



DIVERSITY AND DISTRIBUTION OF BRYOPHYTES (MOSES) IN WEST DISTRICT OF SIKKIM

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Abstract

Bryophytes form an extreme part of the vegetation and they are important with the prospective of understanding Himalayan ecology. Sikkim, one of the smallest states in India supports a rich growth of bryophytes both in luxuriance and species diversity. In this article 30 species of mosses are presented that were studied from West district of Sikkim.

Keywords: Bryophytes, Diversity, Habitat, Mosses, Sikkim.

Introduction

The term bryophyte includes mosses, liverworts, and hornworts, all of which are small, generally non-vascular, spore producing plants. The plant body of bryophytes is generally smaller in size and the physical characteristics are different from the vascular plants. The small size plant body has allowed them to colonize in a great diversity of habitats in most of places on earth. Their body structure and lifecycle have enabled them to survive from more than 400 million years with apparent changes. Approximately 20,000 bryophyte species are known worldwide.

Bryophytes are evolved from the aquatic ancestors of modern day green algae and represent the torch bearer of terrestrial life and the present day vascular plants are evolved from some of the bryophytes like ancestors. Bryophytes do not have complete vascular bundle system but they get access to water, nutrients and air through cells and directly contact to the environment. This mechanism of direct contact makes them susceptible to the challenges posed by environmental degradation and pollution. In addition, they do not have any mechanism to eliminate potentially harmful substances from their body as it found in higher group plants.

Mosses are one of the critical components of Himalayan forest ecosystem as they perform essential ecological functions and contribute to biomass formation. Their wide geographic range of distribution depends on the external environment, their spore dispersal mechanism, habitat availability and the associated plants. The size and thickness of the moss thallus indicate their response to external environment including acid rain and air pollution.

Sikkim is one of the mountainous states of India with an area of 7096 sq. km. and an integral part of the Eastern Himalaya which is known as one of the mega biodiversity hotspot zones. Within the limit of its boundary, it has altitudinal variations ranging from 350 m to 8598m which support the diversity of climatic conditions providing different types of micro and macro habitats suitable for the colonization of bryophytes. According to floristic data report published by the Botanical Survey of India (2020), a total of 2,791 taxa of bryophytes have been reported from India that comprises 5.11% of total Indian flora.

West district of Sikkim is the second largest district which lies between 27° 00' 46" -28° 07' 48" N latitude and 88° 00' 58" - 88° 55' 25" E longitudes covering an area of 1166 sq. and altitudinal range covers from 400m - 8598m. In the present study mosses were collected from different locations within the approximate distance of 10 sq km and the altitudinal range varying from 1785m - 2668 m in the West district of Sikkim.

2. Methodology

2.1 Field work

The collection of mosses was done during the month August-September, 2021 in forest and nearby areas of Hilley and Okhrey of West Sikkim. Guidelines prescribed for covid19 pandemic by the government (SOP) protocol were strictly followed during the study and precautions were taken maintaining physical distance, wearing face mask, hand gloves and using sanitizer as and when required. Photographs of the studied specimens were taken along with substrates (soil, rock, bricks etc.), host for epiphytic moss.

2.2 Identification of mosses

Identification of specimen was done in the laboratory of the Department of Botany, Sikkim University based on morphological characters. Because of their small size and limited morphological characters and colors it possesses challenge to identify without stereo zoom microscope. The first person to write a reasonably comprehensive macroscopic photo guide to mosses was A.J. Grout in 1900. Present identification of the specimens is made on the basis of publications by Robinson Harold E (1968), Barukial Jayanta (2011), Pope Ralph (2016) and the Checklist of Botanical Survey of India prepared by Dandotiya *et al*, (2011).

3. Result and Discussion

In the present paper, 30 species of mosses belonging to 18 families and 25 genera have been recorded from the West district of Sikkim which is enumerated alphabetically irrespective of their taxonomic positions. It is found that most of the mosses are corticolous (grows on tree trunk/bark), terricolous (grows on soil), followed by rupicolous (grows on rocks, cemented wall etc.). High diversity of mosses was found in both Hilley and Okhrey area. Diversity of mosses is high due to remoteness of the area far away from human settlement, undisturbed ecological conditions and suitable slope aspects required for the mosses. The most abundant mosses were *Callicladium imponens*, *Calliergon cordifolium*, *Conardia compacta*, *Dicranum scoparium*, *Eurynchium praelongum*, *Eurynchium straitum*, *Haplocladium microphyllum*, *Hylocomium splendens*, *Oxyrrhynchium hians*, *Plagiomnium cuspidatum*, *Rhynchostegium megapolinatum*, *Rhynchostegium tenuifolium*, *Thuidium delicatulum*, and *Thuidium tamariscinum*, however, species of *Hookeria acutifolia*, *Isothecium myosuroides* were found to be sparsely distributed. Among the 30 species of mosses recorded, 19 genera, namely *Antrichia*, *Callicladium*, *Calliergon*, *Conardia*, *Drepanocladus*, *Eurynchium*, *Haplocladium*, *Homalothecium*, *Hookeria*, *Hylocomium*, *Isothecium*, *Oxyrrhynchium*, *Polytrichum*, *Isopterygium*, *Ptilium*, *Racopilum*, *Rhynchostegium*, *Rhytidiadelphous*, and

Thuidium are pleurocarpous and remaining 6 genera namely *Dicranum*, *Leucobryum*, *Plagiomnium*, *Tortella*, *Tortula* and *Ulota* are acrocarpous.

3.1 For the identification of the collected bryophytes the key characters are:

1. Plant has dark brown stems and green leaves that give the overall matt of intertwined stems and roots a rusty yellow looking colour. This colour varies in intensity depending on the level of moisture being held within them. The hanging stems can grow upto 15-30 cm long. It has three midribs one main and longer midrib going down the center and two fainter and shorter ones on either side. It form large clumps on branches, and tree trunks looking like a cross between a carpet and a blanket.....*Antitrichia curtipendula*

2. Plants medium-sized to large, golden to yellow-green or brownish. Stems 3-10 cm, reddish brown, creeping, regularly pinnate, occasionally partly 2-pinnate or irregularly branched. Stem leaves falcate, triangular-ovate to oblong-lanceolate, gradually narrowed to apex, base somewhat decurrent; margin recurved basally, serrulate distally or rarely nearly entire. Capsule erect to slightly inclined, red-brown, cylindric, 1.5-3 mm; annulus not much differentiated; operculum conic.....*Callicladium imponens*

3. Plants medium-sized to large moss with erect, green shoots. The shoot can reach upto 15 cm with oval-shaped leaves from 2-2.5 mm wide. The leaves extend outwards, away from the stem. Towards the base, the leaves take on a heart shape, while at the tip they are rounded.....*Calliigon cordifolium*

4. Plants in dense to loose mats. Stems erect-ascending or creeping, leaves crowded gradually narrowed to apex. Perichaetia with inner leaves, margins irregularly denticulate distally, apex acuminate. Seta orange-yellow or reddish at base, capsule brownish yellow, operculum conic and annulus present.....*Conardia compacta*

5. Plants form shiny tufts with stem 2-8 cm high. The leaf midrib extends to the tip and usually has 4 ridges along its back. The leaves are lance-shaped with a long, slender point. Most leaves are folded and curved to one side; capsules are 2.3-5mm long, urn-shaped and curved. The capsules have erect stalk and have operculum longer than the capsule.....*Dicranum scoparium*

6. Plants small to medium-sized, yellow or brownish green, forming loose wefts. Stem leaves closely spaced, ovate-lanceolate; branch leaves mostly smaller often circinate at branch tips. Perichaetia scattered on stems

.....*Drepanocladus aduncus*

7. Plant varies in colour from light to dark brownish-green or olive green. It has long creeping stems, and is once or twice pinnately branched. The slender branches intertwined to form tangled mats. Leaves are 1.5 mm long, have a strong midrib. Branch leaves are narrower and spread less, ovate-lanceolate. Capsule short, cylindric and seta slender red-brown

.....*Eurhynchium praelongum*

8. Plant form cushions or mats that extend over large areas. Shoots are generally pale or yellow-green, and more or less pinnately branched. The stems and branches are straight; leaves spread widely reaching 1.5 to 2 mm long. They are triangular but narrowed and heart-shaped at the point of attachment. The margins are finely toothed. Capsules 2 to 3 mm long and operculum is present.....*Eurhynchium straitum*

9. Plants medium-sized. Stems irregularly pinnate; leaves erect, distant, broadly ovate to triangular; margin plane, somewhat recurved basally, serrulate. Branch leaves ovate; capsules inclined to horizontal.....*Haplocladium microphyllum*

10. Plants have green or golden green main shoots grow closely appressed to the substrate. They have short, crowded side branches that curve upwards and inwards when dry, with leaves closely appressed. On wetting, the branches rapidly straighten and the leaves spread outwards. Leaves are 2.5 to 3 mm long, strongly pleated, widest at the base, and taper evenly to pointed tip. The margins are weakly toothed. Capsules long, straight and cylindrical

...*Homalothecium sericeum*

11. Plants yellowish green, medium to large in size, 1.8-3.5 cm long, and 1.5-2.0 cm wide leaves, simple branched, creeping and tightly adherent to substrate. Stems green to yellowish green, leaves widely spread, ovate, widest at the base, and margin entire. Perichaetial leaves narrowly ovate to lanceolate, entire. Seta slender, reddish brown to yellowish brown, smooth. Capsule ovoid-oblong, operculum and peristome teeth present; calyptra mitriform...*Hookeria acutifolia*

12. Plant form loose weft of shoots. Shoots are glossy green or brown-green. Branching pattern is complex. It is composed of one or more bipinnate branched "step by step" and each step represents a year growth. Leaves of the main branch are doubling costate. It appearance is fern-like.....*Hylocomium splendens*

13. Plants green to golden green form a mat or carpet like intertwined of stem and roots; leaves are oblong, pointed at the tip; seta brownish to red, slender; capsule reddish brown, cylindrical.....*Isopterygium albescens*

14. Plants in cushions, olive-green to whitish-green. Stems erect or pendant, pinnately branched, leaves 3.5 mm long, ovate-lanceolate with apex twisted. Margins plane but sometimes entire to serrulate below the middle, and serrate above. Perichaetia on main axis, ligulate-lanceolate base, seta long, capsule brown, and operculum conic.....*Isothecium myosuroides*

15. Creeping stems that often form a large mats or cushions vary in colour from almost white when dry to pale green. Leaves are linear-lanceolate and crowded on the stem, veins broad, gradually narrowed from broadly ovate base; rhizoids fibrous.....*Leucobryum javense*

16. Plant whitish-green, silky, branches arise from the main stem and from basal portion; leaf spreading, not much changed when dry, gradually narrowed to tip

from a wider base; uniform from base to apex. Seta slender, brown in colour, capsule when matured it turns to brown in colour

.....*Leucobryum juniperoideum*

17. Plants are large sized, whitish green, in loose tufts. Stems erect, bearing many soft-twisted branches; leaves typically soft-textured, narrowly lanceolate to lanceolate, gradually narrowed to subtubulose apices from broadly elliptic base, acute at apex; rhizoid fibrous.....*Leucobryum sanctum*

18. Plants glossy. Stems 3-10 cm long, branches 4-12 mm long, stem leaves are broad, branch leaves broadly elliptic, seta slender and capsule cylindrical.....*Oxyrrhynchium hians*

19. This moss is evergreen perennial, short-lived. Sterile shoots produce sprawling unbranched stem, the alternate leaves are arranged horizontally along two sides of such stems, and they tend to be wider in shape than the leaves of fertile shoots. Fertile shoot produce erect unbranched stems. The leaves occur in pseudo whorls along such stem, the leaves of fertile shoots are ascending to spreading. Both the stems and leaves are usually light green when they are moist. On fertile shoots, the leaves are oblong-obovate to oblong-elliptic in shape and on infertile shoots, the leaves are obovate to broadly elliptic in shape. The leaves of both kinds of shoots have tips that are acute and cuspidate and have conspicuous midrib. These leaves have fine sharp teeth along their margins from about the middle of their length to their tips, margin smooth. When they are dry, leaves darken and crinkled; they straighten out and become smooth again with the return of moisture. Stem and leaves are hairless; seta long, more or less erects, green, yellow, light orange, long, smooth. Capsule light green, yellow, orange, ovoid to cylindrical in shape; fibrous rhizoids.....*Plagiomnium cuspidatum*

20. It forms loose to dense tufts. The wiry plants are large and olive to dark green, becoming brown to age. Stems are typically unbranched, stiff, and erect. Leaves are spirally arranged to the stem, erect spreading to curved and twisted when dry, spreading with recurved tips when wet, the base clasps the stem with a membranous, shiny sheath, oblong-lanceolate or elliptical, yellowish; margins with unicellular teeth from leaf base to apex, the midrib ends above the apex in a short. Seta long, yellowish-reddish brown; capsule long, brown to dark red brown, inclined, box-like appearance*Polytrichum commune*

21. Plants grow in beautiful glossy yellow-green mats with stems pinnately branched and arching upwards to look like little plumes. The 2-3 mm leaves are falcate-secund (asymmetric with leaf tips pointing down) to almost bent into a circle. These leaves are plicate with a double costa which is sometimes hard to see with all the leaf folds.....*Ptilium crista-castrensis*

22. It is a creeping moss that forms dense mats of branching stems. There are two rows of lateral leaves with near parallel sides and two rows of triangular dorsal leaves. The capsule stalk is slender and the calyptra covering is only faintly hairy.....*Racomitrium cuspidigerum var. convolutaceum*

23. Plant forms low patches (smooth mats) in unshaded or lightly shaded but avoid driest places. Branches are irregular, leaves are spreading and pointed.....*Rhynchostegium megapolinatum*

24. It forms irregularly branching, creeping stems with widely spreading leaves somewhat flattened into one plane. Leaf margins are toothed with a tapering tip and a vein that extends beyond half way but fails before the leaf tip. The seta is smooth and the capsule lid has a long beak.....*Rhynchostegium tenuifolium*

25. Plant grows as an extensive mat of branching stems upto 15 cm long, sheathed in leaves that are 2-2.5 mm long, and spread outwards from the stem. The leaf bases are broad and include a pair of short midrib. The plant rarely produce capsules.....*Rhytidiadelphous squarrosus*

26. Plants form loose mats of compound leaves that are green to yellowish green. The central stems of these are densely covered with narrow scale-like leaves; larger stem leaves are broadly ovate to triangular in shape. The midribs of these leave extend nearly to their tips. Primary branches radiate from central stem becoming shorter as they approach the tip. Secondary branches radiate from each primary branch; leaves of both primary and secondary are different in size. Stalk with spore-bearing capsules are produced from the leaves of the plant, cylindrical, operculum present with calyptra.....*Thuidium delicatulum*

27. The plant form bright yellow-green fern-like shoots. They are usually tri-pinnately branched and form mats 5 to 25 cm across the area. It grows in woodlands, grassland and in damp places.....*Thuidium tamariscinum*

28. Plants dark green to yellowish or blackish brown. Stem leaves uniform in size and shape along the stem and apex, lowermost leaves mostly without leaf tips; margins plane to erect. Seta long, slender, occasionally two per perichaetium. Capsule 1.8-3 mm, operculum along with peristome teeth present, twisted.....*Tortella fragilis*

29. It forms greyish-green cushions. Leaf margins are narrowly recurved near apex and are pointed. Seta slender; capsule erect and cylindrical, peristome teeth present.....*Tortula muralis*

30. Perennial epiphytic moss. Tufts yellowish green, rusty in colour inside. Leaves moderately or strongly crisped when dry, erect when moist; linear-lanceolate, sharply pointed. Midrib ending below or within the leaf tip. It grows on tree trunks.....*Ulota robusta*

It was also observed that most of the mosses wet, moist, and semi-shaded area in association with other mosses. Mosses that were collected were mainly corricolous and were seen to be grown on barks of the angiospermic trees.

3.2. List of mosses and their habitat, associated plants and local distribution in West district of Sikkim

Sl.No	Name of the plant	Family	Habitat	Distribution	Associated Plants	Reference
1	<i>Antitrichia curtispindula</i> Bridel-Brederi	Leucodontaceae	Bark, tree trunks, logs	Hilley & Okhrey	It was seen to be grown alone.	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)
2	<i>Callicladium imponsens</i> (Hedw.) Hedenas, Schlesak & D. Quandt.	Callicladiaceae	Wet humus, base of tree near bogs	Hilley & Okhrey	<i>Thuidium delicatulum</i> (Hedw.) Schimp, <i>Ptilium crista-castrensis</i> (Hedw.) De Not.	Ralph Pope (2016)
3	<i>Calliergon cordifolium</i> (Hedw.) Kindb.	Calliergonaceae	Wet and moist soil, tree	Hilley & Okhrey	<i>Thuidium delicatulum</i> (Hedw.) Schimp <i>Eurhynchium praelongum</i> (Hedw.) Schimp. <i>Conardia compacta</i> (Mull. Hal.) H. Rob, <i>Leucobryum juniperoideum</i> (Brid.) Mull. Hal., <i>Plagiomnium cuspidatum</i> (Hedw.) T.J. Kop Liverworts: <i>Lophocolea heterophylla</i> (Schrad) Dumort	Dandotiya <i>et al.</i> (2011)
4	<i>Conardia compacta</i> (Mull. Hal.) H. Rob	Amblystegiaceae	Wet and moist soil, tree trunk, logs, bark	Hilley & Okhrey	<i>Drepanocladus aduncus</i> (Hedw.) Warnst <i>Oxyrrhynchium hians</i> (Hedw.) Loeske <i>Calliergon cordifolium</i> (Hedw.) Kindb.	Dandotiya <i>et al.</i> (2011)
5	<i>Dicranum scoparium</i> Hedw.	Dicranaceae	Tree trunk, bark, log	Okhrey	It was seen to be grown alone.	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)
6	<i>Drepanocladus aduncus</i> (Hedw.) Warnst	Amblystegiaceae	Wet and moist soil, tree trunk, logs, bark	Hilley & Okhrey	<i>Conardia compacta</i> (Mull. Hal.) H. Rob, <i>Thuidium delicatulum</i> (Hedw.) Schimp. <i>Hylocomium splendens</i> (Hedw.) Schimp. <i>Haplodadium microphyllum</i> (Hedw.) Broth.	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)

7	<i>Eurhynchium praelongum</i> (Hedw.) Schimp.	Brachytheciaceae	Tree trunk, bark, log	Hilley & Okhrey	<i>Calliergon cordifolium</i> (Hedw.) Kindb. <i>Hylocomium splendens</i> (Hedw.) Schimp. <i>Ptilium crista-castrensis</i> (Hedw.) De Not.	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)
8	<i>Eurhynchium straitum</i> W.P. Schimper	Brachytheciaceae	Tree trunk, bark, log	Hilley & Okhrey	<i>Thuidium delicatulum</i> (Hedw.) Schimp. <i>Haplocladium microphyllum</i> (Hedw.) Broth.	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)
9	<i>Haplocladium microphyllum</i> (Hedw.) Broth.	Thuidiaceae	Tree trunk, bark, log	Hilley & Okhrey	<i>Drepanocladus aduncus</i> (Hedw.) Warnst, <i>Eurhynchium straitum</i> W.P. Schimper	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)
10	<i>Homalothecium sericeum</i> W.P. Schimper	Brachytheciaceae	Rocks, logs, tree, soil	Okhrey	It was seen to be grown alone.	Dandotiya <i>et al.</i> (2011)
11	<i>Hookeria acutifolia</i> Hook & Grev.	Hookeriaceae	Moist soil, logs	Hilley	<i>Thuidium delicatulum</i> (Hedw.) Schimp.	Dandotiya <i>et al.</i> (2011)
12	<i>Hylocomium splendens</i> (Hedw.) Schimp.	Hylocomiaceae	Rocks, logs, tree, soil	Hilley & Okhrey	<i>Eurhynchium praelongum</i> (Hedw.) Schimp, <i>Isopterygium albescent</i> (Hook.) A. Jaeger	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)
13	<i>Isopterygium albescent</i> (Hook.) A. Jaeger	Hypnaceae	Rocks, logs, tree, soil	Okhrey	<i>Hylocomium splendens</i> (Hedw.) Schimp., <i>Rhynchostegium megapolinatum</i> W.P. Schimper	Dandotiya <i>et al.</i> (2011)
14	<i>Isothecium myosuroides</i> Brid	Lembophyllaceae	Tree trunk, bark, log	Hilley	It was grown alone.	Dandotiya <i>et al.</i> (2011)
15	<i>Leucobryum javense</i> (Brid.) Mitten.	Leucobryaceae	Soil, rocks, tree trunks.	Hilley & Okhrey	<i>Oxyrrhynchium hians</i> (Hedw.) Loeske, <i>Ulotrichum robusta</i> Mitt.	Dandotiya <i>et al.</i> (2011) Laha and Lallhiatpuia (2013) Tewari & Pant (2002)
16	<i>Leucobryum juniperoides</i> (Brid.) Mull. Hal.	Leucobryaceae	Tree, rocks	Hilley & Okhrey	<i>Calliergon cordifolium</i> (Hedw.) Kindb.	Dandotiya <i>et al.</i> (2011) Tewari & Pant (2002)
17	<i>Leucobryum sanctum</i> (Nees. ex Schwagr.) Hampe	Leucobryaceae	Soil, rock, tree.	Hilley & Okhrey	<i>Racomitrium cuspidigerum</i> , Liverworts: <i>Lophocolea bidentata</i> (L.) Dumort.,	Dandotiya <i>et al.</i> (2011) Tewari & Pant (2002)

					<i>Plagiochila porelloides</i> (Torr ex Nees) Lindenb	
18	<i>Oxyrrhynchium hians</i> (Hedw.) Loeske	Brachytheciaceae	Tree trunk, bark, log	Hilley & Okhrey	<i>Leucobryum javense</i> (Brid.) Mitten. <i>Conardia compacta</i> (Mull. Hal.) H. Rob, <i>Thuidium delicatulum</i> (Hedw.) Schimp.	Dandotiya <i>et al.</i> (2011)
19	<i>Plagiomnium cuspidatum</i> (Hedw.) T.J. Kop	Mniaceae	Wet and moist soil, tree, and rocks.	Hilley & Okhrey	Liverworts: <i>Lophocolea bidentata</i> (L.) Dumort., <i>Plagiochila porelloides</i> (Torr ex Nees) Lindenb, <i>Lophocolea heterophylla</i> (Schrader) Dumort Moss: <i>Polytrichum commune</i> Hedw, <i>Calliergon cordifolium</i> Hedw.) Hedenas, Schlesak & D. Quandt.	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)
20	<i>Polytrichum commune</i> Hedw.	Polytrichaceae	Soil over rock, marshy places.	Hilley & Okhrey	Liverworts: <i>Dumortiera hirsuta</i> (Sw.) Nees, <i>Marchantia polymorpha</i> L. <i>Marchantia linearis</i> Lehm. & Lindenb, <i>Plagiochasma appendiculatum</i> Lehm. & Lindenb, Moss: <i>Plagiomnium cuspidatum</i> (Hedw.) T.J. Kop Angiosperm: <i>Cynodon dactylon</i> (L.) Pers.	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016) Popov (2018)
21	<i>Ptilium crista-castrensis</i> (Hedw.) De Not.	Pylaisiaceae	Soil over rock, marshy places	Hilley & Okhrey	<i>Eurhynchium praelongum</i> (Hedw.) Schimp, <i>Thuidium tamariscinum</i> W.P.Schimper, <i>Callicladium imponens</i> (Hedw.) Hedenas, Schlesak & D. Quandt., <i>Racopilum cuspidigerum</i> var <i>convolutaceum</i> (Schwagr.)	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)

					Angstrom.	
22	<i>Racopilum cuspidigerum</i> var <i>convolutaceum</i> (Schwagr.) Angstrom.	Racopilaceae	Soil over rock, marshy places	Hillebrand & Okhrey	<i>Leucobryum sanctum</i> (Nees. ex Schwagr.) Hampe, <i>Ptilium cristacastrensis</i> (Hedw.) De Not.	Dandotiya <i>et al.</i> (2011)
23	<i>Rhynchostegium megapolinatum</i> W.P.Schimper	Brachytheciaceae	Wet and moist soil, tree, and rocks.	Hillebrand & Okhrey	<i>Isoeterygium albescentis</i> (Hook.) A. Jaeger	Dandotiya <i>et al.</i> (2011)
24	<i>Rhynchostegium tenuifolium</i> Reichardt.	Brachytheciaceae	Tree trunk, bark, log	Hillebrand & Okhrey	It was seen to be grown alone	Dandotiya <i>et al.</i>
25	<i>Rhytidadelphous squarrosus</i> (Hedw.) Warnst.	Hylocomiaceae	Wet and moist soil, tree, and rocks.	Hillebrand & Okhrey	It was seen to be grown alone	Dandotiya <i>et al.</i> (2011)
26	<i>Thuidium delicatulum</i> (Hedw.) Schimp.	Thuidiaceae	Tree trunk, bark, log	Hillebrand & Okhrey	<i>Callicladium imponens</i> (Hedw.) Hedenas, Schlesak & D. Quandt, <i>Calliergon cordifolium</i> (Hedw.) Kindb, <i>Drepanocladus aduncus</i> (Hedw.) Warnst, <i>Eurhynchium straitum</i> W.P. Schimper, <i>Hookeria acutifolia</i> Hook & Grev, <i>Oxyrrhynchium hians</i> (Hedw.) Loeske	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)
27	<i>Thuidium tamariscinum</i> W.P.Schimper.	Thuidiaceae	Wet and moist soil, tree, and barks.	Okhrey	<i>Ptilium cristacastrensis</i> (Hedw.) De Not.	Dandotiya <i>et al.</i> (2011)
28	<i>Tortella fragilis</i> Limpricht.	Pottiaceae	Over rocks, cemented wall, soil	Hillebrand & Okhrey	It was grown alone.	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)
29	<i>Tortula muralis</i> Hedw.	Pottiaceae	Over rocks, cemented wall, soil	Hillebrand & Okhrey	It was grown alone.	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)
30	<i>Ulota robusta</i> Mitt.	Orthotrichaceae	Wet and moist soil, tree, and barks.	Hillebrand & Okhrey	<i>Leucobryum javense</i> (Brid.) Mitten.	Dandotiya <i>et al.</i> (2011) Ralph Pope (2016)

Some photo plates of mosses studied in the West district of Sikkim



Antitrichia curtispicula Bridel- Brederi



Callicladium imponens (Hedw.) Hedenas, Schlesak & D. Quandt



Calliergon cordifolium (Hedw.) Kindb.



Conardia compacta (Mull. Hal.) H. Rob



Dicranum scoparium Hedw.



Drepanocladus aduncus (Hedw.) Warnst



Eurhynchium praelongum (Hedw.) Schimp.



Eurhynchium straitum W.P. Schimper

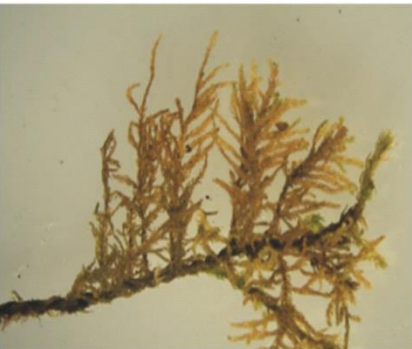
A new record of *Allium rubellum* M. Bieb in Sikkim Himalaya



Haplocladium microphyllum (Hedw.) Broth.



Homalothecium sericeum W.P. Schimper



Hookeria acutifolia Hook & Grev.



Hylocomium splendens (Hedw.) Schimp.



Leucobryum javense (Brid.) Mitten



Leucobryum juniperoideum (Brid) Mull. Hal.



Leucobryum sanctum (Nees, ex. Schwagr.) Hampe



Oxyrrhynchium hians (Hedw.) Loeske



Plagiommium cuspidatum (Hedw.) T.J. Kop



Polytrichum commune Hedw.



Ptilium crista-castrensis (Hedw.) De Not.



Racopilum cuspidigerum var *convolutaceum* (Schwagr.) Angstrom



Rhynchostegium megapolinatum W.P.Schimper



Rhynchostegium tenuifolium Reichenbach



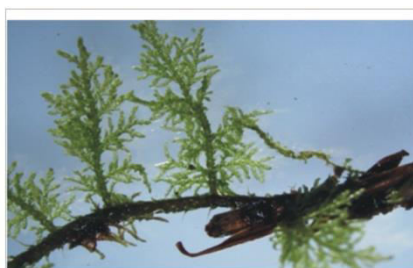
Rhytidadelphous squarrosus (Hedw.) Warnst.



Thuidium delicatulum (Hedw.) Schimp.



Thuidium tamariscinum W.P.Schimper.



Tortella fragilis Limpricht.



Tortula muralis Hedw.



Ulota robusta Mitt.

4. Conclusion

Sikkim Himalayan region exhibits one of the richest angiosperm diversity in the country and it is equally rich in bryophytes diversity. Among the members in plant kingdom, bryophytes are more sensitive to external environment and they act as an indicator of climate change. However, their occurrence and importance have not been clearly appreciated yet that may be due to limited studies and publications. Basic data on mosses presented in this paper may be useful for further studies on various aspects like bio-monitoring characteristics, phyto-chemical analysis and conservation.

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