	Corticolous	
Calymperaceae	<i>Thyridium</i>	Corticolous	
	<i>Barbula</i>	Epilithic / Non-epilithic	
	<i>Hydrogonium</i>	Epilithic	
Pottiaceae	<i>Pseudosymblepharis</i>	Epilithic	
	<i>Tortella</i>	Non-epilithic	
	<i>Funaria</i>	Non-epilithic	
Funariaceae	<i>Splachnobryum</i>	Epilithic	
Splachnobryaceae	<i>Bryum</i>	Epilithic	
Bryaceae	<i>Leptobryum</i>	Epilithic	
	<i>Pohlia</i>	Epilithic	
	<i>Philonotis</i>	Epilithic / Non-epilithic	
Bartramiaceae	<i>Erpodium</i>	Corticolous	
Erpodiaceae	<i>Macromitrium</i>	Corticolous	
Orthotrichaceae	<i>Pterobryopsis</i>	Corticolous	
Pterobryaceae	<i>Barbella</i>	Corticolous	
Meteoriaceae	<i>Meteriopsis</i>	Corticolous	

Table 2. Continued ...

Family	Genus	Habitat	Reference
Neckeraceae	<i>Calypothecium</i>	Corticolous	
	<i>Himanthocladium</i>	Corticolous	
	<i>Neckeropsis</i>	Corticolous	
	<i>Neckera</i>	Corticolous/Non-corticolous	
	<i>Pinnatella</i>	Corticolous	
	<i>Thamnobryum</i>	Corticolous	
Hookeriaceae	<i>Calliostella</i>	Non-epilithic	
	<i>Chaetomitrium</i>	Non-epilithic	
Fabroniaceae	<i>Fabronia</i>	Corticolous	
Thuidiaceae	<i>Anomodon</i>	Corticolous	
	<i>Claopodium</i>	Corticolous	
	<i>Haplocladium</i>	Corticolous	
	<i>Herpetineuron</i>	Corticolous	
	<i>Thuidium</i>	Corticolous/Non-Corticolous	
Amblystegiaceae	<i>Campylium</i>	Corticolous	
Brachytheciaceae	<i>Brachythecium</i>	Non-epilithic	
	<i>Eurhynchium</i>	Corticolous	
	<i>Rhynchostegium</i>	Epilithic	
Entodontaceae	<i>Erythrodontium</i>	Corticolous	
	<i>Trachyphyllum</i>	Corticolous	
Plagiotheciaceae	<i>Stereophyllum</i>	Corticolous/Non-Corticolous	
Sematophyllaceae	<i>Acanthorrhynchium</i>	Corticolous	
	<i>Brotherella</i>	Corticolous	
	<i>Foreauella</i>	Corticolous	
	<i>Meiothecium</i>	Corticolous	
	<i>Sematophyllum</i>	Corticolous	
	<i>Taxithelium</i>	Corticolous	
	<i>Ectropothecium</i>	Epilithic	
Hypnaceae	<i>Isopterygium</i>	Epilithic/Non-epilithic	
	<i>Ptilium</i>	Epilithic	
	<i>Taxiphyllum</i>	Corticolous	
	<i>Vesicularia</i>	Corticolous	
	<i>Macrothamnium</i>	Non-epilithic	

ing to 90 genera under 39 families with their proper habitat. He revealed that *Brotherella falcata*, *Ectropothecium buitenzorgii*, *Eriopus lucidus*, *Foreauella orthothecia*, *Herpetineuron toccocae*, etc are some rare species of corticolous mosses found in Assam. From another report of Barukial, 2011, in which he studied on moss diversity in Assam Valley Wet Evergreen Forest and found 127 species of Mosses under 71 genera belonging to 27 families in this region. On his research work, he recorded the taxa *Pleuridiella colei* Robins. and *Splachnobryum synoicum* Robins are endemic to this area. He revealed that the order *Hypnobryales* is abundant in the study area which consists of 49 species and covers 62.23% of the total species recorded.

Verma *et al.* 2014, survey on Liverwort and Hornwort flora of Hoollongapar Gibbon Sanctuary,

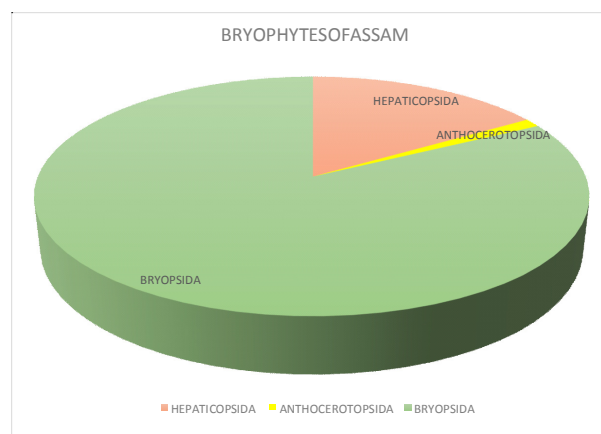


Fig. 2. Pie diagram showing total number of genera in different classes of Bryophytes.

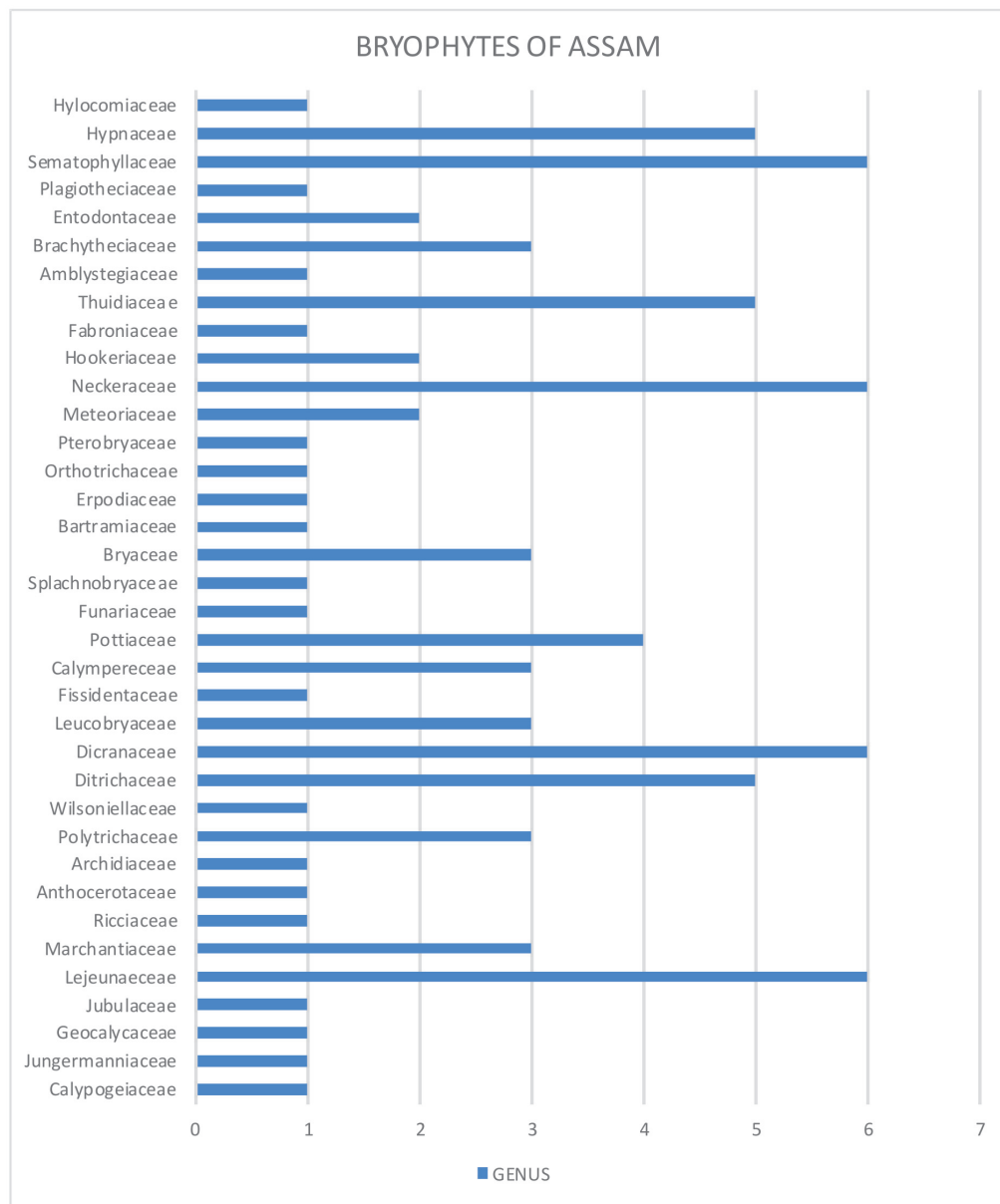


Fig. 3. Bar diagram showing number of genera under the families found in Assam.

Jorhat (Assam). They reported 27 species including 17 new taxa for the first time in this region. Some of the newly recorded taxa are *Heteroscyphus hyalinus* (endemic to India), *Plagiochila flexuosa*, *Lopholejeunea sikkimensis*, *Ptychanthus striatus*, *Rectolejeunea olivacea* etc. Barbhuiya and Singh, 2012, has done a preliminary study on liverworts and hornworts of Borail Wild Life Sanctuary, Assam, India. They enumerated 25 species of liverworts belonging to Marchantiophyta and one species of hornworts under Anthocerotophyta. From their report, it is found

that *Frullania berthoumieuui* is new to India and *Caudalejeunea reniloba* new to North East India. They also recorded 13 new species to Assam and 11 species are reported for the first time from Borail wildlife sanctuary.

Verma *et al.* 2014, found 7 species of bryophytes at 'Talatal Ghar', a famous Archaeological Site of Ahom Dynasty of Sibsagar, Assam (India). Among those recorded species, 4 are liverworts namely *Asterella khasiana*, *Marchantia subintegra*, *Plagiochasma rupestre* and *Marchantia palmata* and rest 3 are mosses

namely *Physcomitrium japonicum*, *Funaria hygrometrica* and *Fissidens* spp.

Conclusion

From this study, it can be stated that bryophytes are globally distributed and North East India can be considered as a hub of many endemic and rare bryoflora. The climatic condition is best apt for the luxuriant growth of bryo-floristic species. From different research works, it has been found that Assam comprises of a number of endemics, vulnerable and rare species of bryophytes. For instance, one of the vulnerable and rare genera is *Monoselenium*. There may be a lesser economic importance of bryophytes, but they play an important ecological role especially in extreme environmental conditions. One critical observation has been noticed by Barukial, 2011, that a moss species *Trematodon ceylonensis*, grows luxuriantly in the riverbed and streams of less polluted sites, but their propagation declined in the riverbed where municipal sewages drains meet. It indicates that pollution can influence the diversity of bryophytes and it also act as a pollution indicator. From this study, it is seen that very restricted /limited amount of research has been conducted in diversity of bryo-flora and also climatic factors and other anthropogenic activities hinders the habitat degradation of bryophytes. Therefore, a notable amount of work is required in diversity conservation of bryophytes to acquire sufficient information for approaching new vision of research.

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